B. TECH. SEMESTER – I (EC/CE/IT)
SUBJECT: MATHEMATICS – I

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	-	4	4	60	40	-	-	100

Reference Code:BSC102

A. COURSE OBJECTIVES

The objective of this course is to familiarize the prospective engineers with techniques in calculus, matrices, vector spaces and multivariable calculus

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] CALCULUS

Evolutes and involutes, Evaluation of definite and improper integrals; Beta and Gamma functions and their properties, Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders; Indeterminate forms and L'Hospital's rule, Maxima and minima.

[2] MATRICES

Matrices, Vectors: addition and scalar multiplication, matrix multiplication; Rank of a matrix, Linear systems of equations, Determinants, Cramer's Rule, Inverse of a matrix, Gauss Elimination and Gauss Jordan method.

[3] VECTOR SPACES

Eigenvalues, Eigenvectors, Symmetric, Skew-symmetric, and Orthogonal Matrices, Linear Independence of vectors, Diagonalization.

[4] MULTIVARIABLE CALCULUS (Differentiation)

Limit, Continuity and Partial derivatives, Directional derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Vector Differential Calculus; Gradient, curl and divergence.

C. RECOMMENDED TEXT/ REFERENCE BOOK

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 40th Edition, 2007.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005
5. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxi Publications, Reprint, 2010.
8. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Solve engineering problems involving calculus, matrices and vector space.
- Use mathematical tools to solve problems in calculus, matrices and vector space.

B. TECH. SEMESTER – I (EC/CE/IT)

SUBJECT: BASIC ELECTRICAL ENGINEERING

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
3	1	2	6	5	60	40	50*	-	150

Reference Code ESC104

*TW Marks include Viva based on TW

A. COURSE OBJECTIVES

The course imparts an in-depth understanding of the fundamental concepts with an objective to expose the students to the various types of electrical, electronic and magnetic circuits and their applications. This course is designed to provide knowledge of fundamentals and various laws in electromagnetic and magnetic circuits, and electrostatics.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] DC CIRCUITS

Electrical circuit elements (R, L, and C), the impact of temperature, voltage, and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems; Time-domain analysis of first-order RL and RC circuits.

[2] AC CIRCUITS

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor; Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance; Three-phase balanced circuits, voltage and current relations in star and delta connections.

[3] ELECTRO-MAGNETIC INDUCTION

Introduction, Magnetic effect of electric current, Current carrying conductor in the magnetic field, Law of electromagnetic induction, Induced emf, Self-Inductance (L), Mutual Inductance (M), and Coupling coefficient between two magnetically coupled circuits (K), Inductances in series and parallel.

[4] MAGNETIC CIRCUITS

Introduction, Definition of Magnetic quantities, Magnetic circuit, Leakage flux, Fringing effect, Comparison between magnetic and electric circuits.

[5] TRANSFORMERS

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation, and efficiency; Auto-transformer and three-phase transformer connections.

[6] ELECTRICAL MACHINES

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic; Loss components and efficiency, starting and speed control of induction motor; Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited DC motor; Construction and working of synchronous generators, Construction, Principles, and working theory and Types of DC Motors & Generators, 1-Ph & 3-Ph Induction Motor, AC Generator.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1. Basic Electrical, Electronics, and Computer Engineering, R. Muthu Subramanian, S. Salvahanan, K. A. Muraleedharan, 2nd Edition, Tata McGraw Hill.
2. Electronics Principles, Albert Paul Malvino, 6th Edition, Tata McGraw Hill
3. Electrical Technology (Vol: II), B. L. Theraja, A. K. Theraja, 23rd Edition, R. Chand & Company
4. Basic Electrical Engineering, D.P. Kothari, I. J. Nagrath, 3rd Edition, Tata McGraw Hill
5. Introduction to VLSI Circuit & Systems, John P. Uyemura, 1st Edition, John Willey & Sons Inc.
6. Basic Electrical Engineering, D.C. Kulshreshtha, 1st Edition, Tata McGraw Hill
7. Electrical and Electronics Technology, E. Hughes, 10th Edition, Pearson
8. Electrical Engineering Fundamentals, V.D. Toro, 2nd Edition, Prentice Hall India
9. Fundamentals of Electrical Engineering, L.S. Bobrow, , Oxford University Press

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Apply basic circuital laws (KVL, KCL, and Ohm's) and Theorems (Thevenin's and Norton's) for simplifying the complex resistive network to compute node voltages and loop currents for given excitation.

- Analyze Single Phase AC Circuits, compute and demonstrate the waveforms and phasor diagram representation of alternating quantities.
- Design low pass, high pass, bandpass, and band elimination filter networks, and analyze the frequency response of circuits to show the correlation between time domain and frequency domain response specifications.
- Analyze the 3-Phase circuit (star-delta) and compute power for the balanced and unbalanced load.
- Predict the behavior of any electrical and magnetic circuits with an ability to identify, formulate, and solve magnetic circuit problems in electrical machines.
- Model the Equivalent Circuit of a Transformer for Performance Analysis
- Discriminate the constructional details, the principle of operation, and applications of AC and DC electrical machines.

B. TECH. SEMESTER – I (EC/CE/IT)

SUBJECT: PROGRAMMING FOR PROBLEM SOLVING - I

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	3	7	5.5	60	40	50*	-	150

Reference Code ESC105

*TW Marks include Viva based on TW

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To impart an in-depth understanding of fundamental programming concepts to build C programs.
- To explain conditional branching, iteration/looping, code reusability, and pointers using C Programming Language.
- To demonstrate and teach how to code, document, test, and implement a well-structured C program.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] OVERVIEW OF C

Basic structure of C program; Compiling and running C program

[2] CONSTANTS, VARIABLES, AND DATA TYPES

Types of constants; Basic data types, Identifier, Variable, Enum, Symbolic constant, Typedef; Keywords, Overflow and Underflow

[3] OPERATORS AND EXPRESSIONS

Arithmetic, relational, logical, Assignment, bitwise, and sizeof operator; Operator precedence and associativity; Expression evaluation

[4] MANAGING INPUT AND OUTPUT OPERATIONS

getchar and putchar functions; Formatted I/O using printf and scanf.

[5] DECISION MAKING AND BRANCHING

if and if...else statement, Nested and ladder if...else, Conditional operator, switch statement, goto statement with a warning.

[6] DECISION MAKING AND LOOPING

while, do...while, for loops, nested loops, break and continue statements.

[7] ARRAYS AND STRINGS

Introduction to arrays; Declaration, initialization, and access of one-dimensional and two-dimensional arrays; Introduction to multi-dimensional and variable length arrays; Declaration and initialization of strings; Printing and scanning strings to/from standard

I/O; String handling functions, list of strings

[8] USER-DEFINED FUNCTIONS

Function prototype and function declaration, function definition, function call, actual and formal parameters/arguments; Return type and return statement; Nested function call, recursion; Scope, visibility, and lifetime of variables

[9] STRUCTURES AND UNIONS

Defining structure, declaring, and initializing structure variables, typedef; Accessing structure members; Copying and comparing structure variables; Nested structures, arrays, and structures; Structures and functions, unions

[10] POINTERS

Introduction, accessing address of a variable; Declaration and initialization of pointer variables; Accessing variable using pointer, chain of pointers; Scale factor and pointer expressions; Pointers and arrays, Pointer to array Vs array of pointers; Passing arrays and strings to the function; Array of pointers, pointers and functions, pointers and structures, const pointer vs pointer to const.

C. RECOMMENDED TEXT/REFERENCE BOOK

1. Programming in ANSI C by Balagurusamy, 8th Ed., Tata McGraw Hil
2. Programming with C by Byron Gottfried, 3rd Ed., McGraw Hill Education
3. The C Programming Language by Kernighan and Ritchie, 2nd Ed., PHI Learning
4. Expert C Programming: Deep C Secrets by Peter Van Der Linden, Pearson Education
5. Let Us C by Yashvant Kanetkar, 12th Ed., BPB Publication
6. Programming in C by Ashok N. Kamthane, 2nd Ed., Pearson Education

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Use and describe language syntax and concepts for C Programming.
- Comprehend and use C Programming concepts to solve algorithmic and logical problems.
- Analyze the given problem and formulate an appropriate C language solution based on definitive language concept(s).
- Design a flowchart or a diagram for a given problem and create C programs using decision making, branching, looping, user-defined function, array, structure, pointers, etc.
- Apply concepts to write, compile, debug, execute, and document C programs with different test cases using an appropriate tool(s).

B. TECH. SEMESTER – I (EC/CE/IT)

SUBJECT: ENGINEERING GRAPHICS & DESIGN

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
1	-	4	5	3	-	-	100*	-	100

Reference Code ESC106

*TW Marks includes Viva based on TW

A. COURSE OBJECTIVES

The objectives of this course are:

- To Understand the drawing importance in Engineering.
- To Describe the 3-Dimensional object in a different 2-Dimensional view.
- To Develop skills in Reading and Interpretation of Engineering Drawings.
- To enhance drawing skills through hands-on training in a CAD lab using engineering software.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] **INTRODUCTION TO ENGINEERING DRAWING**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloids, Hypocycloid and Involutes; Scales –Plain, Diagonal and Venire Scales;

[2] **ORTHOGRAPHIC PROJECTIONS**

Principles of Orthographic Projections-Conventions -Projections of Points and lines inclined to both planes; Projections of planes inclined Planes-Auxiliary Planes;

[3] **PROJECTIONS OF REGULAR SOLIDS**

Planes-Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

[4] **SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS**

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solid s, objects from industry and dwellings (foundation to slab only)

[5] **ISOMETRIC PROJECTIONS**

Principles of Isometric projection –Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice versa, Conventions;

[6] **OVERVIEW OF COMPUTER GRAPHICS**

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software

[7] **CUSTOMIZATION AND CAD DRAWING**

Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

[8] **ANNOTATIONS, LAYERING, AND OTHER FUNCTIONS**

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modelling of parts and assemblies. Parametric and non -parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory includes sketching of perspective, isometric, multi-view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerance techniques; dimensioning and scale multi-views of dwelling;

C. RECOMMENDED TEXT/REFERENCE BOOKS

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publishers) (Corresponding set of) CAD Software Theory and User Manuals

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Understand and interpret engineering drawings so that concepts can be communicated graphically more effectively.
- Demonstrate correct usage of methods, concept, and theories to illustrate and solve problems of conics, lines, planes, solids, surfaces, and many more.
- Choose a suitable standard projection method, break down a complex 3D problem into various orthographic and sectional orthographic views, and highlight missing features.
- Practical Exposure to computer-aided software to generate isometric projection and compose standard components of different streams

B. TECH. SEMESTER – I (EC/CE/IT)

SUBJECT: SOFTWARE WORKSHOP

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
-	-	2	2	1	-	-	50*	-	50

Reference Code ESC107

*TW Marks include Viva based on TW

A. COURSE OBJECTIVES

The objective of the course is to familiarize students with various software tools and technology. The course aims at providing hands-on experience related to basic software installation, usage of Operating systems, and various essential software utilities.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] **OPERATING SYSTEM**
Introduction to Operating System and Linux Architecture.

[2] **SOFTWARE**
Installation of open source/freeware software using the package manager for programming/simulation.

[3] **SHELL COMMANDS**
Linux usage, commands & shell scripting; Command structure, and general-purpose utility.

[4] **FILE HANDLING**
Basic file handling; The file system, Handling ordinary files, File attributes, and permission, file system details.

[5] **SHELL SCRIPTING**
Basic Shell commands, Looping and Branching; Various programs using Shell Scripting

[6] **SHELL UTILITIES**
Find command and shell, simple filters, advance filters.

[7] **EDITORS**
VI editor for basic text editing, LATEX for scientific documents, and report writing

**NOTE: Topics will be covered in experiments

C. RECOMMENDED TEXT/REFERENCE BOOKS

1. Unix: Concepts and Applications, Sumitabha Das, 4th Edition, Tata McGraw Hill

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Have knowledge of installation and maintenance of software
- Perform computational tasks using various utilities and commands related to operating systems.
- Manage and maintain software systems on a PC.

B. TECH. SEMESTER – II (EC/CE/IT)

SUBJECT: MATHEMATICS-II

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
3	1	-	4	4	60	50	-	-	100

Reference Code BSC301

A. COURSE OBJECTIVES

The objective of this course is to familiarize the prospective engineers with techniques in Differential Equations, and numerical methods and Laplace transform.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] **FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS AND INTRODUCTION TO HIGHER ORDER DIFFERENTIAL EQUATIONS**

Exact, linear and Bernoulli's equations; Euler's equations; Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type, second-order linear differential equations with variable coefficients. Method of variation of parameters, Cauchy-Euler equation.

[2] **NUMERICAL METHODS**

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods, Runge- Kutta method of fourth-order for solving first-order equations; Solution of algebraic and transcendental equations: Newton Raphson's Method, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

[3] **MULTIVARIABLE CALCULUS (INTEGRATION)**

Multiple Integration: Double integrals (Cartesian), Change of the order of integration in double integrals, Change of variables (Cartesian to polar); Applications: areas and volumes; Triple integrals (Cartesian), Scalar line integrals, Vector line integrals, Scalar surface integrals, Vector surface integrals, theorems of Green, Gauss and Stoke's.

[4] **LAPLACE TRANSFORM**

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions, Finding inverse Laplace transform by different methods, Convolution theorem; Evaluation of integrals by Laplace transform, Solving ODE by Laplace Transform method.

C. RECOMMENDED TEXT/REFERENCE BOOKS

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 40th Edition, 2007.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. W. E. Boyce and R. C. Di Prima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
5. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
6. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc- Graw Hill, 2004.
9. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2008

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Solve engineering problems involving differential equations, numerical methods, and Laplace transform.
- Use mathematical tools to solve problems in differential equations, numerical methods, and Laplace transform.

B. TECH. SEMESTER – II (EC/CE/IT)

SUBJECT: PROGRAMMING FOR PROBLEM SOLVING - II

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	3	7	5.5	60	40	50*	-	150

Reference Code ESC201

*TW Marks include Viva based on TW

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To provide fundamental concepts of object-oriented programming like abstraction, inheritance, polymorphism, etc. and explain differences between object-oriented programming and procedural programming
- To teach programmatic implementation of these concepts using C++ language.
- To explain the significance of these concepts to learn subjects like software engineering and object-oriented design and analysis.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] BASICS OF C++

Overview, Program structure, keywords, identifiers, constants, data types; Symbolic constants, declaration of variables, operators, namespaces, control structures. Dynamic memory – C style - malloc, calloc, realloc, and free Vs C++ style; New and delete keywords, reference, and pointer.

[2] FUNCTIONS IN C++

Main function (variations in signature), function prototype, inline functions; Call and return by reference, default parameters, function overloading.

[3] INTRODUCTION TO OBJECT-ORIENTED PROGRAMMING

Procedural Vs Object-Oriented Programming; Principles of OOP, Benefits and applications of OOP.

[4] CLASSES AND OBJECTS – ENCAPSULATION AND ABSTRACTION

Introduction, private and public members, defining member functions, static members; Objects as function arguments and return type; Friend functions, const member functions, Constructors and their types, Destructor, Operator overloading, type conversion

[5] INTRODUCTION TO C++ STRING CLASS

[6] INHERITANCE

Introduction, types of inheritance – single, multiple, multilevel, hierarchical, and hybrid inheritance; Protected members, overriding, virtual base class.

[7] POLYMORPHISM

Introduction, Pointers, and Objects, this pointer, pointer to derived classes; virtual and pure virtual functions, dynamic binding.

[8] INPUT/OUTPUT

Introduction to streams, standard I/O stream objects; Stream classes, unformatted and formatted I/O, manipulators.

[9] EXCEPTION HANDLING

Basics of exception handling; Try-catch-throw, re-throwing exceptions, user-defined exceptions.

[10] TEMPLATES

Basics of class templates and function templates.

C. RECOMMENDED TEXT/REFERENCE BOOKS

1. Object-Oriented programming with C++, Seventh Edition, by E Balagurusamy, TMH publication
2. The C++ Programming Language, Fourth Edition, by Bjarne Stroustrup, Addison -Wesley publication
3. Object-Oriented Programming in C++, Fourth Edition, by Robert Lafore, SAMS publication
4. Accelerated C++: Practical Programming by Example, First Edition, by Andrew Koenig and Barbara E. Moo, Addison-Wesley publication
5. C++ Black Book, First edition, by Steven Holzner, Paraglyph Press
6. C++: The Complete Reference, Fourth Edition, by Herbert Schildt, McGraw Hill Education

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Use and describe language syntax and concepts for C++ Programming along with templates for class and function.
- Apply Object-Oriented Programming (OOP) concepts to solve algorithmic and logical problems.
- Identify the given problem and formulate an appropriate C++ language solution based on OOP Principle(s).
- Write C++ programs using Encapsulation, Abstraction, Inheritance, Polymorphism, Exception Handling, etc. to solve given problem(s).

- Apply concepts to write, compile and execute C++ programs with different test cases. Also be able to debug and document C++ programs.

B. TECH. SEMESTER – II (EC/CE/IT)

SUBJECT: PHYSICS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	2	6	5	60	40	50*	-	150

Reference Code BSC101

*TW Marks include Viva based on TW

A. COURSE OBJECTIVES

The course provides an in-depth understanding of the concepts associated with Semiconductor, Optoelectronics, Communication, Oscillators, and Basic Switching devices. It also serves the basic design ideas around rectification and amplification. The course focuses on modulation techniques and their components. The overall aspects of basic physics application in electronics with a practical approach are covered in this subject. This course also includes analog modulation & demodulation techniques (AM, FM, and PM) and digital modulation (ASK, FSK and PSK).

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] SEMICONDUCTORS

Intrinsic and extrinsic semiconductors, Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic & other devices.

[2] DIODE

Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter; Zener diode and its characteristics, Zener diode as a voltage regulator, Special purpose diodes.

[3] LIGHT-SEMICONDUCTOR INTERACTION

Radiative transitions and optical absorption, LED and LASER, Photo detectors.

[4] ACTIVE COMPONENTS AND APPLICATIONS

BJT: Structure and input-output characteristics of a BJT, The Unbiased Transistor, Transistor Currents, Biased Transistor, a single stage voltage divider biasing, Emitter Bias, The CE Connections, The Base Curve, Collector curve, Transistor approximation Variation in current Gain, The Load Line, The Operating point, Recognizing Saturation, BJT as a switch & Amplifiers, LED Drivers.

[5] OSCILLATORS

General form of the oscillator, Sinusoidal oscillator, phase shift oscillator, and Crystal Oscillator.

[6] MOSFET

MOS physics and mode of operations, nFET current-voltage relationship, MOS pass characteristics, and CMOS inverter, Dynamic RAM (DRAM) 1T bit-cell.

[7] FIBER OPTICS

Fiber Optics and Optoelectronics, Historical Developments, A Fiber-Optic Communication System, Advantages of Fiber-Optic Systems, Ray Propagation in Optical Fibers, Fundamental Laws of Optics, Ray Propagation in Step-Index Fibers, Ray Propagation in Graded-Index Fibers.

[8] COMMUNICATION SYSTEMS

Communication system components, Analog modulation- AM, FM, PM; Digital modulation- ASK, FSK, PSK.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1. Electronics Principles, Albert Paul Malvino, 6th Edition, Tata McGraw Hill
2. David Griffiths, Introduction to Electrodynamics
3. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4. R.P Khare, Fiber Optics and Optoelectronics, Oxford University Press
5. Sanjay Sharma, Communication Systems: Analog and Digital
6. Halliday and Resnick, Physics
7. W. Saslow, Electricity, magnetism and light
8. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
9. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
10. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
11. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997)
12. Behrouz A. Forouzan, Data communication, and Networking.
13. B. P lathi, Modern Digital and Analog Communication Systems, 3rd edition.

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Illustrate intrinsic and extrinsic semiconductors, their applications, and carrier generation and recombination with variations in doping density, temperature, and other regulations.
- Design half-wave, full-wave rectifier circuit, and voltage regulator circuit using Zener diode, PN diode, and NPN, PNP transistors.
- Implement a transistor as a switch and Analyse the Transistor input-output characteristics, biasing circuits, Compute load line and calculate the operating point.

- Analyze the structure of the oscillator. Discriminate Sinusoidal oscillator, Phase shift oscillator, and Crystal oscillator.
- Assess the performance & characteristics of Opto-electronic semiconductor devices like LED, LASER, and Photodetectors
- Devise the ray optics propagation in step-index and graded-index fiber and Synthesize the use of optoelectronic devices in fiber optic communications.
- Illustrate the pros and cons of analog and digital modulation techniques (AM, FM, PM, ASK, FSK, PSK) based on the need for system components.
- Justify the requirement of CMOS based on the fundamental study of nMOS and pMOS and describe the working of 1 bit DRAM cell.

B. TECH. SEMESTER – II (EC/CE/IT)

SUBJECT: HARDWARE WORKSHOP

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
-	-	4	4	2	-	-	100*	-	100

Reference Code ESC201

*TW Marks includes Viva based on TW

A. COURSE OBJECTIVES

The objective of the course is to familiarize students with various hardware tools and techniques. The course aims at imparting practical knowledge of various electronic components, computer hardware, and internet technology.

B. DETAILED SYLLABUS

Unit Topic(s)

[1] ELECTRONIC COMPONENTS

Study of Digital Multimeter, Power Supply, Function Generator, Cathode Ray Oscilloscope, Digital Oscilloscope, and their use; Study the Measurement of Phase Difference in single-phase circuit, Study of Various Electrical and Electronics component like LED, LDR, Photo-diode, MOSFET, MCB, and Relay.

[2] COMPUTER HARDWARE

Introduction to a personal computer and its basic peripherals, installation of Operating System, Software, and the required device drivers; Students are suggested to perform similar tasks on the laptop scenario wherever possible.

[3] PERIPHERALS

Programming of Computer Ports & Interfacing of Electronic Components, Cables, and Connectors like RJ45, RS232, and CRO probe.

[4] INTERNET

Introduction to Internet & World Wide Web modules, making a PC Internet ready; Introduction to Internet and TCP/IP, Ethernet Connection, WiFi connection, configure TCP/IP (IP, Gateway, DNS, and Proxy), and use of ping command; Information sharing and data transfer over Local Area Network and Internet.

[5] WEB INFRASTRUCTURE

Basic Components of Web Sites, Front end & back-end tools and technology; HTML & CSS, Developing, Configuring, and deploying a website.

[6] IOT BOARDS AND CIRCUIT SIMULATION

Introduction to IOT boards like Arduino, Raspberry Pie, etc.; Interfacing, Circuit designing, and PCB designing.

[7] MINI PROJECT

Student will develop a mini project related to the topics listed above.

**NOTE: Topics will be covered in experiments

C. RECOMMENDED TEXT/REFERENCE BOOKS

1. Electronic Components and Materials Principles, Dr. Madhuri A Joshi, 2nd Edition, Shroff Publishers & Distributors PVT. LTD.
2. A Textbook of Computer Hardware and Networking, Jyotika Deshmukh, D J Publications
3. Learning Web Design, Jennifer Robbins, 4th edition, O'Reilly Media

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Have knowledge of various electronics components and computer hardware..
- The students will be aware of Internet Technology infrastructure.

B. TECH. SEMESTER – II (EC/CE/IT)

SUBJECT: ENGLISH

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
2	-	2	4	3	40	-	50*	-	90

Reference Code HSMC201

*TW Marks include Viva based on TW

A. COURSE OBJECTIVES

The objective of the course is to provide basic knowledge of the English language to students coming from different backgrounds. The course aims to teach English Grammar and Communications skills which will be useful to engineers.

B. DETAILED SYLLABUS

Unit Topic(s)

[1] VOCABULARY BUILDING

The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.

[2] BASIC WRITING SKILLS

Sentence Structures, use of phrases and clauses in sentences, Importance of proper punctuation, creating coherence, organizing principles of paragraphs in documents, Techniques for writing precisely.

[3] IDENTIFYING COMMON ERRORS IN WRITING

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés.

[4] NATURE AND STYLE OF SENSIBLE WRITING

Describing, Defining, Classifying, providing examples or evidence, Writing introduction and conclusion.

[5] WRITING PRACTICES

Comprehension, Précis Writing, Essay Writing

[6] ORAL COMMUNICATION

Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common, Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations (This unit involves interactive practice sessions in Language Lab).

C. RECOMMENDED TEXT/REFERENCE BOOK

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Understand the vocabulary and their root forms to enhance vocabulary level
- Enhance their Writing in effective way
- Rectify common errors in their Speaking and Writing
- Develop efficiency in writing
- Be competent at Public Speaking and Interviews
- Acquire Proficiency in all four skills of Language

B. TECH. SEMESTER – II (EC/CE/IT)

SUBJECT: ENVIRONMENTAL STUDIES

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	-	-	2	0	40	-	-	-	40

Reference Code MC-II

A. COURSE OBJECTIVES

The objective of this course is to bring awareness about sustainable development is a key to the future of mankind. Understanding, analyzing, and proposing solutions to the contemporary environmental issues and problems of pollution, population explosion, solid waste disposal, environmental degradation, economic productivity, global warming, ozone layer depletion, and loss of biodiversity.

B. DETAILED SYLLABUS

Unit Topic(s)

[1] THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, scope, and importance & need for public awareness.

[2] NATURAL RESOURCES

Renewable and non-renewable resource: Natural resources and associated problems; Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams, and their effects on forests and tribal people; Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts, over water, dams benefit and problems; Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies; Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies; Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies; Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources of sustainable lifestyles

[3] ECOSYSTEMS

Concept of an ecosystem, Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

[4] BIODIVERSITY AND ITS CONSERVATION

Introduction definition: Genetic, species and ecosystem diversity; Bio-geographical classification of India; Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, national and local levels. India as a mega-diversity nation, Hot-spots of biodiversity, threats to biodiversity, habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India; Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity

[5] ENVIRONMENTAL POLLUTION

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards; Solid waste management, causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution, Pollution case studies; Disaster management: floods, earthquake, cyclone, and landslides.

[6] SOCIAL ISSUES AND THE ENVIRONMENT

From unsustainable to sustainable development, urban problems related to energy Water conservation, rainwater harvesting, watershed management; Resettlement and rehabilitation of people: its problems and concerns, Case studies; Environmental ethics: Issues and possible solutions; Climate change: Global warming, acid rain, ozone layer depletion, nuclear accidents, and the holocaust. Case studies, Wasteland reclamation, Consumerism and waste products; Environment Protection Act: Air (Prevention and Control of Pollution) Act, Water (Prevention & Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act; Issues involved in the enforcement of environmental legislation Public awareness

[7] HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations, population explosion, Family Welfare Program, Environment, and human health, human rights, Value education HIV/AIDS, Women and Child Welfare; Role of Information Technology in Environmental and human health Case studies.

[8] FIELD WORK

Visit to a local area to document environmental assets (river/forest/grassland/hill/mountain); Visit a local polluted site – Urban/Rural/Industrial/Agricultural; Study common plants, insects, birds. Study of simple ecosystems – pond, river, hill, slopes, etc.

C. RECOMMENDED TEXT/ REFERENCE BOOK

1. Erach Bharucha Textbook of Environmental Studies; Second Edition, Universities Press: Hyderabad, 2013
2. Poonia, M. P.; Sharma, S. C. Environmental studies; Khanna Publishing House: New Delhi, 2017
3. Rajagopalan, R. Environmental Studies; Oxford University Press: India, 2015
4. Varandani, N. S. Basics of Environmental studies; Lambert Academic Publishing: Germany, 2013.
5. Basak, A. Environmental Studies; Dorling Kindersley: India, 2009.
6. Dhameja, S. K. Environmental studies; S. K. Kataria and Sons: New Delhi, 2007.
7. Rao, C. S. Environmental Pollution Control Engineering; Wiley publishers: New Delhi, 2006.
8. Brunner, R. C. Hazardous Waste Incineration; McGraw Hill: Michigan, 1989.
9. Clark, R. S. Marine Pollution; Clanderson Press Oxford: Bath, 2001.
10. Trivedy, R. K. Handbook of Environmental Laws, Acts, Guidelines, Compliances & standards; B. S. publications: Hyderabad, 2005.
11. Jadhav, H.; Bhosale, V. M. Environmental Protection and Laws; Himalaya Pub. House: Delhi, 1995.
12. Agarwal, K. C. Environmental Biology; Nidi Publ.: Bikaner, 2001.

13. Bharucha, E. The Biodiversity of India; Mapin Publishing: Ahmedabad, India, 2002.
14. Cunningham, W.P.; Cooper; Gorhani, T. H. E.; Hepworth, M.T., Environmental Encyclopedia;Jaico Publ. House: Mumbai, 2001.
15. De, A. K. Environmental Chemistry; Wiley Eastern: New Delhi, 2006.
16. Gleick, H. P. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security; Stockholm Env. Institute Oxford Univ. Press: New York, 1993.
17. Hawkins, R.E., Encyclopedia of Indian Natural History; Bombay Natural History Society: Bombay, 1987.
18. Heywood, V. H.; Waston, R. T. Global Biodiversity Assessment; Cambridge Univ. Press: Cambridge, 1995.
19. Mckinney, M.L.; School, R.M. Environmental Science systems & Solutions; Web enhanced edition: USA, 1996.
20. Miller, T.G. Jr.; Spoolman, S. E. Environmental Science; Cengage learning: Wadsworth, 2014.
21. Odum, E.P. Fundamentals of Ecology; W.B. Saunders: USA, 1971.
22. Rao, M. N.; Datta, A.K. Waste Water treatment; Oxford & IBH Publ.: New Delhi, 1987.
23. Sharma, B. K., Environmental Chemistry; Goel Publ. House: Meerut, 2001.
24. Townsend, C., Harper, J.; Michael, B. Essentials of Ecology; Blackwell: Oxford, 2008.
25. Trivedi, R. K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II; B. S. Publications, Hyderabad, 2010.
26. Trivedi, R. K.; Goel, P. K. Introduction to air pollution; ABD Publishers: Jaipur, 2003.
27. Wanger, K. D., Environmental Management; W.B. Saunders Co. Philadelphia, USA, 1998.

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Recall, understand and interpret the terminologies used in environmental studies correctly
- Relate the importance of natural resources, biodiversity, hotspots and deduce the threats to biodiversity.
- Analyze the factors causing environmental pollution, formulate the role of an individual in abatement and control of pollution, and improve disaster management techniques.
- Evaluate the social issues involved in climate change, water conservation, rainwater harvesting, wasteland reclamation, consumerism and waste generation, environmental ethics, environmental laws, and the requirement of public awareness.
- Understand the issues related to population, family welfare programs, human health, value education, and the role of IT in the environment.
- Make use of the fieldwork including visits to local areas to document environmental assets, assess the polluted sites, and study species and ecosystems in our surroundings.

B. TECH. SEMESTER – III (IT)

SUBJECT: PROBABILITY THEORY AND STATISTICS

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
3	1	-	4	4	60	40	-	-	100

Reference Code BSC3XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To provide an understanding of the basic concepts of probability, conditional probability, and independent events.
- To focus on the random variable, mathematical expectation and different types of distributions, sampling theory, and estimation theory.
- To demonstrate and teach the design of statistical hypothesis about the real-world problem and conduct appropriate tests for drawing valid inferences about the population characteristics
- To explain the significance of hypothesis testing for any research work

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] BASIC PROBABILITY

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

[2] CONTINUOUS PROBABILITY DISTRIBUTIONS

Continuous random variables and their properties, distribution functions and densities, normal, exponential, and gamma densities.

[3] BIVARIATE DISTRIBUTIONS

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

[4] BASIC STATISTICS

Measures of Central tendency: Moments, skewness, and Kurtosis - Probability distributions: Binomial, Poisson, and Normal - evaluation of statistical parameters for these three distributions, Correlation, and regression – Rank correlation.

[5] APPLIED STATISTICS

Curve fitting by the method of least squares- fitting of straight lines, second-degree parabolas, and more general curves; Test of significance: Large sample test for a single proportion, a difference of proportions, a single mean, difference of means, and difference of standard deviations.

[6] SMALL SAMPLES

Test for a single mean, a difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

C. RECOMMENDED TEXT/REFERENCE BOOK

1. Introduction to Probability and Statistics for Engineers and Scientists, Sheldon M. Ross, 4th edition1.
2. Head First Statistics, Dawn Griffiths, O'Reilly
3. Introduction to Probability Theory, P. G. Hoel, S. C. Port, and C. J. Stone, Universal Book Stall, 2003 (Reprint).
4. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
5. An Introduction to Probability Theory and its Applications, W. Feller, Vol. 1, 3rd Ed., Wiley, 1968.

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Define and explain the different statistical distributions (e.g., Normal, Binomial, Poisson) and the typical phenomena that each distribution often describes.
- Apply key concepts of probability, including discrete and continuous random variables, probability distributions, conditioning, independence, expectations, and variances
- Apply the concepts of hypothesis testing and p-value.
- Evaluate correlation coefficient and estimate parameters of regression model using the method of least squares to estimate the parameters in a regression
- Analyse samples of the different populations using sampling theory.

B. TECH. SEMESTER – III (IT)

SUBJECT: COMMUNICATION SYSTEMS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

Reference Code ESC3XX

A. COURSE OBJECTIVES

To impart an in-depth understanding of the major concepts, techniques, and performance criteria used in the analysis of various signal operations (time domain and frequency domain), this course covers the Fourier analysis of the signals, provides knowledge of various blocks that constitute an analog and digital communication system and their interrelation and correlates the concepts of Information Theory with reference to analog & digital communication systems. This course also includes the analog modulation & demodulation techniques (AM, FM, and PM) and digital modulation & demodulation techniques (PCM, DPCM, and DM).

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] WAVEFORM SPECTRA

Introduction, Sinusoidal Waveform, General Periodic Waveforms Trigonometric Fourier Series for a Periodic Waveforms, Fourier Coefficients, Spectrum for the Trigonometric Fourier Series, Rectangular Waves, Sawtooth Waveform, Pulse Train, Some General Properties of Periodic Waveforms, Exponential Fourier Series, Approximate Formulas for the Fourier Coefficient, Energy Signals for Fourier Transform, Filtering of Signals, Power Signals, Bandwidth Requirements for Analog Information Signals.

[2] DIGITAL LINE WAVEFORMS

Symbols, Bits, Bits and Bauds, Functional notations for Pulses, Line codes and Waveforms, M-ary Encoding, Inter Symbol Interference.

[3] AMPLITUDE MODULATION

Introduction, Amplitude Modulation, Amplitude Modulated Transmitters, AM Receivers.

[4] SINGLE SIDEBAND MODULATION

Introduction, Single Sideband Principles, The Balanced Modulator SSB Generation, SSB Reception, Modified SSB Systems.

[5] ANGLE MODULATION

Introduction, Frequency Modulation, Phase Modulation, Equivalence between FM and PM, Angle Modulator Circuits, Angle Modulation Detectors.

[6] PULSE MODULATION

Pulse Amplitude Modulation, Pulse Code Modulation, Pulse Frequency Modulation, Pulse Time Modulation, Pulse Position Modulation, Pulse Width Modulation.

[7] DIGITAL COMMUNICATION

Synchronization, Asynchronous Transmission, Probability of Bit Error in Baseband Transmission, Matched Filters, Optimum Terminal Filters, Bit Timing Recovery, Eye Diagram, Digital Carrier System, Carrier Recovery Circuit, DPSK, Hard and Soft Decision, Error Control Coding.

[8] INTRODUCTION TO INFORMATION THEORY

Measure of Information, Source Encoding.

C. RECOMMENDED TEXT/REFERENCE BOOK

1. Modern Digital and Analog Communication System, B. P. Lathi, 2nd Edition, Oxford Publication
2. Communication Systems, Simon Haykin, 3rd Edition, John Wiley & sons.
3. Electronic Communication System-Fundamental through Advance, Tomas W., 3rd Edition, Wisley.
4. Communication System Analog & Digital, R. P. Singh, Tata McGraw-Hill.

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Analyse and understand the frequency domain representation of time-domain periodic and aperiodic signals.
- Interpret the differences between Polar, Unipolar, Manchester, and AMI line coding schemes and recognize channel encoding techniques.
- Discuss various types of amplitude modulation techniques along with calculation of modulation index, Single sideband principle, and its generation and reception.
- Calculate maximum bandwidth, average power, and deviation ratio for sinusoidal and non-sinusoidal Frequency modulation.
- Differentiate phase and frequency modulation techniques and calculate the modulation index and total power of the modulated signal.
- Describe PAM, PCM, PTM, and PFM pulse modulation techniques.
- Recognize the blocks of the digital communication system along with an illustration of error control, source encoding techniques, and calculation of BER and bit error probabilities for digital carrier schemes.

B. TECH. SEMESTER – III (IT)

SUBJECT: DESIGN OF DIGITAL CIRCUITS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

Reference Code ESC3XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- The subject design of digital circuits aims to explain to the students about the basic knowledge of digital logic and circuit design.
- To familiarize the student with digital representations of information, Number systems, Logic gates, Boolean algebra, designing the circuits and their applications.
- To teach the student about fundamental principles of digital design using combinational and sequential logic to analyze and design digital circuits.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] BINARY SYSTEMS

Introduction to Digital Computers and Digital Systems; Binary Numbers, Number Base Conversion, Octal and Hexadecimal Numbers; Complements, binary Codes; Binary Storage and Registers, Binary Logic; Integrated Circuits.

[2] BOOLEAN ALGEBRA AND LOGIC GATES

Basic Definitions, Axiomatic Definition of Boolean algebra; Basic Theorems and Properties of Boolean algebra; Boolean Functions; Canonical and Standard Forms, Other Logic Operations; Digital Logic Gates, IC Digital Logic Families.

[3] SIMPLIFICATION OF BOOLEAN FUNCTIONS

The Map Method; Two and Three Variable Maps, Four-Variable Map, Five and Six Variable Maps; Product of Sum simplification; NAND and NOR Implementations. Don't-Care Conditions; The Tabulation Method; Determination of Prime- Implicants, selection of Prime implicants.

[4] COMBINATIONAL LOGIC

Introduction, Design Procedure, Adders and Subtractors, Code Conversion, Analysis Procedure, Multilevel NAND Circuits, Multilevel NOR Circuits, Exclusive OR, and Equivalence Functions.

[5] COMBINATIONAL LOGIC WITH MSI AND LSI

Introduction, Binary Parallel Adder, Decimal Adder, Magnitude Comparator, Decoders, Multiplexers, Read-Only Memory (ROM), Programmable Logic Array (PLA).

[6] SEQUENTIAL LOGIC

Introduction, Flip-Flops, Triggering of Flip-Flops, Analysis of Clocked Sequential Circuits, State Reduction, and Assignment; Flip-Flop excitation Tables Design Procedure, Design of Counters, Design with State Equations.

[7] REGISTERS, COUNTERS AND THE MEMORY UNIT

Introduction, Registers, Shift Registers, Ripple Counters, Synchronous Counters, Timing Sequences, The Memory Unit, Examples of Random-Access Memories.

[8] DIGITAL INTEGRATED CIRCUITS

Introduction, Bipolar Transistor Characteristics, RTL and DTL Circuits, Integrated-Injection Logic, Transistor-Transistor Logic, Emitter Coupled logic, Metal-Oxide Semiconductor, Complementary MOS.

C. RECOMMENDED TEXT/ REFERENCE BOOKS

1. Digital Logic and Computer Design by: M. Morris Mano
2. Microelectronics by: Jacob Millman & Arvin Grabel, Second Edition McGraw Hill International Edition

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Describe the basic concepts of digital systems and circuits, the structure of various number systems, and the working and design process of different combinational and sequential circuits.
- Apply knowledge of mathematics to solve the given problem, Also be able to apply different minimization techniques to simplify the hardware requirements for designing the digital circuits.
- Analyze the given problem and be able to choose the appropriate technique(s) for designing the digital circuit.
- Design a solution for a given problem statement, implement it, and also design and apply it for real-time digital systems.
- Apply concepts to write, document, assemble and test the digital circuits.

B. TECH. SEMESTER – III (IT)

SUBJECT: EFFECTIVE TECHNICAL COMMUNICATION

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	-	-	3	3	50	-	50	-	100

Reference Code HSMC3XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To discuss and explain technical writing and professional communication along with the importance of Ethics, etiquette, and Values.
- To prepare students for effective public speaking, group discussion, and interviews.
- To explain how to study and validate various information sources such as websites, business documents, and professional journals.
- To teach how to carry out self development and self assessment.
- To prepare students to produce effective technical documents.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] INFORMATION DESIGN AND DEVELOPMENT

Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

[2] TECHNICAL WRITING, GRAMMAR, AND EDITING

Technical writing process, forms of discourse, Writing drafts and revising Collaborative writing, creating indexes, technical writing style, and language; Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style; Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization

[3] SELF-DEVELOPMENT AND SELF-ASSESSMENT

Self-assessment, Awareness, Perception, and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

[4] COMMUNICATION AND TECHNICAL WRITING

Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, and event report.

[5] ETHICS

Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

C. RECOMMENDED TEXT/REFERENCE BOOK

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Describe the basics of technical writing and professional communication
- Explain and Demonstrate Profession, Social and Business Ethics, Etiquette, and Values.
- Apply communication skills in an effective way in public speaking, group discussion, and interviews
- Analyze self-development and practice self-assessment in all aspects.
- Evaluate effectiveness and validity of information sources, such as websites, business documents, and professional journals
- Create/produce different documents, like reports, assignments, reviews, letters, applications, etc. by applying technical writing skills

B. TECH. SEMESTER – III (IT)

SUBJECT: OBJECT ORIENTED PROGRAMMING USING JAVA

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

Reference Code PCC3XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To teach fundamental knowledge of object-oriented programming principles including defining classes, polymorphism, inheritance, encapsulation, abstraction, and interface, and explain with examples how to represent the solution of a given problem in object oriented representation.
- To explain how to use library API such as String, Arrays, StringBuffer, StringTokenizer, and Math in framing solutions to problems.
- To impart knowledge of package, exception, and multithreading and show their usage in practical problems.
- To discuss concepts of making user interactive programs using GUI programming, Stream API, and Network Programming and demonstrate their use in solving problems.
- To demonstrate skills to write, debug, and execute java programs and enable them to create Java solutions for given problem statements.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] INTRODUCTION TO PROGRAMMING LANGUAGE – JAVA

Java programming: History of Java Primitive data types, variables, constants, scope and lifetime of variables, Comments; Operators, operator hierarchy, expressions; Type conversion and casting.

[2] CONTROL STRUCTURE AND METHODS

Control flow statements and loops, Loops – for, while, do-while; Console input and output, formatting output; Constructors and methods, Overloading of methods and constructors, recursion, Parameter passing, static fields and methods, access control, this reference; Garbage collection.

[3] OBJECT ORIENTED PROGRAMMING PRINCIPLES

OOP Concepts, Classes, and objects, Data abstraction, encapsulation, inheritance, Polymorphism. Procedural and object-oriented programming paradigm; Object-Oriented Programming Using Java, Inheritance: Inheritance types, super and subclasses, member access rules, super keyword, preventing inheritance: final classes and methods, the object class and its methods; Polymorphism: dynamic binding, method overriding, abstract classes and methods; Interface: Interfaces vs Abstract classes, defining an interface, implement interfaces, accessing implementations through interface references, extending interface.

[4] ARRAYS, STRING, AND PACKAGES

Arrays: 1,2, N-dimension array, jagged array, arrays of objects; String: Exploring concepts of String, StringBuffer, and StringTokenizer classes; Packages: Defining, creating, and accessing a package, understanding CLASSPATH, importing packages, Exploring "Java.Util".

[5] EXCEPTION HANDLING

Exception Handling: Benefits of exception handling, the classification of exceptions; Exception hierarchy: Throwable, checked exceptions, and unchecked exceptions; Usage of try, catch, throw, throws, and finally; Re-throwing exceptions, exception specification, built in exceptions; Creating and using own/user-defined exception sub classes.

[6] MULTITHREADING

Multithreading: Multi-Threading and Multitasking; Thread Life Cycle, thread states, creating threads: Thread Priorities, Thread Groups, Daemon Threads, interrupting threads, thread priorities; Synchronizing threads, inter-thread communication.

[7] GETTING STARTED WITH GRAPHIC PROGRAMMING

The AWT class hierarchy, Containers: Frame, Dialog, Panel; Events: Event Sources, Event Classes, Event Listeners, Delegation Event Model; Handling Action, Mouse, Window, Keyboard Events; Adapter Classes

[8] CREATING USER INTERFACE AND ADVANCED GRAPHICS

The AWT Class Hierarchy; User Interface Components: Labels, Button, Canvas, Scrollbars, Text Components, Check Box, Check Box Groups, Choices, Lists; Panels: Scrollpane, Dialogs, Menubar, Graphics, Layout Manager; Layout Manager Types: Border, Grid, Flow, Card, Grid Bag, No layout, etc.

[9] INPUT AND OUTPUT

Input/Output classes. File management using file class Streams: Byte streams, character stream; Text input/output, binary input/output; Random access file operations

[10] NETWORK PROGRAMMING

Networking concepts: Introduction to TCP and UDP protocol; Socket programming classes: Socket, ServerSocket, InetAddress, URL, URL Connection; Client-server and multi-threaded application.

[11] JAVA UNIT TESTING – JUNIT

JUnit: Types of Testing, Test Driven Development, Assert class, Test cases.

C. RECOMMENDED TEXT/REFERENCE BOOKS

1. An Introduction to JAVA programming, Y. Daniel Liang, Publisher: PHI
2. The Complete Reference Java, Herbert Schildt, 5th edition Publisher: Tata McGraw-Hill

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Describe and use Java programming language concepts and API
- Apply the concepts of Java to solve the given problem on the console-based application or GUI based application.
- Analyze the given problem and be able to choose the appropriate concept(s) of Java language to solve the problem.
- Design a solution for a given problem statement and prepare required design diagrams, specifications, class/interface structures, etc. using Java concepts
- Apply concepts to write, document, debug, run, and test Java programs or applications.

B. TECH. SEMESTER – III (IT)

SUBJECT: DATA STRUCTURES AND ALGORITHMS

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

Reference Code PCC3XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To teach different data structures and their operations.
- To teach and demonstrate the selection of efficient data structure for improving the efficiency (time complexity and space complexity) of the system.
- To explain concepts that are useful to students to understand subjects like Database Management System and Design and Analysis of Algorithms.
- To impart the knowledge of real-world applications of the data structures.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] BASIC CONCEPTS

System Life Cycle; Object-Oriented Design: Algorithm Decomposition versus OO Decomposition, Fundamental Definitions, and Concepts of OO programming; Data Abstraction and Encapsulations; Algorithm Specification: Introduction, Recursive Algorithms.

[2] ARRAYS

Abstract Data Types and the C++ Class; The Array as an Abstract Data Type; The Polynomial Abstract Data: Polynomial Representation, Polynomial Addition, Polynomial Multiplication, Disadvantages of Representing Polynomials by Arrays.

[3] STACK AND QUEUE

The Stack Abstract Data Type; The Queue Abstract Data Type; Evaluation of Expressions: Expressions, Postfix Notation, Infix to Postfix, Multiple Stacks, and Queues.

[4] LINKED LISTS

Singly Linked Lists; Representing Lists in C++: Defining a List Node in C++, Designing a List in C++, Pointer Manipulation in C++, List Manipulation Operations, Linked List Operations, Circular Lists, Linked Stacks and Queues; Polynomials: Polynomial Representation, Adding Polynomials; Doubly Linked Lists; Generalized Lists: Representation of Generalized Lists, Recursive Algorithms for Lists, Reference Counts, Shared and Recursive Lists.

[5] TREES

Introduction: Terminology, Representation of Trees; Binary Trees: The Abstract Data Type, Properties of Binary Trees, Binary Tree Representations; Binary Tree Traversal and Tree Iterators: Introduction, Inorder Traversal, Preorder Traversal, Postorder Traversal, Iterative Inorder Traversal, Level-Order Traversal; Additional Binary Tree Operations: Copying Binary Trees, Testing Equality, The Satisfiability Problem;

Threaded Binary Trees: Threads, Inorder Traversal of a Threaded Binary Tree, Inserting a Node into a Threaded Binary Tree. Heaps: Definitions, Insertion, and Deletion Of Max Heaps. Binary Search Trees: Definition, Searching a Binary Search Tree, Insertion and Deletion and Joining into a Binary Search Tree, Height of a Binary Search Tree.

[6] GRAPHS

The Graph Abstract Data Type: Introduction, Definitions, Graph Representations. Elementary Graph Operations: Depth First Search, Breadth-First Search, Connected Components, Spanning Trees, Biconnected Components. Shortest Paths and Transitive Closure: All-Pairs Shortest Paths.

[7] SORTING

Insertion Sort. Quick Sort. Merge Sort: Merging, Iterative Merge Sort, Recursive Merge Sort. Heap Sort. List and Table Sorts. Summary of Internal Sorting.

[8] HASHING

The Symbol Table Abstract Data Type. Static Hashing. Hash Tables. Hashing Functions. Overflow Handling.

[9] ADVANCED SEARCH STRUCTURES

AVL Trees. 2-3 Trees. 2-3-4 Trees. Red-Black Trees. B-Trees. Splay Trees. Digital Search Trees. Tries.

C. RECOMMENDED TEXT/REFERENCE BOOKS

1. Fundamentals of Data Structures using C++ by: Horowitz, Sahni, Galgotia Pub. 1998 ed.
2. Data Structures& Algorithms, by: Aho, Ullman, Addision Wesley
3. An Introduction to Data Strucures with applications, by: Tremblay, Sorenson, McGraw Hill.
4. The art of Computer Programming Vol. I & III, by: Kunth, Addision Wesley.
5. Data Structures using C and C++, by: YedidyahLangsam, Tenenbaum

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Describe and use the concepts of different data structures and algorithms with reusability.
- Apply the concepts of appropriate data structures to solve real-world problems.
- Analyze the given problem and be able to select appropriate data structures like an array, stack, queue, linked list, tree, graph, etc. to solve the problem to improve efficiency.
- Design a solution for a given problem statement and prepare an efficient algorithm using the appropriate data structure.
- Apply different data structures and algorithms to write, document, debug and run the programs.

B. TECH. SEMESTER – IV (IT)

SUBJECT: UNIVERSAL HUMAN VALUES - II

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
3	-	-	3	3	60	-	-	-	60

Reference Code HSMC4XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To help the students appreciate the essential complementarily between 'VALUES' and SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement toward value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior, and mutually enriching interaction with Nature.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] **COURSE INTRODUCTION**

Need, Basic Guidelines, Content, and Process for Value Education Self Exploration–what is it? - it's content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness, and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels

[2] **UNDERSTANDING HARMONY IN THE HUMAN BEING**

Harmony in Myself! Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer, and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, the meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

[3] **UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY**

Harmony in Human-Human Relationship Understanding Harmony in the family – the basic unit of human interaction, Understanding values in human to human relationship; the meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence,

Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in a relationship, Understanding the harmony in the society (society being an extension of the family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family.

[4] UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE

Whole existence as Co-existence: Understanding the harmony in the Nature, Interconnectedness, and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

[5] IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics, Case studies of typical holistic technologies, management models and production systems, Strategy for the transition from the present state to Universal Human Order.

C. RECOMMENDED TEXT/REFERENCE BOOK

1. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2
2. JeevanVidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Start exploring themselves; get comfortable with each other and with the teacher; they start appreciating the need and relevance of the course.
- Note that the natural acceptance (intention) is always for living in harmony, only competence is lacking
- Present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.
- Grasp the right utilization of their knowledge in their streams of Technology/Engineering/Management/any other area of study to ensure mutual fulfillment. E.g. mutually enriching production system with the rest of nature.

B. TECH. SEMESTER – IV (IT)

SUBJECT: DISCRETE MATHEMATICS

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
3	1	-	4	4	60	40	-	-	100

Reference Code PCC4XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To impart an in-depth understanding of various concepts related to Discrete Mathematics, correct terminology, and notation.
- To teach how to construct correct direct and indirect proofs, the division into cases in a proof, use of counterexamples, etc.
- To explain Sets, Functions, Relations, Groups, Graphs, Trees, and their applications using real-world examples.
- Demonstrate and teach how to apply logical reasoning to solve a variety of problems.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] **SETS AND PROPOSITIONS**
Combination of sets, finite, uncountable infinite, and infinite sets, mathematical induction, principles of inclusion, and exclusion, propositions.

[2] **PROPOSITIONAL LOGIC**
Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy.

[3] **PERMUTATIONS, COMBINATIONS, DISCRETE PROBABILITIES**
Rules of sums and products, permutations, combinations, generation, discrete probability, conditional probability, information.

[4] **RELATIONS AND FUNCTIONS**
Relational model of databases, properties of binary relations, equivalence relation, partitions, partial ordering, lattices, chains and antichains, functions, and pigeon-hole principle.

[5] **GRAPHS**
Basic terminology, multi- and weighted graphs, paths, circuits, shortest path, Eulerian path, Travelling Salesman problem, factors of a graph, planar graphs.

[6] **TREES**
Trees, rooted trees, path length, prefix codes, binary search trees, spanning trees and cut-sets, minimum spanning trees, transport networks.

[7] RECURRENCE RELATIONS

Linear recurrence relations with constant coefficient, homogeneous, particular and total solutions, generating functions, sorting algorithms, and matrix multiplication.

[8] DISCRETE NUMERICAL FUNCTIONS

Manipulations of numerical functions, asymptotic behavior, generating functions, combinatorial problems.

[9] GROUP

Groups and sub-groups, generators, evaluation of powers, cossets, Lagrange's theorem, permutation group and Burnsides theorem, group codes, isomorphism, automorphism, homomorphism, normal subgroups, rings, integral domains and fields, ring homomorphism, polynomial rings, and cyclic codes.

[10] LATTICES AND BOOLEAN ALGEBRAS

Lattices and algebraic systems, the principle of duality, properties of algebraic systems, distributive lattices, Boolean algebras, uniqueness, Boolean functions and expressions, propositional calculus.

C. RECOMMENDED TEXT/ REFERENCE BOOK

1. Discrete Mathematics Applications, Kenneth H. Rosen, 7th edition, Mc Graw Hill
2. Elements of Discrete Mathematics, by: C.L. Liu, 2nd Ed. McGraw-Hill
3. Modern Applied Algebra, by: Birkoff and Bartee, McGraw-Hill, CBS.
4. Discrete Mathematics - A Unified Approach, by: Stephen A. Wiitala. Computer Science Series, McGraw-Hill.

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Classify the algebraic structure of the given mathematical problem.
- Express terms of predicates, quantifiers, and logical connectives for the given logic sentence
- Derive the solution using deductive logic and prove the solution based on logical inference for the given problem.
- Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra
- Develop the given problem as graph networks and solve with techniques of graph theory.

B. TECH. SEMESTER – IV (IT)

SUBJECT: COMPUTER AND COMMUNICATION NETWORK

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

Reference Code PCC4XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To teach about network hardware, software, services, and protocols and explain the uses of computer networks in daily life.
- To explain the layered architecture of network software and compare OSI and TCP/IP model
- To explain the functionalities and working of different layers in TCP/IP protocol stack.
- To demonstrate and teach the usage of various network devices, their configurations, and setup

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] INTRODUCTION

Introduction and Applications of computer Networks; Network Hardware-LAN, MAN, WAN, internetworks; Network Software, Design Issues, Interfaces & Services, Connection-Oriented & Connectionless services, Service primitives, Relationship of services to protocols.

[2] STUDY OF REFERENCE MODELS

Introduction OSI & TCP/IP, their comparison & critiques.

[3] THE PHYSICAL LAYER

Guided Transmission Media: magnetic media, twisted pair, baseband & broadband, co-axial cable, fiber optics; Wireless Transmission: radio, microwave, infrared, lightwave.

[4] THE DATA LINK LAYER

DLL Design issues Error Detection & Correction; Elementary Data link Protocols: Simplex protocol, Stop and Wait, Automatic Repeat Request, Sliding Window Protocols (1-bit sliding window, Go Back N, Selective Repeat Protocols); Examples of Data link layer protocols: HDLC, PPP.

[5] MEDIUM ACCESS SUB LAYER

Channel Allocation Problem: Static & Dynamic, Multiple Access protocols (ALOHA, CSMA/CA AND CD, Collision Free Protocols, Limited contention protocols, WDMA, FDMA, TDMA, CDMA); Wireless LAN protocols, IEEE-802.3(Ethernet), 802.4(Token Bus), 802.5(Token Ring); Bridges: From 802.x to 802.y, transparent Bridges, Spanning Tree, Source Routing Bridges, remote bridge.

[6] THE NETWORK LAYER

Network layer Design issues; Internetworking-How networks differ, how networks can

be connected, concatenated virtual circuits, connectionless internetworking, and tunneling, internetwork routing; The network layer in the internet: the IP protocol, IPv4 Header, fragmentation, IP addresses & subnets, Internet Control Protocols – ARP, RARP, ICMP, IGMP; Routing Algorithms: Static Routing, Dynamic Routing, Intra-domain: Distance Vector Routing(RIP), Link-state (OSPF), Inter-domain Routing: Path vector (BGP).

[7] THE TRANSPORT LAYER

The Transport Service: services provided to upper layers, transport services primitives; Elements of Transport Protocols; The Internet Transport Protocols; TCP service model: TCP protocol, TCP Segment Header, TCP Connection Management, TCP Transmission Policy, TCP Congestion Policy; UDP & overview of Socket.

[8] CONGESTION CONTROL AND QUALITY OF SERVICE

Congestion control algorithm general policies, Congestion prevention policies, Traffic shaping, Flow specifications, Congestion control in VC subnets, Congestion controls in Datagram Subnets; Load shedding, jitter control, Quality of services-requirements, Techniques to achieve a good quality of services: Leaky bucket algorithm, Token bucket algorithm, Resource reservation, Admission control, Packet scheduling.

[9] **THE APPLICATION LAYER**

Application Layer Protocols: File transfer protocol, Domain Name System, Electronic mail (SMTP, IMAP, POP), HTTP

C. RECOMMENDED TEXT/ REFERENCE BOOKS

1. Data Communications and Networking by Behrouz A. Forouzan, 4th Edition, Tata- McGraw Hill Edition.
2. Computer Networks By Andrew S. Tanenbaum, 4th Edition. Prentice-Hall of India(PHI)
3. Data & Computer Communications - William Stallings, 2ed, Maxell Macmillan Int.
4. Communication Networks, Fundamental Concepts & key Architectures – Leon Garcia & Widjaja, Tata- McGraw Hill Edition.

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Describe the basics of concepts of networking, layered approach, responsibilities performed at each layer and basic of cryptography and network security.
- Analyze the working of various network protocols, and network devices and configure them.
- Apply concepts of IP addressing, routing algorithm and congestion control, and network programming techniques to resolve the problem in the existing network or system.
- Design a small to medium efficient LAN, WAN in CISCO Packet tracer and client-server paradigm for a given problem using the concepts of computer networks.

B. TECH. SEMESTER – IV (IT)
SUBJECT: DATABASE MANAGEMENT SYSTEM

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

Reference Code PCC4XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To explain basic database concepts, data models, schemas, instances, and applications of database systems.
- To demonstrate the use of constraints and relational algebra principles and operations.
- To describe the basics of SQL and construct queries using SQL / POSTGRESQL.
- To emphasize the importance of normalization in databases.
- To facilitate students in Database designing and implementation through projects.
- To familiarize issues of concurrency control and transaction management.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] BASIC CONCEPTS

Purpose of the database system, View of data, Database abstraction and Models, Database Languages, Transaction management, Storage management, Database administrator, Database users, Overall system structure.

[2] ENTITY RELATIONSHIP MODEL

Entity sets, Relationship sets, Attributes, Constraints, Keys. Entity-relationship diagrams, Weak entity sets, Generalization, Specialization, Aggregation; Design of an E-R database schema. Reduction of an E-R schema to tables.

[3] RELATIONAL DATABASE MANAGEMENT SYSTEM

Relational Model Structure of database, Relational algebra, Extended relational algebra operation, tuple relational calculus, Domain relational calculus; Modification of database, Views. Structured Query Language Background; Constraints (i.e. Integrity Constraints, Domain constraints, Referential integrity), Assertions, Triggers, Functional Dependencies; Database Design Pitfalls in relational database design, Normalization, I, II, III normal Forms, Normalization using functional dependencies, Normalization using multi-valued dependencies, Domain key normal form; Alternative approach to database design.

[4] NOSQL

Introduction to NoSQL, Structure of NoSQL, NoSQL Queries.

[5] FILE SYSTEM STRUCTURE

Indexing & Hashing, File organization, Organization of records in files, Data dictionary storage; Basic concepts of indexing, Order indices, B- Tree index files, B+ -Tree index files, Static hashing & Dynamic Hashing.

[6] QUERY PROCESSING

Cost estimation, Measures of query cost: Selection operation, Sorting, Join operation. Choice of evaluation plans.

[7] TRANSACTION PROCESSING

Transaction concepts, Transaction state, Implementation of atomicity & durability, Concurrent executions, Serializability, Conflict serializability, View serializability; Testing of conflict and view serializability.

[8] CONCURRENCY CONTROL

Lock-based protocols, Time-stamp based protocol, Validation based protocol, Multiple granularities, Multi-version schemes, and Deadlock handling.

[9] RECOVERY SYSTEM

Failure classification, Storage structure, Recovery & Atomicity: Log-based recovery, Shadow paging, Recovery with concurrent transactions, Buffer management, Failure with loss of non-volatile storage, Advance recovery techniques.

[10] DISTRIBUTED DATABASES

Homogeneous and heterogeneous databases, Distributed Transactions

[11] SECURITY AND INTEGRITY OF DATABASE

Overview of Security Mechanisms, Recovery management system

C. RECOMMENDED TEXT / REFERENCE BOOK

1. Database System Concepts, by: Henry F. Korth and A. Silberschatz. 2nd Ed. McGraw-Hill 1991.
2. Fundamentals of Database Systems by: Shamkant Navathe

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Describe different types of keys, databases, transactions, concurrency control and requirement of database management systems
- Apply the concept of database design techniques to solve the given problem on different types of applications
- Analyse the given problem and be able to choose appropriate database concepts to create the normalized and optimized database.
- Design a solution for a variety of applications for given problem statements and prepare the required ER model, Relational Schema, Data Dictionary, and database diagram.
- Apply concepts to write, document, debug, run and test SQL, NO SQL, PLSQL, triggers and cursors for applications

B. TECH. SEMESTER – IV (IT)

SUBJECT: DESIGN AND ANALYSIS OF ALGORITHMS

Teaching Scheme (Hours/Week)				Credit	Examination Scheme				
Lect	Tut	Prac	Total	s	Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

Reference Code PCC4XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To explain the fundamental concepts of algorithms, performance analysis, and problem-solving paradigm in general.
- To demonstrate and teach various methods for performance analysis of different types of algorithms
- To make the students familiar with major algorithmic design paradigms and demonstrate their application using suitable examples.
- To guide students in applying appropriate algorithm design techniques to solve common engineering design requirements.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] **INTRODUCTION TO ALGORITHMS**
Definition of the algorithm, Characteristic of algorithms, Types of algorithm design Paradigm, Recursive Algorithms, The Need for Analysis.

[2] **ANALYZING ALGORITHMS**
Analysis Techniques - Space and Time Complexity, Asymptotic Notations for analysis of algorithms - Omega, Theta, Big Oh, Little Oh, Little omega, Recurrence relations and Analysis of recursive algorithms, Homogeneous, In-homogeneous equations, Recurrence tree, Substitution method, the Master method.

[3] **DIVIDE AND CONQUER ALGORITHM DESIGN STRATEGY**
Introduction to Divide and Conquer, Binary search, Merge Sort, Quicksort.

[4] **GREEDY ALGORITHM DESIGN STRATEGY**
Introduction to Greedy Methods; Knapsack Problem, Minimum Cost Spanning Trees, Optimal Merge Patterns, Single-Source Shortest Paths.

[5] **DYNAMIC PROGRAMMING DESIGN STRATEGY**
Introduction to Dynamic Programming; Multistage Graphs, Matrix Chain Multiplication, Single-Source and All-Pairs Shortest Paths, Travelling Salesperson Problem, Longest Common Subsequence.

[6] **BACK TRACKING**
Graph Traversal using DFS/BFS; Articulation point in Graph; Introduction to Backtracking. N-Queens Problem, Graph Colouring, Hamiltonian Cycles.

[7] **BRANCH-AND-BOUND**

Introduction to Branch and Bound; Knapsack problem, Job assignment problem; Comparison of backtracking and branch and bound

[8] NP-HARD AND NP-COMPLETE

Definition of P and NP classes; Relation between complexity classes; Examples of problems in various classes.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1. G. Brassard, P.Bratley, "Fundamentals of Algorithmics", (PHI).
2. T. H . Cormen, C . E . Leiserson, R. L . Rivest "Introduction to Algorithms", PHI.
3. Ellis Horowitz and Sartaj Sahani, "Fundamentals of Computer Algorithms", Computer Science Press.
4. Design & Analysis of Computer Algorithms, by: Aho, Ullman, Addison Wesley.
5. The art of Computer Programming Vol. I & III, by Kunth, Addison Wesley.

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Describe basic concepts of algorithms, performance analysis of algorithms, algorithm design techniques, tractable and intractable algorithms
- Evaluate the performance of the algorithm using appropriate techniques based on the structure and type of algorithm
- Apply the algorithm design techniques to solve the real-world problems from different domains like searching, sorting, graph theory, optimization, etc.,
- Analyze the given problem definition, understand the nature of the problem, and be able to choose appropriate algorithm design techniques to solve the given problem.
- Design a solution for a given problem statement and clearly mention the requirements, inputs, outputs, processes, models, algorithms, pseudo-code, test cases, etc.,
- Apply concepts to design, document, implement, debug, run, test, and do profiling, of algorithms for various problems from the diversified domains like graph theory, string/text processing, searching, sorting, optimizations, etc., using relevant tools.

B. TECH. SEMESTER – IV (IT)

SUBJECT: MICROPROCESSOR ARCHITECTURE PROGRAMMING AND INTERFACING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

Reference Code PCC4XX

A. COURSE OBJECTIVES

The objectives of teaching this course are:

- To explain the architecture and the instruction set of the Intel 8086/80286 and 80386 microprocessor family.
- To teach the basic concepts of microprocessor and its interfacing with memory and programmable peripheral chips involving system design.
- To impart knowledge about Interrupts and their applications.
- To demonstrate and teach assembly language programming using Turbo Assembler (TASM) software.

B. DETAILED SYLLABUS

Unit **Topic(s)**

[1] MICROPROCESSOR ARCHITECTURES

Introduction, Main features of 8086, 8086 Pin diagram, 8086 internal architecture, Machine cycle, and Instruction Cycle, Minimum and Maximum Mode, 8086 Memory System

[2] 8086 ASSEMBLY LANGUAGE PROGRAMMING

Program Development Steps, Constructing the Machine Codes for 8086 Instructions, Addressing Modes, Assembly Language Program Development Tools.

[3] 8086 INSTRUCTION SET AND ASSEMBLER DIRECTIVES

Assembler Directives, Data Transfer Instructions, Arithmetic Instructions, Logical Instructions, Shift and Rotate Instructions, Transfer or Branch Control Instructions, Looping or Iteration Control Instructions, String Instructions, Processor Control Instructions.

[4] STACKS, PROCEDURES, AND MACROS

Stack Instructions, Defining and Calling Procedure, Parameter Passing Methods, Working with Macros.

[5] 8086 INTERRUPTS AND I/O

The 8086 Interrupts, Interrupt types, Interrupt processing

[6] BASIC INTERFACING TECHNIQUES

Interfacing memory, Peripheral devices interfacing, programming and interfacing of VLSI based peripheral Devices like 8255, 8254, 8259, DMA Controller, etc.

[7] 80286/386/486 MICROPROCESSORS

Multi-User/Multitasking Operating System Concepts, Introduction to 80286/80386

/80486, The 80286386 Segments, Descriptor Tables and Selectors; Real Address Mode and Protected Virtual Address Mode of 80286/80386/80486, Multitasking and Exceptions.

[8] MODERN MICROPROCESSORS

The Pentium Architecture, Hyper-Threading and Multi-core Technologies, Study of latest microprocessors.

C. RECOMMENDED TEXT/ REFERENCE BOOKS

1. Microprocessors and Interfacing (Programming & Hardware), Douglas V. Hall, McGraw Hill
2. 8086 Programming and Advance Processor Architecture, M. T. Savaliya, WIND Series, 2012
3. Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium And Pentium Pro Processor, by: Barry B. Brey

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Describe the architecture and organization of the Intel 8086,80286 and other advance microprocessors, interfacing of the processor with memory and I/O devices, understanding of interrupts and study of descriptors in 80286 & 80386.
- Relate various descriptors and operating modes of 80286/80386 processor.
- Analyze as well as design circuits using various interfacing techniques
- Develop interrupt service routines for specific problem statements.
- Develop, debug and run assembly language programs with the help of the 8086-instruction set and various addressing modes using TASM.

B. PHARM. SEMESTER – I (BPH)
SUBJECT: HUMAN ANATOMY AND PHYSIOLOGY I -THEORY (BP101T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: It is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. It provides the basic knowledge required to understand the various disciplines of pharmacy.

Objectives: Upon completion of the course the student shall be able to

- Explain the gross morphology, structure and functions of various organs of the human body.
- Describe the various homeostatic mechanisms and their imbalances.
- Identify the various tissues and organs of different systems of human body.
- Perform the various experiments related to special senses and nervous system.
- Appreciate coordinated working pattern of different organs of each system

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Introduction to human body** Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology. **Cellular level of organization** Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine **Tissue level of organization** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.	**10**	CO1
[2]	**Integumentary system** Structure and functions of skin **Skeletal system** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction **Joints** Structural and functional classification, types of joints movements and its articulation	**10**	CO1 CO2 CO3

[3]	**Body fluids and blood** Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system. □ **Lymphatic system** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system	10	CO2 CO3 CO4 CO5
[4]	**Peripheral nervous system:** Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves. **Special senses** Structure and functions of eye, ear, nose and tongue and their disorders.	08	C01 CO2 CO3 C04 C05
[5]	**Cardiovascular system** Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart	08	C01 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Charles Herbert Best; Brobeck, J. R.; Norman Burke Taylor. Best & Tailor's Physiológical Basic of Medical Practice; Williams & Wilkins: Baltimore, 1980.
2. Hall, J. E.; Hall, M. E. Guyton and Hall Textbook of Medical Physiology; Elsevier - Health Science: S.L., 2020.

D. REFERENCE BOOKS

1. Scanlon, V. C.; Sander, T. Student Workbook for Essentials of Anatomy and Physiology; F.A. Davis: Philadelphia, 1991.
2. Hall, J. E.; Hall, M. E. Guyton and Hall Textbook of Medical Physiology; Elsevier - Health Science: S.L., 2020.
3. Tortora, G. J.; Derrickson, B. Principles of Anatomy and Physiology, 15th ed.; Wiley: Hoboken, 2017.
4. Charles Herbert Best; Brobeck, J. R.; Norman Burke Taylor. Best & Tailor's Physiológical Basic of Medical Practice; Williams & Wilkins: Baltimore, 1980.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To get knowledge about the basic anatomy and function of the body and remember the position of the various parts of our body
CO2	Remember, Understand and Apply	To know about the working mechanism of the body part and measure the activity of certain body parts by various techniques.
CO3	Understand Apply and Evaluate	To understand about the mechanism behind the action produced by various body part
CO4	Understand	To know about how disease occurs, and for that which organ system is required to defence those disease condition
CO5	Remember, Understand, Apply and evaluate	To get knowledge about functioning and dysfunctioning of various parts of the body/system and disease occur due to these imbalances.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	1	3	1	3	3	1	3	3	3	3	1	1
CO2	3	2	2	3	2	2	2	2	3	1	3	3	3	3	2	2
CO3	3	3	3	3	2	2	2	2	3	2	2	3	3	3	2	2
CO4	3	3	3	3	2	3	3	2	3	2	2	3	3	3	3	2
CO5	3	3	2	2	2	2	3	2	2	2	2	2	3	3	2	2
Avg	3	2.6	3	2.4	1.8	2.4	2.2	2.2	2.8	1.6	2.4	2.8	3	3	2.2	1.8

B. PHARM. SEMESTER – I (BPH)
SUBJECT: PHARMACEUTICAL ANALYSIS I -THEORY (BP102T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Prac.	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	04	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

Objectives: Upon completion of the course student shall be able to

- understand the principles of volumetric and electro chemical analysis
- carryout various volumetric and electrochemical titrations
- Develop analytical skills

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**(a) Pharmaceutical analysis** Definition and scope i) Different techniques of analysis ii) Methods of expressing concentration iii) Primary and secondary standards. iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate **(b)Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures	**10**	CO1 CO5
[2]	**Acid base titration**: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves **Non aqueous titration**: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl	**10**	CO2 CO3 CO4 CO5
[3]	**Precipitation titrations**: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride. **Complexometric titration**: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate. **Gravimetry**: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.	**10**	CO2 CO3 CO4 CO5
[4]	**Redox titrations** (a) Concepts of oxidation and reduction (b) Types of redox titrations (Principles and applications)	**08**	CO2 CO3 CO4 CO5

	Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate		
[5]	Electrochemical methods of analysis **Conductometry**- Introduction, Conductivity cell, Conductometric titrations, applications. **Potentiometry -** Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications. **Polarography** - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications	**07**	CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. G. H. Jeffery J. Bassett J. Mendham R C. Denney, *Vogel's textbook of quantitative chemical analysis*, 5th ed.; Bath press, Avon : Great Britain, 1989.
2. Sharma B. K., *Analytical Chemistry*, 2nd ed.; Krishna Prakashan media (p) Ltd: Delhi, India, 2006.

D. REFERENCE BOOKS

1. P. Gundu Rao, *Inorganic Pharmaceutical Chemistry (Pharma Chemistry-I)*, 2010
2. Arthur Owen Bentley; John Edmund Driver; Lewis Malcolm Atherden. *Bentley and Driver's Textbook of Pharmaceutical Chemistry.*; Oxford University Press: Oxford, 1977.
3. Kennedy, J. H. *Analytical Chemistry : Principles*; Saunders College Pub: New York, 1990.
4. Health, O. Indian Pharmacopoeia 2010. Vol. 1; Ghaziabad Indian Pharmacopoeia Commission, 2010.
5. Skoog, Douglas A, F J. Holler, and Timothy A. Nieman, *Principles of Instrumental Analysis*, 7th ed.; Saunders College Pub: United stated of America, 2016.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand the importance, scope and fundamentals of analytical chemistry.
CO2	Remember, Understand and learn	Understand and learn different analytical and electroanalytical methods
CO3	Understand, remember Apply	Remember and apply various analytical and electroanalytical methods in pharmaceutical drug analysis
CO4	Understand, analyse and evaluate	Analyse and evaluate various volumetric and electrochemical titrations results
CO5	Development and evaluation	Evaluation of sources of errors, promoting ethical practises and development of analytical skills

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	1	1	3	1	1	1	-	3	3	3	2	2	-
CO2	3	1	3	2	1	3	1	1	1	-	3	3	3	2	2	1
CO3	3	1	3	2	1	3	1	1	1	-	3	3	3	2	2	1
CO4	3	1	3	2	1	3	1	1	1	-	3	3	3	2	2	1
CO5	3	1	3	1	1	3	1	1	1	-	3	3	3	2	2	-
Avg.	3	1	3	2	1	3	1	1	1	-	3	3	3	2	2	0.6

B. PHARM. SEMESTER – I (BPH)
SUBJECT: PHARMACEUTICS I -THEORY (BP103T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: Course enables the student to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

Objectives: Upon completion of the course the student shall be able to

- Know the history of profession of pharmacy
- Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
- Understand the professional way of handling the prescription
- Prepare various conventional dosage forms

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Historical background and development of profession of pharmacy:** History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia. · **Dosage forms:** Introduction to dosage forms, classification and definitions · **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription. · **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.	**10**	CO1 CO3 CO4
[2]	**Pharmaceutical calculations**: Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight. · **Powders:** Definition, classification, advantages and disadvantages,Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions. · **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms.Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques	**10**	CO2 CO5
[3]	**Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions. · **Biphasic liquids:** · **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.	**10**	CO2 CO5

	· **Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.		
[4]	**Suppositories**: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories. · **Pharmaceutical incompatibilities**: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.	**8**	CO1 CO2 CO5
[5]	**Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms	**7**	CO2 CO5

C. TEXT BOOKS

1. Gunn, C.; Cooper, J. W.; Sidney James Carter. Cooper and Gunn's Dispensing for Pharmaceutical Students; Cbs: New Delhi, 2008.

D. REFERENCE BOOKS

2. Ansel, H. C.; Allen, L. V.; Popovich, N. G. Pharmaceutical Dosage Forms and Drug Delivery Systems; Philadelphia, Pa Lippincott-Williams & Wilkins, 1999.
3. Arthur Owen Bentley; Ernest Alexander Rawlins. Bentley's Textbook of Pharmaceutics.; All India Traveller Book Seller: New Delhi, 2002.
4. Aulton, M. E. Pharmaceutics : The Science of Dosage Form Design; Churchill Livingstone: Edinburgh Etc., 2003.
5. Gunn, C.; Cooper, J. W.; Sidney James Carter. Cooper and Gunn's Dispensing for Pharmaceutical Students; Cbs: New Delhi, 2008.
6. Françoise Nielloud; Marti-Mestres, G. Pharmaceutical Emulsions and Suspensions; Informa Healthcare, Cop: New York, 2010.
7. Ghebre-Sellassie, I. Pharmaceutical Pelletization Technology; Dekker: New York U.A., 1989.
8. Parikh, D. M. Handbook of Pharmaceutical Granulation Technology; Informa Healthcare: New York, N.Y., 2007.
9. Remington, J. P.; Gennaro, A. R. Remington : Volume 1 : The Science and Practice of Pharmacy; Mack Pub. Co: Easton, Pa., 1995.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Remember	To understand and remember the professional way of handling the prescription
CO2	Understand and Remember	To understand the basics of different dosage forms and pharmaceutical incompatibilities
CO3	Understand	To understand the history of profession of pharmacy
CO4	Perform	To perform the pharmaceutical calculations
CO5	Prepare and evaluate	To prepare and evaluate various conventional dosage forms

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	1	3	3	3	3	2	3	3	3	3	3	3
CO2	3	2	3	3	1	2	1	2	2	1	2	3	3	3	2	2
CO3	3	2	2	1	1	3	-	2	2	-	3	2	2	3	3	3
CO4	3	1	3	3	-	1	1	1	1	1	2	3	2	3	2	1
CO5	3	1	3	3	-	1	1	1	1	1	2	3	3	3	1	1
Avg	3	1.8	2.8	2.6	0.6	2	1.2	1.8	1.8	1	2.6	2.8	2.6	3	2.2	2

B. PHARM. SEMESTER – I (BPH)

SUBJECT: PHARMACEUTICAL INORGANIC CHEMISTRY -THEORY (BP104T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject deals with the monographs of inorganic drugs and pharmaceuticals.
Objectives: Upon completion of the course the student shall be able to

- Know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
- Understand the medicinal and pharmaceutical importance of inorganic compounds

B. COURSE CONTENT

General methods of preparation, assay for the compounds superscripted with **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes

NO	TOPIC	L (Hrs)	COs
[1]	**Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate	**10**	CO1 CO2
[2]	**Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. **Major extra and intracellular electrolytes**: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance. **Dental products**: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.	**10**	CO2 CO3 CO4 CO5
[3]	**Gastrointestinal agents** **Acidifiers:** Ammonium chloride* and Dil. HCl **Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture **Cathartics:** Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite **Antimicrobials**: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations	**10**	CO2 CO3 CO4 CO5
[4]	**Miscellaneous compounds** **Expectorants:** Potassium iodide, Ammonium chloride*. **Emetics**: Copper sulphate*, Sodium potassium tartarate **Haematinics:** Ferrous sulphate*, Ferrous gluconate **Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite333 **Astringents**: Zinc Sulphate, Potash Alum	**8**	CO2 CO3 CO4 CO5

[5]	**Radiopharmaceuticals**: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I_{131}, Storage conditions, precautions & pharmaceutical application of radioactive substances.	**7**	CO2 CO3 CO4 CO5

C. TEXT BOOKS (LATEST EDITION)

1. Anand & G.R. Chatwal, Inorganic Pharmaceutical Chemistry, India, 2010
2. Suhagia B. N., Inorganic Pharmaceutical Chemistry, Nirav Prakashan, India, 2013

D. REFERENCE BOOKS (LATEST EDITION)

1. Schroff, M. L. Pharmaceutical Chemistry; National Book Centre: Calcutta, 1968.
2. Arthur Owen Bentley; John Edmund Driver; Lewis Malcolm Atherden. Bentley and Driver's Textbook of Pharmaceutical Chemistry.; Oxford University Press: Oxford, 1977.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Remember	To know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
CO2	Understand and Remember	To understand the medicinal and pharmaceutical importance of inorganic compounds
CO3	Understand	To understand and learn about various types of inorganic compounds
CO4	Understand and Remember	To study preparation and assay of selected inorganic compounds
CO5	Understand and Remember	To understand and remember synonyms and chemical formula of various inorganic compounds

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	1	-	-	1	-	2	1	3	2	3	1	1	1
CO2	3	-	-	1	-	1	-	-	2	1	3	2	3	1	1	1
CO3	3	-	-	1	-	-	-	-	1	1	3	2	2	1	1	1
CO4	3	-	-	1	-	-	-	-	1	-	3	2	2	1	-	-
CO5	3	-	-	1	-	-	-	-	-	-	3	2	-	-	-	-
Avg	3	-	-	1	-	0.2	0.2	-	1.2	0.6	3	2	2	0.8	0.6	0.6

B. PHARM. SEMESTER – I (BPH)
SUBJECT: COMMUNICATION SKILLS -THEORY (BP105T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Prac.	Total		Ext	Sess.	CM	Prac.	Total
2	-	-	2	2	35	10	5	-	50

A. COURSE OVERVIEW

Scope: This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business

Objectives: Upon completion of the course the student shall be able to

- Understand the behavioural needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
- Communicate effectively (Verbal and Non-Verbal)
- Effectively manage the team as a team player
- Develop interview skills
- Develop Leadership qualities and essentials

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment	**07**	CO1 CO2
[2]	**Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style	**07**	CO1 CO2
[3]	**Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations **Effective Written Communication:** Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message	**07**	CO1 CO2 CO3
[4]	**Interview Skills:** Purpose of an interview, Do's and Dont's of an interview	**05**	CO4

	Giving Presentations: Dealing with Fears, planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery		CO5
[5]	**Group Discussion:** Introduction, Communication skills in group discussion, Do's and Dont's of group discussion	**04**	CO3 CO5

C. TEXT BOOKS

1. Mosam Sinha. *Effective Communication Skills*; Aavishkar Publishers, Distributors: Jaipur, 2017.
2. Lisel Erasmus-Kritzinger. *Introductory Communication : The Ultimate Guide to Effective Communication Skills, Study Skills, Life Skills*; Nasou Via Afrika: Cape Town, 2007.

D. REFERENCE BOOKS

1. Rutherfoord, A. J. *Basic Communication Skills for Technology*; Englewood Cliffs, Nj Prentice Hall, 1991.
2. Worth, R. *Communication Skills.*; Ferguson: New York, 2019.
3. Nira Konar. *Communication Skills for Professionals*; Phi Learning Private Limited: New Delhi, 2011.
4. Mitra, B. K. *Personality Development and Soft Skills*; Oxford University Press: New Delhi, 2011.
5. Wentz, F. H. *Soft Skills Training : A Workbook to Develop Skills for Employment*; Createspace: Charleston, Sc, 2012.
6. Peter, F. S. J. *Soft Skills and Professional Communication*; Tata Mcgraw-Hill: New Delhi, 2012.
7. Araya, M. MTD Training Effective Communication Skills. *www.academia.edu*.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand the behavioural needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
CO2	Learn	Learn to communicate effectively (Verbal and Non Verbal) and apply appropriate communication style in professional context
CO3	Understand	Understand the effective team management as a team player
CO4	Understand and Remember	Understand and remember the requisites for development of an effective interview skills
CO5	Understand and learn	Develop Leadership qualities and essentials

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	-	-	1	3	-	3	-	-	3	1	1	-	3	-
CO2	-	-	-	-	3	3	-	3	-	-	3	1	1	-	3	-
CO3	-	-	-	-	3	1	-	1	-	-	3	1	1	-	3	-
CO4	-	-	-	-	-	1	-	1	-	-	3	1	1	-	3	-
CO5	-	-	-	-	3	3	-	3	-	-	3	1	1	-	3	-
Avg.	-	-	-	-	2	2.2	-	2.2	-	-	3	1	1	-0	3	-

B. PHARM. SEMESTER – I (BPH)
SUBJECT: REMEDIAL BIOLOGY -THEORY (BP106RBT)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
2	--	---	2	2	35	10	5	-	50

A. COURSE OVERVIEW

Scope: To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

Objectives: Upon completion of the course the student shall be able to

- know the classification and salient features of five kingdoms of life
- Understand the basic components of anatomy & physiology of plant
- Know understand the basic components of anatomy & physiology animal with special reference to human

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Living world:** Definition and characters of living organisms • Diversity in the living world • Binomial nomenclature • Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus, **Morphology of Flowering plants** • Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. • General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones	7	CO1 CO4 CO5
[2]	**Body fluids and circulation** • Composition of blood, blood groups, coagulation of blood • Composition and functions of lymph • Human circulatory system • Structure of human heart and blood vessels • Cardiac cycle, cardiac output and ECG **Digestion and Absorption** • Human alimentary canal and digestive glands • Role of digestive enzymes • Digestion, absorption and assimilation of digested food **Breathing and respiration** • Human respiratory system • Mechanism of breathing and its regulation • Exchange of gases, transport of gases and regulation of respiration • □ Respiratory	7	CO2 CO3

[3]	**Excretory products and their elimination** • Modes of excretion • Human excretory system- structure and function • Urine formation • Rennin angiotensin system **Neural control and coordination** • Definition and classification of nervous system • Structure of a neuron • Generation and conduction of nerve impulse • Structure of brain and spinal cord • Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata **Chemical coordination and regulation** • Endocrine glands and their secretions • Functions of hormones secreted by endocrine glands **Human reproduction** • Parts of female reproductive system • Parts of male reproductive system • Spermatogenesis and Oogenesis • □ Menstrual cycle	**07**	CO2 CO3
[4]	**Plants and mineral nutrition:** • Essential mineral, macro and micronutrients • Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation **Photosynthesis** • Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.	**05**	CO2 CO3
[5]	**Plant respiration:** Respiration, glycolysis, fermentation (anaerobic). **Plant growth and development** • Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators **Cell - The unit of life** • Structure and functions of cell and cell organelles. Cell division **Tissues** • Definition, types of tissues, location and functions	**04**	CO1 CO4 CO5

C. TEXT BOOKS

1. A Gokhale, S. B.; Kokate, C. K.; Gokhale, A. S.; Kalaskar, M. G. Pharmacognosy of Traditional Drugs - I; Nirali Prakashan, August: Pune, 2014.
2. Scanlon, V. C.; Sander, T. Student Workbook for Essentials of Anatomy and Physiology; F.A. Davis: Philadelphia, 1991.

D. REFERENCE BOOKS

1. Gokhale, S. B.; Kokate, C. K.; Gokhale, A. S.; Kalaskar, M. G. Pharmacognosy of Traditional Drugs - I; Nirali Prakashan, August: Pune, 2014.
2. Dutta, A. C. Botany for Degree Students.; Oxford University Press: Kolkata, 1996.
3. Gokhale, S. B.; Kokate, C. K.; Pharmaceutical Biology; Nirali Prakashan, August: Pune, 2015.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To get knowledge about the basic part of the living world i.e plants, the parts of plant, its morphology and physiology, classification of kingdom. diversity in the world.
CO2	Remember and understand	To know about the anatomy and function of the various parts of the body
CO3	Understand Remember and Evaluate	To understand about the mechanism behind the action produced by various body part, evaluation of functions of the body part. To know about how disease occurs, and for that which organ system is required to defence those disease condition
CO4	Understand and evaluate	To know about plant photosynthesis, minerals, and factor affecting photosynthesis
CO5	Remember, Understand, Apply and evaluate	To get knowledge about plant respiration, plant growth and detail about the cell and tissue structure and function.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	2	3	3	3	2	3	3	3	2	2	3	2	1
CO2	3	1	2	3	2	2	2	2	3	2	3	3	3	3	2	2
CO3	3	2	3	3	2	2	2	2	3	2	2	3	3	3	2	3
CO4	3	2	3	3	2	3	3	2	3	2	2	3	3	3	3	3
CO5	3	2	2	2	2	2	3	2	2	2	2	2	3	3	2	2
Avg	3	1.6	2.4	2.6	2.5	2.4	2.6	2	2.8	2.2	2.4	2.6	2.8	3	2.2	2.2

B.PHARM. SEMESTER – I (BPH)
SUBJECT: REMEDIALMATHEMATICS-THEORY (BP106RMT)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
2	-	-	2	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and La Place transform.

Objectives: Upon completion of this course the student should be able to

- Know the theory and their application in Pharmacy.
- Solve the different types of problems by applying theory.
- Appreciate the important application of mathematics in Pharmacy.
- Apply mathematics in solving statistical problems in pharmacy.
- Know the basics of mathematical problem-solving skills in Pharmacy.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Partial fraction** Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics **Logarithms** Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems. **Function:** Real Valued function, Classification of real valued functions. **Limits and continuity:** Introduction, Limit of a function, Definition of limit of a function. (ϵ-δ definition) , $\lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}$, $\lim_{\theta\to 0}\frac{\sin\theta}{\theta}=1,$	**06**	CO1, CO2, CO4.
[2]	**Matrices and Determinant:** Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co-Factors, Adjoin or adjutant of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method,Cramer'srule, Characteristics equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations.	**06**	CO1, CO2, CO4.
[3]	**Calculus** Differentiation: Introductions, Derivative of a function ,Derivative of a constant, Derivative of a product of a constant and a function, Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula),Derivative of the quotient of two functions (Quotient formula)–Without Proof, Derivative of x^nw.r.tx,where n is any rational number, Derivative of e^xDerivative of log	**06**	CO1, CO3, CO5.

	e^x, Derivative of a^x ,Derivative of trigonometric functions from first principles(without Proof),Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application		
[4]	**Analytical Geometry** Introduction: Signs of the Coordinates, Distance formula, Straight Line: Slope or gradient of a straight line, Conditions for parallel is m and perpendicularity of two lines, Slope of a line joining two points, Slope– intercept form of a straight line Integration: Introduction, Definition, Standard formulae, Rules of integration, Method of substitution,MethodofPartialfractions,Integrationbyparts,definite integrals, application	**06**	CO1, CO3, CO4.
[5]	**Differential Equations**: Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations Laplace **Transform:** Introduction, Definition, Properties of La place transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, Application in solving Chemical kinetics and Pharmacokinetics equations	**06**	CO3, CO4, CO5.

C. TEXT BOOKS

1. Hari Kishan. *Differential Calculus*; Atlantic Publishers & Distributors: New Delhi, 2007.
2. Ranganath, G. K. *Remedial Mathematics.* 2017.

D. REFERENCE BOOKS

1. Hari Kishan. *Differential Calculus*; Atlantic Publishers & Distributors: New Delhi, 2007.
2. Ranganath, G. K. *Remedial Mathematics.* 2017.
3. Hyma, P. *Pharmaceutical Mathematics with Application to Pharmacy*; Anmol Publications Pvt. Ltd: New Delhi, India, 2017.
4. H S Govinda Rao. *Higher Engineering Mathematics*; Viva Books: New Delhi, 2007.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and apply	Know the theory and their application in Pharmacy.
CO2	Understand and apply	Solve the different types of problems by applying theory.
CO3	Evaluate	Appreciate the important application of mathematics in Pharmacy.
CO4	Apply and Remember	Apply mathematics in solving statistical problems in pharmacy.
CO5	Analyse and Evaluate	Know the basics of mathematical problem solving skills in Pharmacy.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	1	3	3	0	3	1	1	3	3	3	3	1
CO2	3	1	3	3	1	3	3	0	1	1	0	3	3	3	3	1
CO3	3	1	3	3	1	3	3	0	2	1	1	3	3	3	3	1
CO4	3	1	3	3	2	3	3	1	1	1	0	2	3	3	3	1
CO5	3	1	3	3	1	3	3	1	1	1	1	2	3	3	3	1
Avg	3	1.4	3	3	1.2	3	3	0.4	1.6	1	0.6	2.6	3	3	3	1

B. PHARM. SEMESTER – I (BPH)

SUBJECT: HUMAN ANATOMY AND PHYSIOLOGY I -PRACTICAL (BP107 P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
---	--	4	4	2	35	10	5	-	50

A. COURSE OVERVIEW

Scope: It is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. It provides the basic knowledge required to understand the various disciplines of pharmacy.

Objectives:

- Practical allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Study of compound microscope. 2. Microscopic study of epithelial and connective tissue 3. Microscopic study of muscular and nervous tissue 4. Identification of axial bones 5. Identification of appendicular bones 6. Introduction to hemocytometry. 7. Enumeration of white blood cell (WBC) count 8. Enumeration of total red blood corpuscles (RBC) 9. Determination of bleeding time 10. Determination of clotting time 11. Estimation of haemoglobin count 12. Determination of blood group 13. Determination of erythrocyte sedimentation rate (ESR) 14. Determination of heart rate and pulse rate 15. Recording of blood pressure.	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. A Textbook of Practical Physiology; Jaypee Brothers Medical Publishers (P) Ltd: New Delhi, 2013.
2. Sri Nageswari K; Sharma, R. Practical Workbook of Human Physiology; Jaypee Brothers Medical Publishers (P) Ltd, 2006.

D. REFERENCE BOOKS

1. Scanlon, V. C.; Sander, T. Student Workbook for Essentials of Anatomy and Physiology; F.A. Davis: Philadelphia, 1991.
2. Hall, J. E.; Hall, M. E. Guyton and Hall Textbook of Medical Physiology; Elsevier - Health Science: S.L., 2020.

3. Tortora, G. J.; Derrickson, B. Principles of Anatomy and Physiology, 15th ed.; Wiley: Hoboken, 2017.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To get knowledge about the basic instruments used in this subject and how to operate it
CO2	Remember, Understand and evaluate	To know about the working mechanism of the instruments, understanding of models and result evaluation.
CO3	Understand Apply Evaluate and remember	To understand about procedure for measurement of various biochemical parameter, evaluation of result and after interpretation of result
CO4	Understand Apply and Evaluate	To know the value, obtain from the test and apply it in healthy or disease condition and give interpretation
CO5	Remember, Apply and evaluate	To get knowledge about parts of the instrument used in lab, its working principle, measurement and interpretation of result

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	1	3	3	2	3	3	3	2	3	3	3	1
CO2	3	2	2	3	1	3	2	2	3	1	3	3	3	3	2	1
CO3	3	3	3	3	2	2	2	3	3	1	2	3	3	3	2	2
CO4	3	2	3	3	2	3	3	2	3	2	2	3	3	3	3	2
CO5	3	3	3	3	2	2	3	2	2	2	2	2	3	3	2	2
Avg	3	2.4	2.8	3	1.6	2.6	2.6	2.2	2.8	1.8	2.4	2.6	3	3	2.4	1.6

B. PHARM. SEMESTER – I (BPH)
SUBJECT: PHARMACEUTICAL ANALYSIS I -PRACTICAL (BP108P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs.

Objectives: Upon completion of the course student shall be able to

- understand the principles of volumetric and electro chemical analysis
- carryout various volumetric and electrochemical titrations
- Develop analytical skills

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	**Preparation and standardization of** (1) Sodium hydroxide (2) Sulphuric acid (3) Sodium thiosulfate (4) Potassium permanganate (5) Ceric ammonium sulphate **Assay of the following compounds along with Standardization of Titrant** (1) Ammonium chloride by acid base titration (2) Ferrous sulphate by Cerimetry (3) Copper sulphate by Iodometry (4) Calcium gluconate by complexometry (5) Hydrogen peroxide by Permanganometry (6) Sodium benzoate by non-aqueous titration (7) Sodium Chloride by precipitation titration **Determination of Normality by electro-analytical methods** (1) Conductometric titration of strong acid against strong base (2) Conductometric titration of strong acid and weak acid against strong base (3) Potentiometric titration of strong acid against strong base	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Ministry, India.; Indian Pharmacopoeia Commission. *Indian Pharmacopoeia, 2010*; Indian Pharmacopoeia Commission: Ghaziabad, 2010.
2. Jain, D. S. M.; Patel, D. V. B. *Pharmaceutical Analysis*; Nirali Prakashan, 2018.

D. REFERENCE BOOKS

1. Beckett, A. H.; Stenlake, J. B. *Practical Pharmaceutical Chemistry*; Athlone Press: London, 1988
2. Muhammad Sajid Hamid Akash; Kanwal Rehman. *Essentials of Pharmaceutical Analysis*; Singapore Springer, 2020.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand, learn and remember	Understand, learn and remember various calculations for quantification of drugs by analytical and electroanalytical methods.
CO2	Learn and remember	Learn and remember the concept of calibration of apparatus and instruments
CO3	Understand and apply	Understand and apply the analytical and electroanalytical methods for assay and quantification of drugs in an unknown samples.
CO4	Understand	Understand the importance of data integrity and ethical practices in every steps of drugs quantification
CO5	Develop	Develop skills in performing the volumetric titration and handling electroanalytical instruments

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	1	1	1	1	2	-	3	3	3	2	2	-
CO2	3	3	2	1	1	2	1	1	2	-	3	3	3	2	2	-
CO3	3	3	3	3	2	2	1	1	2	1	3	3	3	2	2	1
CO4	3	1	3	1	2	2	1	1	2	-	3	3	3	2	2	1
CO5	3	3	1	1	1	2	1	1	2	1	3	3	3	2	2	-
Avg	3	2.6	2.2	1.8	1.4	1.8	1	1	2	0.4	3	3	3	2	2	0.4

B. PHARM. SEMESTER – I (BPH)
SUBJECT: PHARMACEUTICS I -PRACTICAL (BP109P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	-	Total
-	-	4	4	2	35	10	5	-	50

A. COURSE OVERVIEW

Scope: Course enables the student to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

Objectives: Upon completion of the course the student shall be able to

- Know the history of profession of pharmacy
- Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
- Understand the professional way of handling the prescription
- Prepare various conventional dosage forms

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	**1 . Syrups** a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68 **2. Elixirs** a) Piperazine citrate elixir b) Paracetamol pediatric elixir **3.Linctus** a) Terpin Hydrate Linctus IP'66 **4. Solutions** b) Iodine Throat Paint (Mandles Paint) a) Strong solution of ammonium acetate b) Cresol with soap solution c) Lugol's solution **5. Suspensions** a) Calamine lotion b) Magnesium Hydroxide mixture c) Aluminimum Hydroxide gel **6. Emulsions** a) Turpentine Liniment b) Liquid paraffin emulsion **7. Powders and Granules** a) ORS powder (WHO) b) Effervescent granules c)Dusting powder d)Divded powders **8. Suppositories** a) Glycero gelatin suppository b) Coca butter suppository c) Zinc Oxide suppository **8. Semisolids** a) Sulphur ointment b) Non staining-iodine ointment with methyl salicylate c) Carbopal gel	**60**	CO1 CO2 CO3 CO4 CO5

	9. Gargles and Mouthwashes a) Iodine gargle b) Chlorhexidine mouthwash		

C. TEXT BOOKS

1. Sanmathi. Dispensing Pharmacy : A Practical Manual.; Pharma Book Syndicate, 2010.
2. Gunn, C.; Cooper, J. W.; Sidney James Carter. Cooper and Gunn's Dispensing for Pharmaceutical Students; Cbs: New Delhi, 2008.

D. REFERENCE BOOKS

1. Ansel, H. C.; Allen, L. V.; Popovich, N. G. Pharmaceutical Dosage Forms and Drug Delivery Systems; Philadelphia, Pa Lippincott-Williams & Wilkins, 1999.
2. Arthur Owen Bentley; Ernest Alexander Rawlins. Bentley's Textbook of Pharmaceutics.; All India Traveller Book Seller: New Delhi, 2002.
3. Aulton, M. E. Pharmaceutics : The Science of Dosage Form Design; Churchill Livingstone: Edinburgh Etc., 2003.
4. Gunn, C.; Cooper, J. W.; Sidney James Carter. Cooper and Gunn's Dispensing for Pharmaceutical Students; Cbs: New Delhi, 2008.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To convert the values of different parameters in different unit system for the calculation of ingredients in the formulation.
CO2	Apply	To perform the calculation for preparation of different dosage forms.
CO3	Create and prepare	To prepare the conventional dosage forms.
CO4	Evaluate	To evaluate the conventional dosage forms.
CO5	Apply and evaluate	To learn the packaging conditions, labeling and storage conditions for different dosage forms.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	3	3	2	2	-	2	2	-	3	3	3	3	3	1
CO2	3	1	3	3	1	2	1	3	2	2	3	3	3	3	3	2
CO3	3	1	3	3	1	1	-	1	1	1	3	3	3	3	3	1
CO4	3	1	3	3	1	1	-	1	1	1	3	3	3	3	3	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3
Avg	3	1.6	3	3	1.6	1.8	0.6	1.8	1.8	1.4	3	3	3	3	3	1.6

B. PHARM. SEMESTER – I (BPH)

SUBJECT: PHARMACEUTICAL INORGANIC CHEMISTRY -PRACTICAL (BP110P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: This subject deals with the monographs of inorganic drugs and pharmaceuticals.
Objectives: Upon completion of the course the student shall be able to

- know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
- understand the medicinal and pharmaceutical importance of inorganic compounds

B. COURSE CONTENT

NO	TOPIC	P(Hrs)	COs
[1]	**Limit tests for following ions** Limit test for Chlorides and Sulphates Modified limit test for Chlorides and Sulphates Limit test for Iron Limit test for Heavy metals Limit test for Lead Limit test for Arsenic **Identification test** Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate **Test for purity** Swelling power of Bentonite Neutralizing capacity of aluminum hydroxide gel Determination of potassium iodate and iodine in potassium Iodide **Preparation of inorganic pharmaceuticals** Boric acid Potash alum Ferrous sulphate	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS (LATEST EDITION)

1. Dhake A S, Inorganic pharmaceutical chemistry, First edition, Career publications, India, 2004

D. REFERENCE BOOKS (LATEST EDITION)

1. Ministry, India.; Indian Pharmacopoeia Commission. Indian Pharmacopoeia, 2010. Addendum 2012; Indian Pharmacopoeia Commission: Ghaziabad, 2012.
2. Anand & G.R. Chatwal, Inorganic Pharmaceutical Chemistry, India, 2010

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Apply	To study limit tests of various inorganic compounds
CO2	Understand and Remember	To perform identification tests of various inorganic compounds
CO3	Understand and Remember	To understand and remember the preparations of various inorganic pharmaceuticals
CO4	Understand and Remember	To understand and remember the reactions involved in preparation of various inorganic pharmaceuticals
CO5	Understand and Evaluate	To understand and evaluate tests for purity of various inorganic pharmaceuticals

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	-	1	-	1	1	-	2	3	3	3	2	1	1
CO2	3	1	1	-	1	-	-	1	-	-	3	3	2	2	-	-
CO3	2	1	1	-	1	-	-	1	-	-	3	3	2	-	-	1
CO4	2	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-
CO5	3	1	1	-	1	-	1	1	1	-	3	3	3	2	1	1
Avg	2.6	0.8	0.8	-	0.8	-	0.4	0.8	0.2	0.4	3	2.6	2	1.2	0.4	0.6

B. PHARM. SEMESTER – I (BPH)
SUBJECT: COMMUNICATION SKILLS -PRACTICAL (BP111P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Prac.	Total		Ext	Sess.	CM	Prac.	Total
-	-	2	2	1	15	5	5	-	25

A. COURSE OVERVIEW

Scope: This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business

Objectives: Upon completion of the course the student shall be able to

- Communicate effectively (Verbal and Non-Verbal)
- Effectively manage the team as a team player
- Develop interview skills, writing skills, Leadership qualities and essentials

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Basic communication covering the following topics** Meeting People Asking Questions Making Friends What did you do? **Pronunciations covering the following topics** Pronunciation (Consonant Sounds) Pronunciation and Nouns Pronunciation (Vowel Sounds) **Advanced Learning** Listening Comprehension / Direct and Indirect Speech Figures of Speech Effective Communication Writing Skills Effective Writing Interview Handling Skills E-Mail etiquette Presentation Skills	**30**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Fujishin, R. *The Art of Communication : Improving Your Fundamental Communication Skills*; Rowman & Littielfied: Lanham, 2016.
2. Pandey, M.; Phil, M.; Lit, E.; Lib, M. *FIRST YEAR B. PHARM. Semester I*

D. REFERENCE BOOKS

1. Burton, L.; Dalley, D.; University Of Learning Ltd. *Developing Your Influencing Skills : A Guide to Developing the 7 Traits of Influential People*; Universe Of Learning: Great Britain, 2010.
2. Shikha Kapoor. *Personality Development and Soft Skills : Preparing for Tomorrow*; I.K. International Publishing House Pvt. Ltd: New Delhi, 2018.
3. Thomson, A. J.; Martinet, A. V. A *Practical English Grammar*; Oxford Univ. Press, 2012.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and learn	Understand and learn the basics of communication and apply it appropriately in professional and social context
CO2	Learn, remember and apply	Learn, remember and apply the key concepts of pronunciations in speaking
CO3	Display/ Demonstrate	Display competence in oral, written, and visual communication
CO4	Learn	Learn to prepare an audience – centric presentation
CO5	Understand, learn and apply	Understand, Learn and apply the requisites for an effective writing skills and listening skills

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	-	-	-	3	-	3	1	-	3	1	-	-	3	-
CO2	-	-	-	-	-	3	-	3	3	-	3	1	-	-	3	-
CO3	-	-	-	-	-	3	-	3	3	-	3	1	-	-	3	-
CO4	-	-	-	-	-	3	-	3	3	-	3	1	-	-	3	-
CO5	-	-	-	-	-	3	-	3	3	-	3	1	-	-	3	-
Avg.	-	-	-	-	-	3	-	3	2.6	-	3	1	-	-	3	-

B. PHARM. SEMESTER – I (BPH)
SUBJECT: REMEDIAL BIOLOGY – PRACTICAL (BP112RBP)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
--	--	1	2	1	15	10	5	-	25

A. COURSE OVERVIEW

1. Scope: To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

Objectives: Upon completion of the course the student shall be able to

- know the classification and salient features of five kingdoms of life
- Understand the basic components of anatomy & physiology of plant
- Know understand the basic components of anatomy & physiology animal with special reference to human

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Introduction to Experiments in Biology A) Study of Microscope B) Section Cutting Techniques C) Mounting and Staining D) Permanent Slide Preparation 2. Study of Cell and Its Inclusions 3. Study of Stem, Root, Leaf, Seed, Fruit, Flower and Their Modifications 4. Detailed Study of Frog by Using Computer Models 5. Microscopic Study and Identification of Tissues Pertinent To Stem, Root 6. Leaf, Seed, Fruit and Flower 7. Identification of Bones 8. Determination of Blood Group 9. Determination of Blood Pressure 10. Determination of Tidal Volume	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Gokhale, S. B.; Kokate, C. K.; Pharmaceutical Biology; Nirali Prakashan, August: Pune, 2015.
2. Kale, S. R.; Kale, R. R. Practical Human Anatomy and Physiology for First Year Diploma Course in Pharmacy; Nirali Prakashan: Pune, India, 2007.

D. REFERENCE BOOKS

1. Kale, S. R.; Kale, R. R. Practical Human Anatomy and Physiology for First Year Diploma Course in Pharmacy; Nirali Prakashan: Pune, India, 2007.
2. Gokhale, S. B.; Kokate, C. K.; Pharmaceutical Biology; Nirali Prakashan, August: Pune, 2015.
3. Shafi, M.J.H. Biology practical manual according to National core curriculum .Biology forum of Karnataka.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To get knowledge about the basic instruments used in this subject and how to operate and what is the procedure behind it.
CO2	Remember, Understand and evaluate	To know about the working mechanism of the instruments, understanding of models and result evaluation.
CO3	Understand Apply Evaluate and remember	To understand about parts of the plant and animals, evaluation of study in both animals and plants
CO4	Understand Apply and Evaluate	To know the about the parts and function of the parts of body
CO5	Remember, Apply and evaluate	To get knowledge about parts of the instrument used in lab, its working principle, measurement and interpretation of result

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	2	3	3	3	2	3	3	3	3
CO2	3	2	2	3	2	2	2	2	3	2	3	3	3	3	2	2
CO3	3	3	3	3	2	2	2	2	3	2	2	3	3	3	2	2
CO4	3	3	3	3	2	3	3	2	3	2	2	3	3	3	3	2
CO5	3	3	2	2	2	2	3	2	2	2	2	2	3	3	2	2
Avg	3	2.8	2.6	2.8	2	2.4	2.6	2	2.8	2.2	2.4	2.6	3	3	2.4	2.2

B. PHARM. SEMESTER – II (BPH)

SUBJECT: HUMAN ANATOMY AND PHYSIOLOGY II -THEORY (BP201T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

Objectives: Upon completion of the course the student shall be able to

- Explain the gross morphology, structure and functions of various organs of the human body.
- Describe the various homeostatic mechanisms and their imbalances.
- Identify the various tissues and organs of different systems of human body.
- Perform the haematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time, etc. and also record blood pressure, heart rate, pulse and respiratory volume.
- Appreciate coordinated working pattern of different organs of each system.
- Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Nervous system** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters. **Central nervous system:** Meninges, ventricles of brain and cerebrospinal fluid. Structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)	**10**	CO1
[2]	**Digestive system** Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT. **Energetics** Formation and role of ATP, Creatinine Phosphate and BMR.	**06**	CO2 CO4

[3]	**Respiratory system** Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration. Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods. **Urinary system** Anatomy of urinary tract with special reference to anatomy of kidney and Nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.	**10**	CO3 CO4
[4]	**Endocrine system** Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, Adrenal gland, pancreas, pineal gland, thymus and their disorders.	**10**	C04
[5]	**Reproductive system** Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition **Introduction to genetics** Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance	**09**	CO4 CO5

C. TEXT BOOKS

1. Scanlon, V. C.; Sander, T. Student Workbook for Essentials of Anatomy and Physiology; F.A. Davis: Philadelphia, 1991.

D. REFERENCE BOOKS

1. Sembulingam, K. Essentials of Medical Physiology: With Free Review of Medical Physiology. Jaypee Brothers: S.L., 2019.
2. Waugh, A.; Ross, J. S.; Grant, A.; Wilson, K. J. W. Ross and Wilson Anatomy and Physiology in Health and Illness : Anne Waugh, Allison Grant ; Illustrations by Graeme Chambers.; Churchill Livingstone: Edinburgh, 2001.
3. Charles Herbert Best; Brobeck, J. R.; Norman Burke Taylor. Best & Tailor's Physiológical Basic of Medical Practice; Williams & Wilkins: Baltimore, 1980.
4. Hall, J. E.; Hall, M. E. Guyton and Hall Textbook of Medical Physiology; Elsevier - Health Science: S.L., 2020.
5. Tortora, G. J.; Derrickson, B. Principles of Anatomy and Physiology, 15th ed.; Wiley: Hoboken, 2017.
6. Singh, I. Textbook of Human Histology: (with Colour Atlas & Practical Guide); Jaypee Brothers Medical Publishers: New Delhi, 2011.
7. Ghai, C. L. A Textbook of Practical Physiology; Jaypee Brothers Medical Publishers (P) Ltd: New Delhi, 2013.
8. Srinageswari, K.; Sharma, R. Practical workbook of Human Physiology; Jaypee brother's medical publishers, New Delhi
9. Charles Herbert Best; Brobeck, J. R.; Norman Burke Taylor. Best & Tailor's Physiológical Basic of Medical Practice; Williams & Wilkins: Baltimore, 1980.
10. Chatterjee, C. C. Human Physiology: For Preclinical Medical and Degree Courses in Physiology; CBS Publishers & Distributors: New Delhi, 2016.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remember, Understand and Apply	To know the basic fundamental structural features of neurons, mechanism of neurotransmitters along with processes of neuroconduction and neurotransmission.
CO2	Remember, Understand and Apply	To understand the basic biochemical processes occurs in the body related to digestion and energy production
CO3	Understand and remember	To understand the structure and basic functioning of the respiratory tract and urinary tract.
CO4	Understand and remember	To know about various hormones in the body and its related disorders
CO5	Understand and remember	To get knowledge about human reproductive system and its importance and know the basic genetics processes

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	2	3	2	3	3	2	2	3	3	3	3	2
CO2	3	1	2	3	2	3	2	3	3	2	2	3	3	3	3	2
CO3	3	1	2	3	2	3	2	3	3	2	2	3	3	3	3	2
CO4	3	1	2	3	2	3	2	3	3	2	2	3	3	3	3	2
CO5	3	1	2	3	2	3	2	3	3	2	2	3	3	3	3	2
Avg	3	1	2	3	2	3	2	3	3	2	2	3	3	3	3	2

B. PHARM. SEMESTER – II (BPH)

SUBJECT: PHARMACEUTICAL ORGANIC CHEMISTRY I -THEORY (BP202T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.

Objectives: Upon completion of the course the student shall be able to

- write the structure, name and the type of isomerism of the organic compound
- write the reaction, name the reaction and orientation of reactions
- account for reactivity/stability of compounds,
- identify/confirm the identification of organic compound

B. COURSE CONTENT

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained

To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

NO	TOPIC	L (Hrs)	COs
[1]	**Classification, nomenclature and isomerism** Classification of Organic Compounds Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds) Structural isomerisms in organic compounds	**07**	CO1 CO2
[2]	**Alkanes*, Alkenes* and Conjugated dienes** SP3hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP2 hybridization in alkenes E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E 1 verses E 2 reactions, Factors affecting E1 and E2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement	**10**	CO1 CO3 CO4 CO5
[3]	**Alkyl halides** SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. Alcohols*- Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol	**10**	CO1 CO3 CO4 CO5
[4]	**Carbonyl compounds**	**10**	CO1

	Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde**.**		CO3 CO4 CO5
[5]	**Carboxylic acids** Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids ,amide and ester Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid **Aliphatic amines** - Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine	**8**	CO1 CO3 CO4 CO5

C. TEXT BOOKS (LATEST EDITION)

1. Mehta, B.; Mehta, M. Organic Chemistry; Prentice Hall Of India: New Delhi, 2005.

D. REFERENCE BOOKS (LATEST EDITION)

1. Robert Thornton Morrison; Robert Neilson Boyd. Organic Chemistry. 2 : Study Guide; Allyn And Bacon: Boston, Mass., 1987.
2. Finar, I. L. Organic Chemistry : Volume 1: The Fundamental Principles; Pearson Eduation: India, 2003.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Remember	To learn about name, structure, isomerism and uses of organic compound
CO2	Understand and Remember	To understand about various factors which affect the reactions of organic compounds
CO3	Understand and Apply	To know the reaction, name of the reaction and orientation of reactions
CO4	Understand	To understand the reactivity/stability of organic compounds
CO5	Understand and Remember	To understand and remember the preparation of organic compounds

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	2	-	-	-	1	1	-	3	3	2	2	1	-
CO2	3	-	-	2	-	-	-	1	1	-	3	3	2	2	1	-
CO3	3	1	1	2	-	-	-	1	1	-	3	3	2	2	1	-
CO4	3	-	-	2	-	-	-	1	1	-	3	3	2	2	1	-
CO5	3	-	-	2	-	-	-	1	1	3	3	3	2	3	1	-
Avg	3	0.2	0.2	2	-	-	-	1	1	0.6	3	3	2	2.2	1	-

B. PHARM. SEMESTER – II (BPH)
SUBJECT: BIOCHEMISTRY (BP203T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac.	Total		Ext	Sess.	CM	Prac	Total
3	1	-	04	04	75	15	10	-	100

A. COURSE OVERVIEW

Scope:.Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

Objectives: Upon completion of course student shell able to

- Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
- Understand the metabolism of nutrient molecules in physiological and pathological conditions.
- Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Carbohydrate metabolism** Glycolysis – Pathway, energetics and significance Citric acid cycle- Pathway, energetics and significance HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance Hormonal regulation of blood glucose level and Diabetes mellitus **Biological oxidation** Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its mechanism and substrate level phosphorylation Inhibitors ETC and oxidative phosphorylation/Uncouplers	**10**	CO2 CO4
[2]	**Lipid metabolism** β-Oxidation of saturated fatty acid (Palmitic acid) Formation and utilization of ketone bodies; ketoacidosis De novo synthesis of fatty acids (Palmitic acid) Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity. **Amino acid metabolism** General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders	**10**	CO2 CO4

	Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia) Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice		
[3]	**Nucleic acid metabolism and genetic information transfer** Biosynthesis of purine and pyrimidine nucleotides Catabolism of purine nucleotides and Hyperuricemia and Gout disease Organization of mammalian genome Structure of DNA and RNA and their functions DNA replication (semi conservative model) Transcription or RNA synthesis Genetic code, Translation or Protein synthesis and inhibitors	**10**	CO3 CO4
[4]	**Biomolecules** Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. **Bioenergetics** Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential. Energy rich compounds; classification; biological significances of ATP and cyclic AMP	**08**	CO2 CO4 CO5
[5]	**Enzymes** Introduction, properties, nomenclature and IUB classification of enzymes Enzyme kinetics (Michaelis plot, Line Weaver Burke plot) Enzyme inhibitors with examples Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes –Structure and biochemical functions	**07**	CO1

C. TEXT BOOKS

1. Murray, R.; Bender, D.; Botham, K.; Kennelly, P.; Rodwell, V.; Weil, P.; York, N.; San, C.; Lisbon, F.; Madrid, L.; City, M.; Delhi, M.; Juan, S. *Twenty-Eighth Edition*..
2. U Satyanarayana. *Biochemistry*; Elsevier India: New Delhi, 2021.

D. REFERENCE BOOKS

1. Cox, D. L. *Lehninger principles of biochemistry: International Edition.*; W H Freeman & Co Ltd: S.L., 2021..
2. Berg, J. M.; Tymoczko, J. L.; J, G.; Lubert Stryer. *Biochemistry*; W.H. Freeman/Mcmillan Learning: New York, 2019..

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and learn	Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
CO2	Understand and learn	Understand the metabolism of nutrient molecules in physiological and pathological conditions.
CO3	Understand and learn	Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.
CO4	Learn and remember	Learn and remember the basic chemical structure of nutrient molecules and biological importance of biological macromolecules
CO5	Understand	Explain biological mechanisms, such as the processes and control of bioenergetics and metabolism, as chemical reactions

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	3	1	-	2	1	1	3	-	3	3	3	3	1	1
CO2	3	-	3	1	-	2	1	1	3	-	3	3	3	3	1	1
CO3	3	-	3	1	-	2	1	1	2	-	3	3	3	3	1	1
CO4	3	-	3	1	-	2	1	1	2	-	3	3	3	3	1	1
CO5	3	-	3	1	-	2	1	1	3	-	3	3	3	3	1	1
Avg.	3	-	3	1	-	2	1	1	2.6	-	3	3	3	3	1	1

B. PHARM. SEMESTER – II (BPH)
SUBJECT: PATHOPHYSIOLOGY-THEORY (BP 204T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	---	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes. This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

Objectives: Upon completion of the course the student shall be able to

- Describe the etiology and pathogenesis of the selected disease states;
- Name the signs and symptoms of the diseases; and
- Mention the complications of the diseases.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Basic principles of Cell injury and Adaptation:** Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, nuclear damage), Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia), Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis & Alkalosis, Electrolyte imbalance **Basic mechanism involved in the process of inflammation and repair:** Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis	**10**	CO1
[2]	**Cardiovascular System:** Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis) ● **Respiratory system**: Asthma, Chronic obstructive airways diseases. ● **Renal system** : Acute and chronic renal failure .	**10**	CO2 CO3 CO4 CO5

[3]	**Haematological Diseases:** Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia ● **Endocrine system**: Diabetes, thyroid diseases, disorders of sex hormones ● **Nervous system**: Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. ● **Gastrointestinal system**: Peptic Ulcer	**10**	CO2 CO3 CO4 CO5
[4]	Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease. ● **Disease of bones and joints**: Rheumatoid arthritis, osteoporosis and gout ● **Principles of cancer**: classification, etiology and pathogenesis of cancer	**08**	CO2 CO3 CO4 CO5
[5]	**Infectious diseases**: Meningitis, Typhoid, Leprosy, Tuberculosis Urinary tract infections ● **Sexually transmitted diseases**: AIDS, Syphilis, Gonorrhea	**07**	CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Harsh Mohan; Damjanov, I. Textbook of Pathology; Jaypee Brothers Medical Publishers:New Delhi, 2019.
2. Walker, R.; Cate Whittlesea. Clinical Pharmacy and Therapeutics; Churchill Livingstone: Edinburgh ; New York, 2007.

D. REFERENCE BOOKS

1. Hall, J. E.; Hall, M. E. Guyton and Hall Textbook of Medical Physiology; Elsevier - Health Science: S.L., 2020
2. Walker, R.; Cate Whittlesea. Clinical Pharmacy and Therapeutics; Churchill Livingstone: Edinburgh ; New York, 2007.
3. Blumenthal, D. K.; Rollins, D. E. Workbook and Casebook for "Goodman and Gilman's the Pharmacological Basis of Therapeutics"; Mcgraw Hill: New York ; Madrid Etc, 2016.
4. Davidson's Principles and Practice of Medicine.; Elsevier Health Sciences: S.L., 2022.

RECOMMENDED JOURNALS

1. Toner, P. G. The Journal of Pathology 1999, 187 (1), 187. https://doi.org/3.0.co;2-n">10.1002/(sici)1096-9896(199901)187:1<187::aid-path269>3.0.co;2-n.
2. Robbins, J. KCNQ Potassium Channels: Physiology, Pathophysiology, and Pharmacology. Pharmacology & Therapeutics 2001, 90 (1), 1–19. https://doi.org/10.1016/s0163-7258(01)00116-4.
3. Quiz Page. Indian Journal of Pathology and Microbiology 2015, 58 (4), 568. https://doi.org/10.4103/0377-4929.168897.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To get knowledge about the mechanism behind cell death, inflammatory process and repair mechanism in human body
CO2	Remember, Understand and Apply	To know about the system and function of the body and disease associated with dysfunctioning of the system
CO3	Understand Apply and Evaluate	To understand about the mechanism behind generation of the disease and/or cause of diseases
CO4	Understand	To know about cause, and treatment of the communicable and non-communicable diseases.
CO5	Remember, Understand, Apply and evaluate	To get knowledge about medication used to treat the disease according to the pathway of disease production.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	1	1	3	3	2	2	3	3	3	2	1
CO2	3	2	2	3	1	1	1	3	3	2	2	3	3	3	2	1
CO3	3	2	3	3	2	3	2	3	3	1	2	3	3	3	2	1
CO4	3	1	3	3	1	3	3	3	3	2	2	3	3	3	3	2
CO5	3	3	2	3	2	2	3	3	2	3	2	2	3	3	2	2
Avg	3	2	2.4	2.8	1.6	2	2	3	2.8	2	2	2.8	3	3	2.2	1.4

B. PHARM. SEMESTER – II (BPH)
SUBJECT: COMPUTER APPLICATIONS IN PHARMACY-THEORY (BP205T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	-	-	3	3	50	15	10	-	75

A. COURSE OVERVIEW

Scope: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases

Objectives: Upon completion of the course the student shall be able to

- Know the various types of application of computers in pharmacy
- Know the various types of databases
- Know the various applications of databases in pharmacy

B. COURSE CONTENT

NO	TOPIC	L(Hrs)	COs
[1]	**Number system:** Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement ,Two's complement method, binary multiplication, binary division **Concept of Information Systems and Software :**Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project	**06**	CO2
[2]	**Web technologies**: Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database	**06**	CO3 CO4
[3]	**Application of computers in Pharmacy** – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System	**06**	CO1
[4]	**Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery	**06**	CO5
[5]	**Computers as data analysis in Preclinical development**: Chromatographic dada analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)	**06**	CO1

C. TEXT BOOKS

1. V. Bhagat, S. Narkhede, D. Kardile, S. Shankar.*Computer Application in Pharmacy*.NiraliPrakashan, Pune. 1st Edition 2018.

D. REFERENCE BOOKS

1. William E Fassett; Dale B Christensen. *Computer Application in Pharmacy*. Lea and Febiger, USA, 1986.
2. Sean Ekins. *Computer Application in Pharmaceutical Research and Development*. Wiley-Interscience, USA, 2006.
3. S.C. Rastogi. *Bioinformatics: Concept, Skills and Applications*. CBS Publishers and Distributors, New Delhi, 2nd Edition 2019.
4. Cary N. Prague. *Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath*. Wiley Dreamtech India (P) Ltd., New Delhi,

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand various applications of computers in pharmacy
CO2	Understand and apply	Understand and apply concept of Information Systems and Software
CO3	Remember and Evaluate	Remember and evaluate various types of databases
CO4	Understand and Remember	Understand and remember about Web technologies
CO5	Understand and analyse	Understand and anlyse concept of Bioinformatics

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	3	-	2	-	-	1	-	3	2	2	1	-	-
CO2	2	1	1	2	-	1	-	-	1	-	2	1	2	1	-	-
CO3	1	-	2	2	-	-	-	-	-	-	1	1	1	-	-	-
CO4	-	-	1	1	-	-	-	1	-	-	2	2	1	-	-	-
CO5	2	1	-	3	-	-	1	-	1	-	-	2	3	1	-	-
Avg	1.4	0.8	1.2	2.2	-	0.6	0.2	0.2	0.6	-	1.6	1.6	1.8	0.6	-	-

B. PHARM. SEMESTER – II (BPH)

SUBJECT: ENVIRONMENTAL SCIENCES- THEORY (BP206T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
2	-	-	2	3	50	15	10	-	75

A. COURSE OVERVIEW

Scope: Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Objectives: Upon completion of the course the student shall be able to**:**

- Create the awareness about environmental problems among learners.
- Impart basic knowledge about the environment and its allied problems.
- Develop an attitude of concern for the environment.
- Motivate learner to participate in environment protection and environment improvement.
- Acquire skills to help the concerned individuals in identifying and solving environmental problems.
- Strive to attain harmony with Nature.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	The Multidisciplinary nature of environmental studies Natural Resources Renewable and non-renewable resources: Natural resources and associated problems a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.	**10**	CO1 CO3 CO4
[2]	Ecosystems ▪ Concept of an ecosystem. ▪ Structure and function of an ecosystem. ▪ Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	**10**	CO1 CO2 CO3
[3]	Environmental Pollution: Air pollution; Water pollution; Soil pollution	**10**	CO1 CO3 CO5

C. TEXT BOOKS

1. S.S. Randhava, Environmental Sciences, Vikas and Company Medical Publishers, Pee vee publication, Jalandhar, 2019.
2. Prof. M. K. Gupta, Prof. Manish Jaimini, Environmental sciences,Vikas Pandey, published by Nirali Prakashan, Pune, 2018

D. REFERENCE BOOKS

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. Environmental Biology, Nidi Publ. Ltd. Bikaner, 2001
3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clanderson Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopedia, Jaico Publ. House, Mumbai, 2001, 1196p
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down of Earth, Centre for Science and Environment

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and create	Discuss environmental problems among learners and create the awareness and strive to attain harmony with Nature.
CO2	Understand and remember	Describe concept of Ecosystems and remember structure and function of it.
CO3	Create	To create an attitude of concern for the environment protection and environment improvement.
CO4	Understand and remember	Explain Natural Resources of Environment
CO5	Understand and analyse	Describe and analyse the environmental pollution.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	3	2	1	2	2	3	3	3	2	2	2	2
CO2	2	3	3	1	2	2	1	2	2	3	3	3	2	2	2	2
CO3	2	3	3	2	2	2	1	2	2	3	3	3	3	2	2	2
CO4	2	3	2	2	2	2	2	2	2	3	3	3	3	2	2	2
CO5	2	3	3	2	3	2	2	2	2	3	3	3	3	2	2	2
Avg	2.2	3	2.8	1.6	2.4	2	1.4	2	2	3	3	3	2.6	2	2	2

B. PHARM. SEMESTER – II (BPH)

SUBJECT: HUMAN ANATOMY AND PHYSIOLOGY II - PRACTICAL (BP207P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	5	-	50

A. COURSE OVERVIEW

Scope: Practical physiology is complimentary to the theoretical discussions in physiology.
Objectives: Practical allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.

B. COURSE CONTENT

NO	TOPIC	P(Hrs)	COs
[1]	1. To study the integumentary and special senses using specimen, models, etc., 2. To study the nervous system using specimen, models, etc., 3. To study the endocrine system using specimen, models, etc 4. To demonstrate the general neurological examination 5. To demonstrate the function of olfactory nerve 6. To examine the different types of taste. 7. To demonstrate the visual acuity 8. To demonstrate the reflex activity 9. Recording of body temperature 10. To demonstrate positive and negative feedback mechanism. 11. Determination of tidal volume and vital capacity. 12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens. 13. Recording of basal mass index 14. Study of family planning devices and pregnancy diagnosis test. 15. Demonstration of total blood count by cell analyser 16. Permanent slides of vital organs and gonads.	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Ghai, C. L. A Textbook of Practical Physiology; Jaypee Brothers Medical Publishers (P) Ltd: New Delhi, 2013.
2. Scanlon, V. C.; Sander, T. Student Workbook for Essentials of Anatomy and Physiology; F.A. Davis: Philadelphia, 1991

D. REFERENCE BOOKS

1. Waugh, A.; Ross, J. S.; Grant, A.; Wilson, K. J. W. Ross and Wilson Anatomy and Physiology in Health and Illness : Anne Waugh, Allison Grant ; Illustrations by Graeme Chambers.; Churchill Livingstone: Edinburgh, 2001.
2. Tortora, G. J.; Derrickson, B. Principles of Anatomy and Physiology, 15th ed.; Wiley: Hoboken, 2017.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To get knowledge about basic anatomy and physiology of the human organ systems
CO2	Remember, Understand and evaluate	To know about performance of experiments like neurological reflex, body temperature measurement, body mass index, olfaction, gestation reflex and eye sight, etc.
CO3	Understand Apply Evaluate and remember	To understand about procedure for measurement of various haematological parameter, evaluation and interpretation of result
CO4	Understand Apply and Evaluate	To know about family planning
CO5	Remember, Apply and evaluate	To know the histological structures of the body organs

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	3	3	3	1	3	3	1	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	1	1	3	3	3	1	3	3	3	3	3	3	3	3	3
Avg	3	2.2	2.2	3	3	3	2.2	3	3	2.6	2.8	3	3	3	3	3

B. PHARM. SEMESTER – II (BPH)

SUBJECT: PHARMACEUTICAL ORGANIC CHEMISTRY I -PRACTICAL (BP208P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.

Objectives: Upon completion of the course the student shall be able to

- write the structure, name and the type of isomerism of the organic compound
- write the reaction, name the reaction and orientation of reactions
- account for reactivity/stability of compounds,
- identify/confirm the identification of organic compound

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Systematic qualitative analysis of unknown organic compounds like Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc. 2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test 3. Solubility test 4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides. 5. Melting point/Boiling point of organic compounds 6. Identification of the unknown compound from the literature using melting point/ boiling point. 7. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point. 8. Minimum 5 unknown organic compounds to be analysed systematically. 2. Preparation of suitable solid derivatives from organic compounds 3. Construction of molecular models	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS (LATEST EDITION)

1. Raval H G, Practical organic Chemistry, First edition, Nirav & Roopal Prakashan, India, 2008

D. REFERENCE BOOKS (LATEST EDITION)

1. Mann, F. G.; Saunders, B. C. Practical Organic Chemistry; Pearson: New Delhi, 2009..
2. Arthur Israel Vogel; Furniss, B. S. Vogel's Textbook of Practical Organic Chemistry Including Qualitative Organic Analysis; London Longman Scientific & Technical [U.A, 1987.

3. Vishnoi, N. K. Advanced Practical Organic Chemistry.; Vikas Publishing House: Noida, 2009.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Remember	To understand the various preliminary test for organic compounds
CO2	Understand and apply	To perform nature identification test for various organic compounds
CO3	Understand and evaluate	Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test
CO4	Understand and evaluate	To study about various functional groups identification for organic compounds
CO5	Understand & Apply	Identification of unknown organic compound from the literature using melting point/boiling point

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	-	1	-	-	1	1	1	2	3	2	3	1	1
CO2	3	1	2	-	1	-	-	1	1	1	2	3	2	3	1	1
CO3	3	1	2	-	1	-	-	1	1	1	2	3	2	3	1	1
CO4	3	1	2	-	1	-	-	1	1	1	2	3	2	3	1	1
CO5	3	1	2	-	1	-	-	1	1	1	2	3	2	3	1	1
Avg	3	1	2	-	1	-	-	1	1	1	2	3	2	3	1	1

B. PHARM. SEMESTER – II (BPH)
SUBJECT: BIOCHEMISTRY PRACTICAL (BP209P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Prac.	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4		35	10	5	-	50

A. COURSE OVERVIEW

Scope: The scope of the subject deals with complete understanding of different qualitative test to be performed for identification of carbohydrates, lipids and proteins. It is also emphasizing on quantitative estimation of sugars and proteins, preparation of buffers and studying the activity of enzyme.

Objectives: Upon completion of course, student shell able to

- Perform various qualitative tests for identification of carbohydrates, proteins and abnormal constituents.
- Understand the Principles for quantitative estimation of glucose and cholesterol.
- Understand and evaluate activity of salivary amylase enzyme

B. COURSE CONTENT

NO	TOPIC	P(Hrs)	COs
[1]	Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch) Identification tests for Proteins (albumin and Casein) Qualitative analysis of urine for abnormal constituents Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method) Determination of blood creatinine Determination of blood sugar Determination of serum total cholesterol Preparation of buffer solution and measurement of pH Study of enzymatic hydrolysis of starch. Determination of Salivary amylase activity Study the effect of Temperature on Salivary amylase activity. Study the effect of substrate concentration on salivary amylase activity.	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. G. Raval, H. Practicals in biochemistry
2. Gupta, R. C. *Practical Biochemistry*; Cbs Publishers And Distributors: New Delhi, 2006.

D. REFERENCE BOOKS

1. Plummer David T. *An Introduction to Practical Biochemistry*; Tata Mcgraw Hill: New Delhi, 1990.
2. G Rajagopal; Es Rāmakiruṣṇan. *Practical Biochemistry for Medical Students*; Orient Longman ; New York, Ny: Hyderabad, 1983.
3. Varley, H. *Practical Clinical Biochemistry*; Cbs Publishers & Distributors: Delhi, 1988.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand, remember and learn	Understand, remember, learn principles and perform various test ethically for qualitative analysis of carbohydrates, proteins and abnormal constituent in urine.
CO2	Understand, learn and apply and evaluate	Understand, learn and perform the quantitative test for analysis of reducing sugars and protein.
CO3	Understand Apply and Evaluate	Analyse and evaluate the factors affecting enzyme activity
CO4	Understand Apply and Evaluate	Understand and learn the concept of buffers
CO5	Understand Apply and Evaluate	Evaluation and interpretation of data emanating from a pathological lab for various carbohydrates, lipids and protein.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	2	2	1	1	3	-	3	3	2	-	2	1
CO2	3	3	3	1	2	2	1	1	3	-	3	3	2	-	2	1
CO3	3	3	3	1	2	2	1	1	3	-	3	3	2	-	2	1
CO4	3	3	3	1	2	2	1	1	3	-	3	3	2	-	2	1
CO5	3	3	3	1	2	2	1	1	3	-	3	3	2	-	2	1
Avg.	3	3	3	1	2	2	1	1	3	-	3	3		-	2	1

B. PHARM. SEMESTER – II (BPH)

SUBJECT: COMPUTER APPLICATIONS IN PHARMACY-PRACTICAL(BP210P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	2	2	1	15	5	5	-	25

A. COURSE OVERVIEW

Scope: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases

Objectives: Upon completion of the course the student shall be able to

- Know the various types of office tools and their applications
- Create he various databases
- Know the various applications of databases in pharmacy

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	CO
[1]	1. Design a questionnaire using a word processing package to gather information about a particular disease. 2. Create a HTML web page to show personal information 3. Retrieve the information of a drug and its adverse effects using online tools 4. Creating mailing labels Using Label Wizard , generating label in MS WORD 5. Create a database in MS Access to store the patient information with the required fields Using access 6. Design a form in MS Access to view, add, delete and modify the patient record in the database 7. Generating report and printing the report from patient database 8. Creating invoice table using – MS Access 9. Drug information storage and retrieval using MS Access 10. Creating and working with queries in MS Access 11. Exporting Tables, Queries, Forms and Reports to web pages 12. Exporting Tables, Queries, Forms and Reports to XML pages	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. V. Bhagat, S. Narkhede, D. Kardile, S. Shankar.*Computer Application in Pharmacy*.NiraliPrakashan, Pune. 1st Edition 2018.

D. REFERENCE BOOKS

1. William E Fassett; Dale B Christensen. *Computer Application in Pharmacy*. Lea and Febiger, USA, 1986.

2. Sean Ekins. *Computer Application in Pharmaceutical Research and Development*. Wiley-Interscience, USA, 2006.
3. S.C. Rastogi. *Bioinformatics: Concept, Skills and Applications*. CBS Publishers and Distributors, New Delhi, 2nd Edition 2019.
4. Cary N. Prague. *Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath*. Wiley Dreamtech India (P) Ltd., New Delhi,

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Apply	Understand basic tools of MS Word, MS Excel and MS Power point and apply them to create documents.
CO2	Remember, Understand and Create	Remember and Understand HTML tags and create HTML web page.
CO3	Create	Create mailing labels Using Label Wizard, generating label in MS WORD
CO4	Design	Design questionnaire/reports using a word processing package to gather information about a particular disease.
CO5	Understand and Apply	Understand tools of MS Access and apply in creating database, queries, relationship and reports from patient database

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	-	1	2	-	-	-	2	-	-	1	1	2	-	-	-
CO2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	1	-	-	-	1	-	-	1	1	-	-	1	-
CO4	1	-	1	2	-	-	-	1	1	-	-	1	1	-	-	-
CO5	1	-	1	2	-	-	-	-	-	-	-	1	-	-	-	-
Avg	0.6	-	0.6	1.6	-	-	-	0.8	0.2	-	0.4	0.8	0.6	-	0.2	-

B. PHARM. SEMESTER – III (BPH)
SUBJECT: PHARMACEUTICAL ORGANIC CHEMISTRY II -THEORY (BP301T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.
Objectives: Upon completion of the course the student shall be able to

- write the structure, name and the type of isomerism of the organic compound
- write the reaction, name the reaction and orientation of reactions
- account for reactivity/stability of compounds,
- prepare organic compounds

B. COURSE CONTENT

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained
To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

NO	TOPIC	L (Hrs)	COs
[1]	**Benzene and its derivatives** **A.** Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule **B.** Reactions of benzene - nitration, sulphonation, halogenation- reactivity, Friedel crafts alkylation- reactivity, limitations, Friedelcrafts acylation. **C.** Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction **D.** Structure and uses of DDT, Saccharin, BHC and Chloramine	**10**	CO1 CO3 CO4 CO5
[2]	**Phenols* -** Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols **Aromatic Amines* -** Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts **Aromatic Acids* –** Acidity, effect of substituents on acidity and important reactions of benzoic acid.	**10**	CO1 CO3 CO4 CO5
[3]	**Fats and Oils** a. Fatty acids – reactions. b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.	**10**	CO1 CO3 CO5
[4]	**Polynuclear hydrocarbons:** a. Synthesis, reactions b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives	**8**	CO1 CO3 CO5

[5]	**Cyclo alkanes*** Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only	**7**	CO1 CO3 CO4 CO5

C. TEXT BOOKS (LATEST EDITION)

1. Mehta, B.; Mehta, M. Organic Chemistry; Prentice Hall Of India: New Delhi, 2005.

D. REFERENCE BOOKS (LATEST EDITION)

1. Robert Thornton Morrison; Robert Neilson Boyd. Organic Chemistry. 2 : Study Guide; Allyn And Bacon: Boston, Mass., 1987.
2. Finar, I. L. Organic Chemistry : Volume 1: The Fundamental Principles; Pearson Eduation: India, 2003.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Apply	To write the structure, name of organic compound
CO2	Understand and Remember	To understand the type of isomerism of the compound
CO3	Understand and Remember	To know the reaction, name of the reaction and orientation of reactions
CO4	Understand and Remember	To understand the reactivity/stability of organic compounds
CO5	Understand and Remember	To understand and remember the preparation of organic compounds

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	2	1	1	-	1	2	3	3	3	3	1	1	1
CO2	3	1	1	1	1	1	-	1	3	2	3	3	3	1	1	1
CO3	3	1	1	1	1	1	-	1	3	2	3	3	3	3	1	1
CO4	3	1	1	1	1	1	-	1	3	1	3	3	3	3	1	1
CO5	3	1	1	1	1	1	-	1	2	2	3	3	3	2	1	1
Avg	2.8	1	1	1.2	1	1	-	1	2.6	2	3	3	3	2	1	1

B. PHARM. SEMESTER – III (BPH)
SUBJECT: PHYSICAL PHARMACEUTICS I-THEORY (BP302T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon completion of the course the student shall be able to

- Understand various physicochemical properties of drug molecules in the designing the dosage forms
- Know the principles of solubility, pH & buffers to use them for designing of formulations

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partiallymiscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications	**10**	CO1
[2]	**States of Matter and properties of matter:** State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid crystalline, amorphous & polymorphism. **Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications	**10**	CO2 CO3
[3]	**Surface and interfacial phenomenon:** Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.	**10**	CO4
[4]	**Complexation and protein binding:** Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants	**08**	CO3
[5]	**pH, buffers and Isotonic solutions:** Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.	**07**	CO5

C. TEXT BOOKS

1. Subrahmanyam, C. V. S. Textbook of Physical Pharmaceutics. India: Vallabh Prakashan. 2000.

D. REFERENCE BOOKS

1. Sinko, Patrick J., and Alfred N. Martin. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences. 5th ed. Philadelphia: Lippincott Williams & Wilkins, 2006.
2. Parrott, E. L., Saski, W. Experimental Pharmaceutics. United States: Burgess Publishing Company. 1977
3. Carter, S. J. Cooper and Gunn's Tutorial Pharmacy. India: CBS Publishers & Distributors. 2021.
4. Ansel, H. C., Stoklosa, M. J. Pharmaceutical Calculations. United Kingdom: Lea &Febiger. 1986.
5. Gilbert S. Banker, Herbert Lieberman, Martin Rieger. Pharmaceutical Dosage Forms: Disperse Systems. United States: CRC Press. 2020.
6. Manavalan, R., Ramasamy, C. Physical Pharmaceutics. India: Pharma Med Press. 2017.
7. Jain, G., KrishenKhar, R., Ahmad, F. J. Theory and Practice of Physical Pharmacy - E-Book. India: Elsevier Health Sciences. 2011.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Analyse	Understand and analyse the principles of solubility and partition coefficient
CO2	Remember, Evaluate and apply	Remember and evaluate various physicochemical properties of drug molecules and apply in the designing the dosage form
CO3	Understand and Apply	Understand and apply physical principles of states of matter and complexation
CO4	Remember and evalaute	Remember and evaluate the role of surfactants, interfacial phenomenon and adsorption
CO5	Understand	Understand the importance of pH and buffers in pharmaceutical dosage forms and maintaining stability

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	1	-	-	-	-	1	-	-	3	1	3	-	1
CO2	3	-	-	1	-	-	-	-	1	-	-	3	1	2	-	-
CO3	3	-	-	-	-	-	-	-	1	-	-	3	1	2	-	1
CO4	3	-	-	-	-	-	-	-	1	-	-	3	1	1	-	-
CO5	3	-	-	-	-	-	-	-	1	-	-	3	1	1	-	-
Avg	3	-	-	0.4	-	-	-	-	1	-	-	3	1	1.8	-	0.4

B. PHARM. SEMESTER – III (BPH)
SUBJECT: PHARMACEUTICAL MICROBIOLOGY-THEORY (BP303T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: Course enables the student to learn all categories of microorganisms especially for the production of alcohol, antibiotics, vaccines, vitamins, enzymes etc.
Objectives: Upon completion of the course the student shall be able to understand the concepts related to various microorganisms, sterility testing and its application in pharmaceutical industries.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	Introduction, history of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes Study of ultrastructure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.	**10**	CO1
[2]	Identification of bacteria using staining techniques (simple, Gram's &Acid fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipment employed in large scale sterilization. Sterility indicators.	**10**	CO2 CO3
[3]	Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.	**10**	CO5
[4]	Designing of aseptic area, laminar flow equipment; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.	**08**	CO2 CO5
[5]	Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage.	**07**	CO4

	Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations. Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research.		

C. TEXT BOOKS

1. Pelczar, M. J.; Chan, E. C. S.; Krieg, N. R. *Microbiology*; Tata Mcgraw-Hill: New Delhi, 2010.

D. REFERENCE BOOKS

1. Denyer, S. P.; Hodges, N. A.; Gorman, S. P.; Hugo, W. B.; Russell, A. D. *Pharmaceutical Microbiology*; Blackwell Science: Malden, 2004.
2. Prescott; Dunn. *Industrial Microbiology*, 4th edition.; CBS Publishers & Distributors, Delhi.
3. Denyer, S. P.; Hugo, W. B. *Hugo and Russell's Pharmaceutical Microbiology*; Wiley-Blackwell: Chichester, West Sussex, Uk ; Hoboken, Nj, 2011.
4. Rose, A. H. *Industrial Microbiology*; Butterworths: London, 1961.
5. Probisher; Hinsdill. *Fundamentals of Microbiology*, 9th ed.; Japan.
6. Cooper, J. W.; Gunn, C.; Sidney James Carter. *Cooper and Gunn's Tutorial Pharmacy*; Cbs Publishers: Editorial: New Delhi, 2005.
7. Peppler, H. J.; Perlman, D. *Microbial Technology.*; New York, Etc., Academic P, 1979.
8. I.P., B.P., U.S.P.- latest editions.
9. Edward Alcamo. *Fundamentals of Microbiology*; Jones And Bartlett: Sudbury, Mass., 2001.
10. Jain, N. K. *Pharmaceutical Microbiology.*; Vallabh Prakashan: Delhi, 2001.
11. Brenner, D. J.; Krieg, N. R.; Staley, J. T.; Garrity, G. M. *Bergey's Manual of Systematic Bacteriology. Volume Two, the Proteobacteria. Part A, Introductory Essays. Part B, the Gammaproteobacteria. Part C, the Alpha-, Beta-, Delta-, and Epsilonproteobacteria*; Springer: New York, 2005.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand Apply and Evaluate	To Understand methods of identification, cultivation and preservation of various microorganisms
CO2	Remember, Understand and Evaluate	To understand the importance and implementation of sterilization in pharmaceutical processing and industry
CO3	Understand Apply and Evaluate	To Understand the cell culture technology and its applications in pharmaceutical industries
CO4	Understand and Remember	To understand structure and growth of bacteria, virus and fungi
CO5	Understand Apply and Evaluate	To perform and evaluate microbial assay of various antibiotics and vitamin

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	0	2	0	3	2	3	3	3	1	3	2	3
CO2	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	-	2	3	2	2	0	2	1	2	2	3	3	3	2	3
CO4	3	2	2	2	2	2	2	2	1	3	3	3	1	3	2	3
CO5	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
Avg	3	2	2.6	2.8	1.6	2.4	1.6	2.6	2	2.8	2.8	3	2.2	3	2.4	3

B. PHARM. SEMESTER – III (BPH)
SUBJECT: PHARMACEUTICAL ENGINEERING - THEORY (BP304T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

Objectives: Upon completion of the course student shall be able:

- To know various unit operations used in Pharmaceutical industries.
- To understand the material handling techniques.
- To perform various processes involved in pharmaceutical manufacturing process.
- To carry out various test to prevent environmental pollution.
- To appreciate and comprehend significance of plant lay out design for optimum use of resources.
- To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Flow of fluids:** Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer. **Size Reduction:** Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill. **Size Separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.	**10**	CO2 CO3 CO1
[2]	**Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. **Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator. **Distillation:** Basic Principles and methodology of simple distillation,flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation	**10**	CO2 CO3
[3]	**Drying:** Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits	**10**	CO2 CO3

	of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer. **Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier		
[4]	**Filtration:** Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits anddemerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter. **Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.	**8**	CO2 CO3
[5]	**Materials of pharmaceutical plant construction, Corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.	**7**	CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. C V S Subrahmanyam; J Thimma Setty; Suresh, S.; V Kusum Devi. Pharmaceutical Engineering : Principles and Practices.; Vallabh Prakashan: Delhi, 2002.
2. C V S Shubramanyam. Pharmaceutical Engineering : Unit Operations - II; Vallabh Prakashan: Delhi, 2014.

D. REFERENCE BOOKS

1. Badger, W. L. Introduction to Chemical Engineering; Mc Graw Hill: Auckland, 1987.
2. Cooper, J. W.; Gunn, C.; Sidney James Carter. Cooper and Gunn's Tutorial Pharmacy; Cbs Publishers: Editorial: New Delhi, 2005.
3. Joseph Price Remington; Eric Wentworth Martin. Remington's Practice of Pharmacy Easton, Pa. Mack, 1961.
4. Khar, R. K.; Vyas, S. P.; Ahmad, F. J.; Jain, G. K. Lachman/Lieberman's the Theory and Practice of Industrial Pharmacy; Cbs Publishers & Distributor, Repr: New Delhi, 2015.
5. Mccabe, W. L.; Smith, J. C.; Harriott, P. Unit Operations of Chemical Engineering; Chennai Mcgraw-Hill Education (India) Private Limited, 2014.
6. Simpson, N. J. K. Solid-Phase Extraction Principles, Techniques, and Applications; New York, N.Y. Dekker, 2000.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remember and Understand	To understand and remember the various unit operations used in Pharmaceutical industries.
CO2	Understand	To understand the material handling techniques.
CO3	Apply and Evaluate	To perform various processes involved in pharmaceutical manufacturing process.
CO4	Understand and apply	To appreciate and comprehend significance of plant lay out design for optimum use of resources and to carry out various test to prevent environmental pollution.
CO5	Apply and evaluate	To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2	2	-	2	2	2	3	3	3	3	3	3
CO2	3	1	3	3	2	2	-	2	2	2	2	3	3	3	2	2
CO3	3	2	2	3	2	1	2	2	1	2	3	3	3	2	3	2
CO4	3	1	2	3	-	1	1	-	-	3	3	3	2	2	2	3
CO5	3	1	2	3	-	1	1	2	2	3	2	3	3	3	1	3
Avg	3	1.4	2.4	3	1.2	1.4	0.8	1.6	1.4	2.4	2.6	3	2.8	2.6	2.2	2.6

B. PHARM. SEMESTER – III (BPH)

SUBJECT: PHARMACEUTICAL ORGANIC CHEMISTRY II -PRACTICAL (BP305P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.
Objectives: Upon completion of the course the student shall be able to

- write the structure, name and the type of isomerism of the organic compound
- write the reaction, name the reaction and orientation of reactions
- account for reactivity/stability of compounds,
- prepare organic compounds

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	**Experiments involving laboratory techniques** • Recrystallization • Steam distillation **Determination of following oil values (including standardization of reagents)** • Acid value • Saponification value • Iodine value **Preparation of compounds** • Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by acylation reaction. • 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/ Acetanilide by halogenation (Bromination) reaction. 1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions. 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction. • Benzoic acid from Benzyl chloride by oxidation reaction. • Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction. Benzil from Benzoin by oxidation reaction. • Dibenzal acetone from Benzaldehyde by Claison Schmidt reaction • Cinnammic acid from Benzaldehyde by Perkin reaction, *P*-Iodo benzoic acid from *P*-amino benzoic acid	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS (LATEST EDITION)

1. Raval H G, Practical organic Chemistry, First edition, Nirav & Roopal Prakashan, India, 2008

D. REFERENCE BOOKS (LATEST EDITION)

1. Mann, F. G.; Saunders, B. C. Practical Organic Chemistry; Pearson: New Delhi, 2009..
2. Arthur Israel Vogel; Furniss, B. S. Vogel's Textbook of Practical Organic Chemistry Including Qualitative Organic Analysis; London Longman Scientific & Technical [U.A, 1987.
3. Vishnoi, N. K. Advanced Practical Organic Chemistry.; Vikas Publishing House: Noida, 2009.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Apply	To understand the experimental laboratory techniques
CO2	Understand and Remember	Determination of oils values for fats and oils
CO3	Understand and Apply	To study the name of the reaction involved in the organic compound
CO4	Understand and Remember	To understand the preparation of organic compound
CO5	Understand & Evaluate	To perform the purification of compound

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	1	1	-	1	1	2	1	1	2	3	3	1	1
CO2	3	1	2	1	1	-	1	1	3	1	2	2	3	3	1	1
CO3	3	1	2	1	1	-	-	1	3	2	1	2	3	2	1	1
CO4	3	1	2	1	1	-	1	1	3	1	2	2	3	2	1	1
CO5	3	1	2	1	1	-	1	1	3	2	1	2	3	3	1	1
Avg	3	1	2	1	1	-	0.8	1	2.8	1.4	1.4	2	3	2.6	1	1

B. PHARM. SEMESTER – III (BPH)
SUBJECT: PHYSICAL PHARMACEUTICS I-PRACTICAL (BP306P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	5	-	50

A. COURSE OVERVIEW

Scope: The course deals with the various physical and physicochemical properties, and principals involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon completion of the course the student shall be able to

- Know and determine physical properties such as solubility, surface tension, partition coefficient and pKa and apply in the design of dosage forms.
- Know the principles of solubility, pH & buffers to use them for designing of formulations

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Determination the solubility of drug at room temperature 2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation 3. Determination of Partition co- efficient of benzoic acid in benzene and water 4. Determination of Partition co- efficient of Iodine in CCl_4 and water 5. Determination of % composition of NaCl in a solution using phenol-water system by CST method 6. Determination of surface tension of given liquids by drop count and drop weight method 7. Determination of HLB number of a surfactant by saponification method 8. Determination of Freundlich and Langmuir constants using activated char coal 9. Determination of critical micellar concentration of surfactants 10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method 11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Sen, K. K., Dutta, S. K. A Laboratory Manual of Physical Pharmaceutics. India: PharmaMed Press. 2019.

D. REFERENCE BOOKS

1. Sinko, Patrick J., and Alfred N. Martin. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences. 5th ed. Philadelphia: Lippincott Williams & Wilkins, 2006.
2. Parrott, E. L., Saski, W. Experimental Pharmaceutics. United States: Burgess Publishing Company. 1977
3. Carter, S. J. Cooper and Gunn's Tutorial Pharmacy. India: CBS Publishers & Distributors. 2021.
4. Ansel, H. C., Stoklosa, M. J. Pharmaceutical Calculations. United Kingdom: Lea &Febiger. 1986.
5. Gilbert S. Banker, Herbert Lieberman, Martin Rieger. Pharmaceutical Dosage Forms: Disperse Systems. United States: CRC Press. 2020.
6. Manavalan, R., Ramasamy, C. Physical Pharmaceutics. India: Pharma Med Press. 2017.
7. Subrahmanyam, C. V. S. Textbook of Physical Pharmaceutics. India: Vallabh Prakashan. 2000.
8. Jain, G., KrishenKhar, R., Ahmad, F. J. Theory and Practice of Physical Pharmacy - E-Book. India: Elsevier Health Sciences. 2011.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand, Evaluate and Apply	Understand and evaluate physical properties such as solubility, surface tension, partition coefficient and pKa and apply in the design of dosage forms.
CO2	Understand and apply	Understand and apply Henderson – Hasselbalch equation for determination of pKa value of drugs.
CO3	Understand and Evaluate	Understand and evaluate the HLB value and critical micellar concentration of a surfactant.
CO4	Understand and Evaluate	Understand adsorption isotherms and determine Freundlich-Langmuir adsorption isotherm.
CO5	Evaluate	Evaluate the stability constants of complexes by various methods.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	1	-	-	-	-	-	1	-	-	3	-	3	-	-
CO2	3	-	1	-	-	-	-	-	1	-	-	3	-	3	-	-
CO3	3	-	1	-	-	-	-	-	1	-	-	3	-	3	-	-
CO4	3	-	1	-	-	-	-	-	1	-	-	3	-	3	-	-
CO5	3	-	1	-	-	-	-	-	1	-	-	3	-	3	-	-
Avg	3	-	1	-	-	-	-	-	1	-	-	3	-	3	-	-

B. PHARM. SEMESTER – III (BPH)
SUBJECT: PHARMACEUTICAL MICROBIOLOGY-PRACTICAL (BP307P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	5	-	50

A. COURSE OVERVIEW

Scope: Course enables the student to learn all categories of microorganisms especially for the production of alcohol, antibiotics, vaccines, vitamins enzymes etc..

Objectives: Upon completion of the course the student shall be able to

- Understand methods of identification, cultivation and preservation of various microorganisms.
- To understand the importance and implementation of sterilization in pharmaceutical processing and industry
- Learn sterility testing of pharmaceutical products.
- Carried out microbiological standardization of Pharmaceuticals.
- Understand the cell culture technology and its applications in pharmaceutical industries.

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology. 2. Sterilization of glassware, preparation and sterilization of media. 3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations. 4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical). 5. 4.Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques 6. Microbiological assay of antibiotics by cup plate method and other methods 7. Motility determination by Hanging drop method. 8. Sterility testing of pharmaceuticals. 9. Bacteriological analysis of water 10. Biochemical test.	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

(1) Arora, B.; Arora, D. R. *Practical Microbiology*; Cbs Publishers & Distributors, Pvt Ptd: New Delhi, 2020.

D. REFERENCE BOOKS

(1) G Sirockin; Cullimore, S. *Practical Microbiology*; London Mcgraw-Hill C, 1969.
(2) Pelczar, M. J.; Chan, E. C. S.; Krieg, N. R. *Microbiology*; Tata Mcgraw-Hill: New Delhi, 2010.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand Apply and Evaluate	To perform and Evaluate sterility testing of pharmaceutical products.
CO2	Understand Apply and Evaluate	To perform microbiological standardization of Pharmaceuticals.
CO3	Understand Apply and Evaluate	To perform staining techniques for different microbes
CO4	Understand Apply and Evaluate	To evaluate motility of microorganism
CO5	Understand Apply and Evaluate	To perform microbial assay of antibiotics

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	1	1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	1	1	3	3	3	3	2	3	3	3	2	2
CO3	3	3	3	2	1	1	1	2	1	2	1	2	2	3	2	1
CO4	3	3	3	2	1	1	1	1	1	1	1	1	1	3	1	1
CO5	3	3	3	2	1	1	2	3	3	3	2	3	2	3	2	3
Avg	3	3	3	2.4	1	1	2	2.4	2.2	2.4	1.8	2.4	2.2	3	2	2

B. PHARM. SEMESTER – III (BPH)
SUBJECT: PHARMACEUTICAL ENGINEERING-PRACTICAL (BP308P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	-	Total
-	-	4	4	2	35	10	5	-	50

A. COURSE OVERVIEW

Scope: This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

Objectives: Upon completion of the course student shall be able:

- To know various unit operations used in Pharmaceutical industries.
- To understand the material handling techniques.
- To perform various processes involved in pharmaceutical manufacturing process.
- To carry out various test to prevent environmental pollution.
- To appreciate and comprehend significance of plant lay out design for optimum use of resources.
- To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Determination of radiation constant of brass, iron, unpainted and painted glass. 2. Steam distillation – To calculate the efficiency of steam distillation. 3. To determine the overall heat transfer coefficient by heat exchanger. 4. Construction of drying curves (for calcium carbonate and starch). 5. Determination of moisture content and loss on drying. 6. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method. 7. Description of Construction working and application of Pharmaceutical 8. Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill,de humidifier. 9. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots. 10. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill. 11. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such othermajor equipment. 12. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity 13. To study the effect of time on the Rate of Crystallization. 14. To calculate the uniformity Index for given sample by using Double Cone Blender.	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Momin M, Mehta T, Practical Manual of Pharmaceutical Engineering, B.S. Shah Prakashan, Ahmedabad, Gujarat, 2002.

D. REFERENCE BOOKS

1. C V S Shubramanyam. Pharmaceutical Engineering : Unit Operations - II; Vallabh Prakashan: Delhi, 2014.
2. C V S Subrahmanyam; J Thimma Setty; Suresh, S.; V Kusum Devi. Pharmaceutical Engineering : Principles and Practices.; Vallabh Prakashan: Delhi, 2002.
3. Badger, W. L. Introduction to Chemical Engineering; Mc Graw Hill: Auckland, 1987.
4. Cooper, J. W.; Gunn, C.; Sidney James Carter. Cooper and Gunn's Tutorial Pharmacy; Cbs Publishers: Editorial: New Delhi, 2005.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To understand and convert the values of factors in different units to perform various unit operations in Pharmaceutical industries.
CO2	Apply	To perform basic unit operations such as filtration, centrifugation, drying etc.
CO3	Evaluate	To check the effect of various processing parameters on different unit operations.
CO4	Apply	To create plant lay out design for optimum use of resources and to carry out various tests to prevent environmental pollution.
CO5	Apply and evaluate	To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2	-	1	1	2	1	3	3	3	2	2	2
CO2	3	2	3	3	2	2	-	2	2	2	3	3	3	3	1	2
CO3	3	2	3	3	-	2	-	2	2	2	3	3	3	3	2	2
CO4	3	2	3	3	2	-	-	2	1	1	3	3	3	2	3	2
CO5	3	3	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Avg	3	2.2	3	3	1.6	1.4	0.6	2	2	1.8	3	3	3	2.4	2.2	2.2

B. PHARM. SEMESTER – VII (BPH)
SUBJECT: INTRODUCTION TO YOGA (BP309P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	2	2	-	-	-	-	-	-

* Non-University Examination with grading satisfactory/ unsatisfactory

A. COURSE OVERVIEW

Scope: This subject is designed to impart basic knowledge and practical skill of Yoga

Objectives: Upon completion of the course student shall be able

- To introduce the student to the fundamentals of a Yoga practice in a safe, supportive and academic environment.
- To learn proper body alignment & the basics of breathing techniques (pranayama)
- To understand various forms of yoga mediation & yogic asanas.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)
[1]	TRAINING IN YOGIC ASANAS, PRANAYAMS AND MUDRAS – Kapalbhati, Anulom-vilom, Pranayam, Omkar Pranayam, Bharmari, Pranayam, Body Roration, Shavasan, Suryanamaskar, – Asans for Meditaion: Padmasan, Swastikasan, Siddhasan, Bhadrasan, Vajrasan, Makarasan, Savasan. – Asans to be performed in Standing Position: Trikonasan, Pervatasan, Utkatukasan, Hastpadsan – Asans to be performed while lying in Supine position: Servangasan, Halasan, Savasan, Kosthavishramasan, Matshendrasan, Suptavajrasan – Asans to be performed while lying in Prone position: Uttanpadasan, Uttanadhasan, Serpasan, Bhujasan, Salabhasan, Dhanurasan, Makarasan – Asans to be performed in sitting position: Pavanmuktasan, Hastapadasan, Vajrasan, Ardhamatshyendrasan, Shishuasan, Saptamudrasan, Gomukhasan. – Yoga Mudras (Seven Types)	**30**

B. PHARM. SEMESTER – IV (BPH)

SUBJECT: PHARMACEUTICAL ORGANIC CHEMISTRY III -THEORY (BP401T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

Objectives: At the end of the course, the student shall be able to

- understand the methods of preparation and properties of organic compounds
- explain the stereo chemical aspects of organic compounds and stereo chemical reactions
- know the medicinal uses and other applications of organic compounds

B. COURSE CONTENT

To emphasize on definition, types, mechanisms, examples, uses/applications

NO	TOPIC	L (Hrs)	COs
[1]	**Stereo isomerism** Optical isomerism – Optical activity, enantiomerism, diastereoisomerism, meso compounds Elements of symmetry, chiral and achiral molecules DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers Reactions of chiral molecules Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute	**10**	CO3
[2]	Geometrical isomerism Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems) Methods of determination of configuration of geometrical isomers. Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity. Stereospecific and stereoselective reactions	**10**	CO3
[3]	**Heterocyclic compounds:** Nomenclature and classification Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene	**10**	CO1 CO2 CO4
[4]	Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrazole, Imidazole, Oxazole and Thiazole. Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine Synthesis & medicinal uses of Pyrimidine, Purine, azepines and their dvts	**8**	CO2 CO3 CO4
[5]	**Reactions of synthetic importance**	**7**	CO5

	Metal hydride reduction (NaBH 4 and LiAlH 4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation		

C. TEXT BOOKS (LATEST EDITION)

1. Mehta, B.; Mehta, M. Organic Chemistry; Prentice Hall Of India: New Delhi, 2005.

D. REFERENCE BOOKS (LATEST EDITION)

1. Bansal R, Heterocyclic Chemistry; New Age International (P) Limited, Publishers: New Delhi, 2014.
2. Finar, I. L. Organic Chemistry : Volume 1: The Fundamental Principles; Pearson Eduation: India, 2003.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Remember	To understand the methods of preparation for various organic compounds
CO2	Understand and Remember	To understand chemical properties for various organic compounds
CO3	Understand and Apply	To know the stereo chemical aspects of organic compounds and stereochemical reactions
CO4	Understand and Apply	To know medicinal uses and Other application of organic compounds
CO5	Understand and Remember	To understand and remember the reaction of synthetic importance

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	3	-	-	-	-	1	1	3	3	2	3	1	1
CO2	3	-	-	3	-	-	-	-	1	-	3	3	2	3	1	1
CO3	3	-	-	3	-	-	-	-	1	-	3	3	2	3	1	1
CO4	3	-	-	2	-	-	-	-	1	-	3	3	3	3	1	1
CO5	3	-	-	2	-	-	-	-	1	-	3	3	3	3	2	1
Avg	3	-	-	2.6	-	-	-	-	1	0.2	3	3	2.4	3	1.2	1

B. PHARM. SEMESTER – IV (BPH)
SUBJECT: MEDICINAL CHEMISTRY I -THEORY (BP402T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the course the student shall be able to

- understand the methods of preparation and properties of organic compounds
- explain the stereo chemical aspects of organic compounds and stereo chemical reactions
- know the medicinal uses and other applications of organic compounds

B. COURSE CONTENT

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

NO	TOPIC	L (Hrs)	COs
[1]	**Introduction to Medicinal Chemistry** **History and development of medicinal chemistry** **Physicochemical properties in relation to biological action** Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism. **Drug metabolism** Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects.	**10**	CO1 CO2
[2]	**Drugs acting on Autonomic Nervous System** **Adrenergic Neurotransmitters:** Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha & Beta) and their distribution. **Sympathomimetic agents: SAR of Sympathomimetic agents** Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. • Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine. • Agents with mixed mechanism: Ephedrine, Metaraminol. **Adrenergic Antagonists:** **Alpha adrenergic blockers:** Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide. **Beta adrenergic blockers:** SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.	**10**	CO2 CO3 CO4 CO5
[3]	**Cholinergic neurotransmitters:**	**10**	CO2

	Biosynthesis and catabolism of acetylcholine. Cholinergic receptors (Muscarinic & Nicotinic) and their distribution. **Parasympathomimetic agents: SAR of Parasympathomimetic agents** **Direct acting agents:** Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine. **Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):** Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiophate iodide, Parathione, Malathion. **Cholinesterase reactivator:** Pralidoxime chloride. **Cholinergic Blocking agents: SAR of cholinolytic agents** **Solanaceous alkaloids and analogues:** Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*. **Synthetic cholinergic blocking agents:** Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.		CO3 CO4 CO5
[4]	**Drugs acting on Central Nervous System** **A. Sedatives and Hypnotics:** **Benzodiazepines:** SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem **Barbiturtes:** SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital **Miscelleneous:** Amides & imides: Glutethmide. Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde. **B. Antipsychotics** **Phenothiazeines:** SAR of Phenothiazeines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Trifluprom azine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. **Ring Analogues of Phenothiazeines:** Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine. **Fluro buterophenones:** Haloperidol, Droperidol, Risperidone. **Beta amino ketones:** Molindone hydrochloride. **Benzamides:** Sulpieride. **C. Anticonvulsants:** SAR of Anticonvulsants**,** mechanism of anticonvulsant action **Barbiturates**: Phenobarbitone, Methabarbital. **Hydantoins:** Phenytoin*, Mephenytoin, Ethotoin **Oxazolidine diones:** Trimethadione, Paramethadione **Succinimides:** Phensuximide, Methsuximide, Ethosuximide* **Urea and monoacylureas**: Phenacemide, Carbamazepine* **Benzodiazepines**: Clonazepam **Miscellaneous:** Primidone, Valproic acid , Gabapentin, Felbamate	**8**	CO2 CO3 CO4 CO5
[5]	**Drugs acting on Central Nervous System** **General anesthetics:** **Inhalation anesthetics:** Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.	**7**	CO2 CO3 CO4 CO5

	Ultra short acting barbitutrates: Methohexital sodium*, Thiamylal sodium, Thiopental sodium. **Dissociative anesthetics:** Ketamine hydrochloride.* **Narcotic and non-narcotic analgesics** **Morphine and related drugs:** SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate. **Narcotic antagonists:** Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride. **Anti-inflammatory agents:** Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.		

C. TEXT BOOKS (LATEST EDITION)

1. Kadam S S, Bothara, K G Principles of Medicinal Chemistry, Volume I & II, 17th edition, Nirali Prakashan, India, 2008
2. Alagarswamy, V Textbookm of Medicinal Chemistry, Volume I & II, Elesevier, India 2012

D. REFERENCE BOOKS (LATEST EDITION)

1. Delgado, J. N.; Remers, W. A. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry; Lippincott-Raven: Philadelphia, 1998.
2. Foye, W. O.; Lemke, T. L.; Williams, D. A. Principles of Medicinal Chemistry; Williams & Wilkins, Cop: Baltimore Etc., 1995.
3. Remington, J. P.; Gennaro, A. R. Remington's Pharmaceutical Sciences; Mack Pub. Co: Easton, Pa., 1990.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Remember	To understand the chemistry of drugs with respect to their pharmacological activity
CO2	Understand and Remember	To understand the classification of drugs with their structures
CO3	Understand	To understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
CO4	Understand and Remember	To know the Structural Activity Relationship (SAR) of different class of drugs
CO5	Understand and Apply	To learn about the chemical synthesis of some drugs

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	1	1	1	-	-	2	-	3	3	3	2	1	1
CO2	3	-	-	1	1	1	-	-	2	-	3	3	1	2	1	1
CO3	3	-	-	1	1	1	-	-	2	-	3	3	3	2	1	1
CO4	3	-	-	1	1	1	-	-	1	-	3	3	2	2	1	1
CO5	3	-	-	1	1	1	-	-	2	-	3	3	1	2	1	1
Avg	3	-	-	1	1	1	-	-	1.8	-	3	3	2	2	1	1

B. PHARM. SEMESTER – IV (BPH)
SUBJECT: PHYSICAL PHARMACEUTICS-II-THEORY (BP403T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon completion of the course the student shall be able to

- Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
- Know basics of the dispersed systems and colloidal dispersions.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Colloidal dispersions:** Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action.	**07**	CO1
[2]	**Rheology:** Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers **Deformation of solids:** Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus	**08**	CO2
[3]	**Coarse dispersion:** Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.	**10**	CO1 CO3
[4]	**Micromeretics:** Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.	**10**	CO4
[5]	**Drug stability:** Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention	**10**	CO3 CO4

C. TEXT BOOKS

1. Subrahmanyam, C. V. S. Textbook of Physical Pharmaceutics. India: Vallabh Prakashan. 2000.

D. REFERENCE BOOKS

1. Sinko, Patrick J., and Alfred N. Martin. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences. 5th ed. Philadelphia: Lippincott Williams & Wilkins, 2006.
2. Parrott, E. L., Saski, W. Experimental Pharmaceutics. United States: Burgess Publishing Company. 1977
3. Carter, S. J. Cooper and Gunn's Tutorial Pharmacy. India: CBS Publishers & Distributors. 2021.
4. Ansel, H. C., Stoklosa, M. J. Pharmaceutical Calculations. United Kingdom: Lea &Febiger. 1986.
5. Gilbert S. Banker, Herbert Lieberman, Martin Rieger. Pharmaceutical Dosage Forms: Disperse Systems. United States: CRC Press. 2020.
6. Manavalan, R., Ramasamy, C. Physical Pharmaceutics. India: Pharma Med Press. 2017.
7. Jain, G., KrishenKhar, R., Ahmad, F. J. Theory and Practice of Physical Pharmacy - E-Book. India: Elsevier Health Sciences. 2011.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and apply	Understand basics of the dispersed systems and apply principles of colloidal dispersions.
CO2	Interpret and Evaluate	Interpret the rheological behaviour of fluids and evaluate the physics of tablet compression.
CO3	Evaluate and apply	Formulate and evaluate coarse dispersions making use of rheological and electrical properties.
CO4	Understand, Evaluate and apply	Understand and evaluate the properties of powders and apply them in formulation development.
CO5	Understand and Analyse	Understand principles of kinetics in the stabilization of dosage forms. Analyze the chemical stability of various drug products

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	1	-	-	-	-	-	2	-	-	3	2	3	-	-
CO2	3	-	1	-	-	-	-	-	2	-	-	3	2	3	-	-
CO3	3	-	1	-	-	-	-	-	2	-	-	3	2	3	-	-
CO4	3	-	1	-	-	-	-	-	2	-	-	3	2	3	-	-
CO5	3	-	2	-	-	-	-	-	3	-	-	3	2	3	-	-
Avg	3	-	1.2	-	-	-	-	-	2.2	-	-	3	2	3	-	-

B. PHARM. SEMESTER – IV (BPH)
SUBJECT: PHARMACOLOGY I -THEORY (BP401T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	---	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

Objectives: Upon completion of the course the student shall be able to

- Understand the pharmacological actions of different categories of drugs
- Explain the mechanism of drug action at organ system/sub cellular/macromolecular levels.
- Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
- Observe the effect of drugs on animals by simulated experiments
- Appreciate correlation of pharmacology with other bio medical sciences

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**1. General Pharmacology** a. Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy. **b. Pharmacokinetics-** Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination	**08**	CO1 CO4 CO5
[2]	**General Pharmacology** **a. Pharmacodynamics-** Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action. **b. Adverse drug reactions**. **c. Drug interactions** (pharmacokinetic and pharmacodynamic) **d. Drug discovery and clinical evaluation of new drugs** -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance	**12**	CO1 CO2 CO3 CO4 CO5

[3]	**Pharmacology of drugs acting on peripheral nervous system** a. Organization and function of ANS. b. Neurohumoral transmission-transmission and classification of neurotransmitters. c. Parasympathomimetic, Parasympatholytic, Sympathomimetics, sympatholytic. d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). e. Local anaesthetic agents. f. Drugs used in myasthenia gravis and glaucoma	10	CO1 CO2 CO3 CO4 CO5
[4]	**Pharmacology of drugs acting on central nervous system** a. Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. b. General anaesthetics and pre-anaesthetics. c. Sedatives, hypnotics and centrally acting muscle relaxants. d. Anti-epileptics e. Alcohols and disulfiram.	08	C01 CO2 CO3 CO4 CO5
[5]	**Pharmacology of drugs acting on central nervous system** a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manic and hallucinogens. b. Drugs used in Parkinson's disease and Alzheimer's disease. c. CNS stimulants and nootropics. d. Opioid analgesics and antagonists e. Drug addiction, drug abuse, tolerance and dependence.	07	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Ritter, J.; Flower, R. J.; Henderson, G.; Yoon Kong Loke; Rang, H. P. Rang and Dale's Pharmacology, 9th ed.; Elsevier: Endinburgh, 2020.
2. Tripathi, K. D. Essentials of Medical Pharmacology; Jaypee Bros: New Delhi, 1988.
3. Brunton, L. L.; Hilal-Dandan, R.; Knollmann, B. C. Goodman & Gilman's the Pharmacological Basis of Therapeutics, 13th ed.; McGraw-Hill Education: New York, 2018.

D. REFERENCE BOOKS

1. Ritter, J.; Flower, R. J.; Henderson, G.; Yoon Kong Loke; Rang, H. P. Rang and Dale's Pharmacology, 9th ed.; Elsevier: Endinburgh, 2020.
2. Tripathi, K. D. Essentials of Medical Pharmacology; Jaypee Bros: New Delhi, 1988.3.
3. Brunton, L. L.; Hilal-Dandan, R.; Knollmann, B. C. Goodman & Gilman's the Pharmacological Basis of Therapeutics, 13th ed.; McGraw-Hill Education: New York, 2018.
4. Bickley, L. S.; Bates, B. Bates' Guide to Physical Examination and History Taking.; Lippincott Williams & Wilkins: Philadelphia, 2020.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To know about general idea of pharmacology subject, the contents of the subject, the basic about the drug and its action inside the body
CO2	Remember, Understand and Apply	To get knowledge about how to body react towards the drug and basic action and adverse effects produced by the drugs
CO3	Understand Apply and Evaluate	To understand about the system, disease and drug used in treatment of that type of disease
CO4	Understand and remember	To know about how disease occurs and drugs used in those diseases and drug interaction with others.
CO5	Remember, Understand, Apply and evaluate	To get knowledge about various agonist and antagonist and drugs dependence abuse and tolerance about certain drugs

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3	3	3	3	3	1	2	3	3	3	3	1
CO2	3	2	3	3	3	3	2	3	3	2	3	3	3	3	3	1
CO3	3	2	3	3	3	3	2	3	3	2	2	3	3	3	3	1
CO4	3	2	3	3	3	3	2	3	3	2	2	3	3	3	3	1
CO5	3	2	3	3	3	3	3	3	3	2	2	2	3	3	3	1
Avg	3	2	3	3	3	3	2.4	3	3	1.8	2.2	2.8	3	3	3	1

B. PHARM. SEMESTER – IV (BPH)
SUBJECT: PHARMACOGNOSY AND PHYTOCHEMISTRY -THEORY (BP405T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

Objectives: Upon completion of the course, the student shall be able

- To know the techniques in the cultivation and production of crude drugs.
- To know the crude drugs, their uses and chemical nature.
- Know the evaluation techniques for the herbal drugs.
- To carry out the microscopic and morphological evaluation of crude drugs.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Introduction to Pharmacognosy:** (a) Definition, history, scope and development of Pharmacognosy (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins). **Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero-taxonomical classification of drugs **Quality control of Drugs of Natural Origin:** Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida.	**10**	CO2 CO5
[2]	**Cultivation, Collection, Processing and storage of drugs of natural origin:** Cultivation and Collection of drugs of natural origin Factors influencing cultivation of medicinal plants. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants **Conservation of medicinal plants**	**10**	CO1
[3]	**Plant tissue culture:** Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines	**07**	CO4
[4]	**Pharmacognosy in various systems of medicine:** Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine. **Introduction to secondary metabolites:**	**10**	CO2 CO3 CO5

	Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins		
[5]	Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs **Plant Products:** Fibers - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens **Primary metabolites:** General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic uses and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites: **Carbohydrates:** Acacia, Agar, Tragacanth, Honey **Proteins and Enzymes :**Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin). **Lipids(Waxes, fats, fixed oils)** : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax . **Marine Drugs:** Novel medicinal agents from marine sources.	**08**	CO2 CO5

C. TEXT BOOKS

1. Dr. Shukla P., Dr. Shashi, A. &Dr. Shukla P., A textbook of "Pharmacognosy& Phytochemistry-I" 1st Edition, Nirali Prakashan, 2019.
2. Kabra, A., Dr. Ashok PK. & Setia, S., A textbook of "Pharmacognosy & Phytochemistry-I", Pee Vee Book , S. Vikas & Company (Medical Publishers) ,2019.

D. REFERENCE BOOKS

1. Deore SL., **"**Pharmacognosy & Phytochemistry-I-A Comprehensive Approach" 2nd edition, Pharma Med. Press, 2019.
2. Ali, M., "Pharmacognosy- Pharmacognosy & Phytochemistry-I", Volume-I CBS Publishers & Distributors PVT. Ltd., 2018
3. Shah, B., & Seth, AK., "Textbook of Pharmacognosy & Phytochemistry" , 2nd Edition, CBS Publishers & Distributors PVT. Ltd., 2017.
4. Quadry, JS., "Textbook of Pharmacognosy (Theory & Practical)" 17th Edition, CBS Publishers &Distributors PVT. Ltd., 2020.
5. Rangari VD., "Pharmacognosy & Phytochemistry" Volume-I 3rd Edition, Career Publications,2017.
6. Rangari VD., "Pharmacognosy & Phytochemistry" Volume-II 3rd Edition, Career Publications, 2017.
7. Jarald EE. &Jarald SE., "Textbook of Pharmacognosy & Phytochemistry" 1st edition, CBS Publishers & Distributors PVT. Ltd., 2007.
8. Neha Tyagi &Dr. Verma Santosh Kumar "A textbook of Pharmacognosy & Phytochemistry-I", 1st Edition, BFC Publication, 2020.
9. Gokhale, SB., Dr.Kokate CK., Dr.Tatiya AV., Dr. Kalaskar MG., "Pharmacognosy & Phytochemistry-I" 1st Edition, Nirali Prakashan, 2019.
10. Ashutosh Kar, "Pharmacognosy& Phytochemistry-I ", 1st Edition, New Age International Private LTD. Publishers. 2020.
11. Dr. Das K., "Pharmacognosy & Phytochemistry-I" 1st Edition, Nirali Prakashan, 2019.
12. Kalia AN., Textbook of "Pharmacognosy & Phytochemistry-I" CBS Publishers & Distributors PVT. Ltd., 2021.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Analyse	Identify and analyse the techniques in the cultivation and production of crude drugs.
CO2	Remember and Understand Evaluate	Describe Pharmacognostic parameters & Pharmacognostic study of crude drug with their evaluation.
CO3	Understand and Apply	Explain & apply the basic principle of Indian systems of medicines.
CO4	Understand and apply	Discuss and apply the basic principle and techniques of Plant tissue culture.
CO5	Understand and apply	Discuss primary and secondary metabolites systematically from the source of their pharmaceutical and industrial application.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	-	2	-	2	2	3	2	3	2	2	2	1
CO2	3	2	2	2	-	2	2	1	2	1	2	3	2	3	2	1
CO3	3	2	2	1	-	2	3	2	2	1	2	3	2	3	3	1
CO4	3	2	2	2	-	2	2	1	2	1	2	3	2	2	3	1
CO5	3	2	2	2	-	2	-	2	2	1	2	3	2	2	2	1
Avg	3	2	2	1.8	-	2	1.4	1.6	2	1.4	2	3	2	2.4	2.4	1

B. PHARM. SEMESTER – IV (BPH)
SUBJECT: MEDICINAL CHEMISTRY I -PRACTICAL (BP406P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the course the student shall be able to

- understand the methods of preparation and properties of organic compounds
- explain the stereo chemical aspects of organic compounds and stereo chemical reactions
- know the medicinal uses and other applications of organic compounds

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	**Preparation of drugs/ intermediates** 1,3-pyrazole 1,3-oxazole Benzimidazole Benztriazole 2,3- diphenyl quinoxaline Benzocaine Phenytoin Phenothiazine Barbiturate **Assay of drugs** Chlorpromazine Phenobarbitone Atropine Ibuprofen Aspirin Furosemide **Determination of Partition coefficient for any two drugs**	**60**	CO1 CO2 CO4 CO5

C. TEXT BOOKS (LATEST EDITION)

1. Raval H G, Practical organic Chemistry, First edition, Nirav & Roopal Prakashan, India, 2008

D. REFERENCE BOOKS (LATEST EDITION)

1. Mann, F. G.; Saunders, B. C. Practical Organic Chemistry; Pearson: New Delhi, 2009..
2. Arthur Israel Vogel; Furniss, B. S. Vogel's Textbook of Practical Organic Chemistry Including Qualitative Organic Analysis; London Longman Scientific & Technical [U.A, 1987.
3. Vishnoi, N. K. Advanced Practical Organic Chemistry.; Vikas Publishing House: Noida, 2009.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Apply	To determine the partition coefficient of some drugs
CO2	Understand and Apply	To carry out the synthesis of drugs
CO3	Understand and Evaluate	To perform the assay of drugs using various analytical methods
CO4	Understand and Apply	To synthesize intermediates using different chemical reaction
CO5	Understand and Apply	To purify synthesized compounds and determine their physical constants

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	1	1	1	-	1	1	-	3	3	1	2	1	0
CO2	3	1	1	1	1	1	1	1	1	1	3	3	2	3	1	1
CO3	3	1	1	1	1	1	-	1	1	-	3	3	1	1	1	1
CO4	3	1	1	1	1	1	-	1	1	1	3	3	2	2	1	1
CO5	3	1	1	1	1	1	1	1	1	1	3	3	1	2	1	2
Avg	3	1	1	1	1	1	0.4	1	1	0.6	3	3	1.4	2	1	1

B. PHARM. SEMESTER – IV (BPH)
SUBJECT: PHYSICAL PHARMACEUTICS-II-PRACTICAL(BP407P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	5	-	50

A. COURSE OVERVIEW

Scope: The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon completion of the course the student shall be able to

- Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
- Know basics of the micromeritics, dispersed systems and colloidal dispersions

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Determination of particle size, particle size distribution using sieving method 2. Determination of particle size, particle size distribution using Microscopic method 3. Determination of bulk density, true density and porosity 4. Determine the angle of repose and influence of lubricant on angle of repose 5. Determination of viscosity of liquid using Ostwald's viscometer 6. Determination sedimentation volume with effect of different suspending agent 7. Determination sedimentation volume with effect of different concentration of 8. single suspending agent 9. Determination of viscosity of semisolid by using Brookfield viscometer 10. Determination of reaction rate constant first order. 11. Determination of reaction rate constant second order 12. Accelerated stability studies	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Sen, K. K., Dutta, S. K. A Laboratory Manual of Physical Pharmaceutics. India: PharmaMed Press. 2019.

D. REFERENCE BOOKS

1. Sinko, Patrick J., and Alfred N. Martin. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences. 5th ed. Philadelphia: Lippincott Williams & Wilkins, 2006.
2. Parrott, E. L., Saski, W. Experimental Pharmaceutics. United States: Burgess Publishing Company. 1977
3. Carter, S. J. Cooper and Gunn's Tutorial Pharmacy. India: CBS Publishers & Distributors. 2021.
4. Ansel, H. C., Stoklosa, M. J. Pharmaceutical Calculations. United Kingdom: Lea &Febiger. 1986.
5. Gilbert S. Banker, Herbert Lieberman, Martin Rieger. Pharmaceutical Dosage Forms: Disperse Systems. United States: CRC Press. 2020.
6. Manavalan, R., Ramasamy, C. Physical Pharmaceutics. India: Pharma Med Press. 2017.
7. Subrahmanyam, C. V. S. Textbook of Physical Pharmaceutics. India: Vallabh Prakashan. 2000.
8. Jain, G., KrishenKhar, R., Ahmad, F. J. Theory and Practice of Physical Pharmacy - E-Book. India: Elsevier Health Sciences. 2011.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Evaluate	Understand and evaluate basic, derived and flow properties of powders and apply to prepare a stable formulation.
CO2	Understand and Evaluate	Understand and evaluate viscosity of fluids and formulations.
CO3	Remember and Analyse	Remember various type of suspending agent and anlyse them to formulate a stable suspension.
CO4	Apply and Analyse	Apply principles of chemical kinetics in determination of rate constants as per the chemical reaction.
CO5	Understand and Analyse	Understand and analyse the shelf life of a formulation by accelerated stability studies.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	1	-	-	-	-	-	2	-	-	3	2	3	-	-
CO2	3	-	1	-	-	-	-	-	1	-	-	3	1	3	-	-
CO3	3	-	1	-	-	-	-	-	1	-	-	3	1	3	-	-
CO4	3	-	2	-	-	-	-	-	1	-	-	3	2	3	-	-
CO5	3	-	2	-	-	-	-	-	1	-	-	3	2	3	-	-
Avg	3	-	1.4	-	-	-	-	-	1.2	-	-	3	1.6	3	-	-

B. PHARM. SEMESTER – IV (BPH)
SUBJECT: PHARMACOLOGY I -PRACTICAL (B408 P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
--	--	4	4	2	35	10	5	-	50

A. COURSE OVERVIEW

Scope: It is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. It provides the basic knowledge required to understand the various disciplines of pharmacy.

Objectives: Upon completion of the course the student shall be able to

- Explain the gross morphology, structure and functions of various organs of the human body.
- Describe the various homeostatic mechanisms and their imbalances.
- Identify the various tissues and organs of different systems of human body.
- Perform the various experiments related to special senses and nervous system.
- Appreciate coordinated working pattern of different organs of each system

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Introduction to experimental pharmacology. 2. Commonly used instruments in experimental pharmacology. 3. Study of common laboratory animals. 4. Maintenance of laboratory animals as per CPCSEA guidelines. 5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anaesthetics and euthanasia used for animal studies. 6. Study of different routes of drugs administration in mice/rats. 7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice. 8. Effect of drugs on ciliary motility of frog oesophagus 9. Effect of drugs on rabbit eye. 10. Effects of skeletal muscle relaxants using rota-rod apparatus. 11. Effect of drugs on locomotor activity using actophotometer. 12. Anticonvulsant effect of drugs by MES and PTZ method. 13. Study of stereotype and anti-catatonic activity of drugs on rats/mice. 14. Study of anxiolytic activity of drugs using rats/mice. 15. Study of local anaesthetics by different methods Microscopic study of epithelial and connective tissue	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Ritter, J.; Flower, R. J.; Henderson, G.; Yoon Kong Loke; Rang, H. P. Rang and Dale's Pharmacology, 9th ed.; Elsevier: Endinburgh, 2020.
2. Tripathi, K. D. Essentials of Medical Pharmacology; Jaypee Bros: New Delhi, 1988.
3. Brunton, L. L.; Hilal-Dandan, R.; Knollmann, B. C. Goodman & Gilman's the Pharmacological Basis of Therapeutics, 13th ed.; McGraw-Hill Education: New York, 2018.

D. REFERENCE BOOKS

1. Kulkarni, R. S. Index Theorems of Atiyah, Bott, Patodi and Curvature Invariants; Presses De L'université De Montreal: Montreal, 1975.
2. F Hoffmeister; G Stille. Handbook of Experimental Pharmacology. Vol. 55/2, Psychotropic Agents, Part 2, Anxiolytics, Gerontopsychopharmacological Agents, and Psychomotor Stimulants; Springer: Berlin, 1981.
3. Kapadia, S. R.; Chew, D.; Cura, F.; L'allier, P. L.; Roffi, M.; E Murat Tuzcu. Textbook of Interventional Cardiology: A Global Perspective; Jaypee: The Health Sciences Publisher: New Delhi, 2017.
4. Fundamentals of Experimental Pharmacology; Hilton & Company: Kolkata, 2015.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To know about general idea of pharmacology subject, the contents of the subject, the basic instrument used in pharmacology
CO2	Remember, Understand and Apply	To get knowledge about animals used in experimental pharmacology its detail, housing, feeding, dissection etc
CO3	Understand Apply and Evaluate	To understand about the drugs acting on the animals body part and instruments used to check the activity of the animal
CO4	Understand and remember	To know about how diseases are produced in the animals and drug used for those diseases.
CO5	Remember, Understand, Apply and evaluate	To get knowledge about which animals, which instrument and which kind of drug we can used to induce the disease and for treatment of those disease,

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	2	3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	2	3	2	3	3	1	2	3	3	3	3	3
CO4	3	2	3	3	2	3	2	3	3	1	2	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	2	2	2	3	3	3	2
Avg	3	2.6	3	3	2	3	2.4	3	3	2	2.2	2.8	3	3	3	2.8

B. PHARM. SEMESTER – IV (BPH)
SUBJECT: PHARMACOGNOSY AND PHYTOCHEMISTRY I -PRACTICAL (BP409P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

Objectives: Upon completion of the course, the student shall be able

- To know the techniques in the cultivation and production of crude drugs.
- To know the crude drugs, their uses and chemical nature.
- Know the evaluation techniques for the herbal drugs.
- To carry out the microscopic and morphological evaluation of crude drugs.

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Analysis of crude drugs by chemical tests: (i)Tragacanth (ii) Acacia (iii)Agar 1. (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil. 2. Determination of stomatal number and stomatal index. 3. Determination of vein islet number, vein islet termination and palisade ratio. 4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer. 5. Determination of Fiber length and width 6. Determination of number of starch grains by Lycopodium spore method 7. Determination of Ash value. 8. Determination of Extractive values of crude drugs. 9. Determination of moisture content of crude drugs. 10. Determination of swelling index and foaming index.	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Rana, M. &Kabra A., "Practical Mannual - Pharmacognosy & Phytochemistry-I" Pee Vee Book , S. Vikas & Company (Medical Publishers) ,2019.
2. Dr. Khandelwal, KR., "Practical Pharmacognosy" 19th edition, Nirali Prakashan, 2008.

D. REFERENCE BOOKS

1. Kabra, A., Dr. Ashok PK. & Setia, S., A textbook of "Pharmacognosy & Phytochemistry-I", Pee Vee Book , S. Vikas & Company (Medical Publishers) ,2019.
2. Deore, SL., **"**Pharmacognosy & Phytochemistry-I-A Comprehensive Approach" 2nd edition, Pharma Med. Press, 2019.
3. Ali, M., "Pharmacognosy- Pharmacognosy & Phytochemistry-I", Volume-I CBS Publishers & Distributors PVT. Ltd., 2018.

4. Shah, B., & Seth, AK., "Textbook of Pharmacognosy & Phytochemistry" , 2nd Edition, CBS Publishers & Distributors PVT. Ltd., 2017.
5. Quadry, JS., "Textbook of Pharmacognosy (Theory & Practical)" 17th Edition, CBS Publishers & Distributors PVT. Ltd., 2020.
6. Rangari VD., "Pharmacognosy & Phytochemistry" Volume-I 3rd Edition, Career Publications, 2017.
7. Rangari VD., "Pharmacognosy & Phytochemistry" Volume-II 3rd Edition, Career Publications, 2017.
8. Jarald EE. &Jarald SE., "Textbook of Pharmacognosy & Phytochemistry" 1st edition, CBS Publishers & Distributors PVT. Ltd., 2007.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Identify and Analyse	Identify and Analyse unorganised and organized crude drugs by chemical tests.
CO2	Remember, Understand and Evaluate	Evaluation of Crude drug by qualitative and quantitative microscopic method.
CO3	Understand, Evaluate and Analyse	Discuss the evaluation and analyse Physicochemical parameters for crude drugs.
CO4	Understand, Remember and Apply	Describe the principle of different microscopic measurement techniques.
CO5	Apply and Analyse	Explain evaluation of crude drugs.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	-	2	-	1	2	1	3	2	2	3	2	1
CO2	3	3	2	3	-	2	-	1	2	1	3	2	2	3	2	1
CO3	3	3	2	3	-	2	-	1	2	1	3	2	2	3	2	1
CO4	3	3	2	3	-	1	-	1	1	1	3	2	2	3	2	1
CO5	3	3	2	3	-	2	-	1	2	1	3	2	2	3	2	1
Avg	3	3	2	3	-	1.8	-	1	1.8	1	3	2	2	3	2	1

B.PHARM. SEMESTER – V (BPH)
SUBJECT: MEDICINAL CHEMISTRY II -THEORY (BP501T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the course the student shall be able to

- Understand the chemistry of drugs with respect to their pharmacological activity
- Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
- Know the Structural Activity Relationship of different class of drugs
- Study the chemical synthesis of selected drugs

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Classification, mechanism of action, uses, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted(*) of following class of drugs in all units.** **Antihistaminic agents**: Histamine, receptors and their distribution in the human body **H1–antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium **H2-antagonists:** Cimetidine*, Famotidine, Ranitidin **Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole **Anti-neoplastic agents:** **Alkylating agents: Mecloretha**mine*, Cyclophosphamide, Melphalan Chlorambucil, Busulfan, Thiotepa Antimetabolites: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin Plant products: Etoposide, Vinblastin sulphate, Vincristin sulphate Miscellaneous: Cisplatin, Mitotane.	**10**	CO1 CO2 CO3 CO4 CO5
[2]	**Anti-anginal:** **Vasodilators:** Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole **Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazem	**10**	CO1 CO2 CO3 CO4

	hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine **Diuretics:** **Carbonic anhydrase inhibitors:** Acetazolamide*, Methazolamide, Dichlorphenamide **Thiazides:** Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide **Loop diuretics:** Furosemide*, Bumetanide, Ethacrynic acid **Potassium sparing Diuretics:** Spironolactone, Triamterene, Amiloride. **Osmotic Diuretics:** Mannitol **Anti-hypertensive Agents:** Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.		CO5
[3]	**Anti-arrhythmic Drugs:** Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol **Anti-hyperlipidemic agents:** Clofibrate, Lovastatin, Cholesteramine and Cholestipol **Coagulant & Anticoagulants:** Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel **Drugs used in Congestive Heart Failure:** Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan	**10**	CO1 CO2 CO3 CO4 CO5
[4]	**Drugs acting on Endocrine system** Nomenclature, Stereochemistry and metabolism of steroids **Sex hormones:** Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol **Drugs for erectile dysfunction:** Sildenafil, Tadalafil **Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrol **Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone **Thyroid and antithyroid drugs:** L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole	**08**	CO1 CO2 CO3 CO4 CO5
[5]	**Antidiabetic agents:** Insulin and its preparations **Sulfonylureas:** Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. **Thiazolidinediones:** Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acrabose, Voglibose. Local Anesthetics: SAR of Local anesthetics **Benzoic Acid derivatives;** Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine **Amino Benzoic acid derivatives:** Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate **Lidocaine/Anilide derivatives:** Lignocaine, Mepivacaine, Prilocaine, Etidocaine. **Miscellaneous:** Phenacaine, Diperodon, Dibucaine.*	**07**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Alagarsamy, V. Textbook of Medicinal Chemistry, Volume I and Volume II, 3rd ed.; CBS Publishers, India, 2016
2. Kadam, S.S., Mahadik, K.R., Bothara, K.G. Principles of Medicinal Chemistry, Volume I and II, 20th ed.; Nirali Prakashan, India, 2010

D. REFERENCE BOOKS

1. Hansch, C., Semmes, P.G., Taylor, J.B. Comprehensive Medicinal Chemistry, Volume I to VI, 1st ed.; Elsevier, India, 2005
2. Abraham, D.J. Burger's Medicinal Chemistry and Drug Discovery, Volume I to VI, 6th ed.; Wiley-Interscience, New Jersey, 2003
3. Lemke, T.L., Williams, D.A. FOYE'S Principles of Medicinal Chemistry, 7th ed.; Lippincott Williams & Wilkins, Baltimore, 2013
4. Baele, J.M., Block J. H. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 12th ed.; Lippincott Williams & Wilkins; Baltimore, 2011
5. Lendnicer, D., Mitscher, L.A. The Organic Chemistry of Drug Synthesis, Volume I to VI, Wiley-Interscience, New Jersey, 2008
6. Johnson, D.S., Li, J.J. Art of Drug Synthesis, 1st ed,; Wiley-Interscience, New Jersey, 2007
7. Smith, J.H., Williams, H. Smith and Williamson's Introduction to the Principles of Drug Design and Action, 3rd ed; CRC Press, The Netherlands, 2005
8. Vardanyan, R., Hruby, V. Synthesis of Essential Drugs, Volume I & II, 1st ed.; Elsevier, The Netherlands, 2006

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To describe classification and chemistry of drugs
CO2	Understand and remember	To discuss mechanism of action of various drugs
CO3	Understand and remember	To explain drug metabolic pathways and adverse effects of drugs
CO4	Analysis	To explain Structural Activity Relationship of different class of drugs
CO5	Apply	To describe synthesis of selected drugs.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	1	1	-	-	-	-	-	-	3	2	3	1	1	-
CO2	3	-	2	2	-	-	-	-	-	-	3	2	3	1	2	-
CO3	3	-	1	1	-	-	-	-	-	-	3	2	3	1	2	-
CO4	3	-	2	1	-	-	-	-	-	-	3	2	3	1	1	-
CO5	3	3	3	2	3	-	-	-	-	3	3	2	3	3	2	3
Avg	3	0.6	1.8	1.4	0.6	-	-	-	-	0.6	3	2	3	1.4	1.6	0.6

B. PHARM. SEMESTER – V (BPH)
SUBJECT: INDUSTRIAL PHARMACY I -THEORY (BP502T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.
Objectives: Upon completion of the course the student shall be able to

- Know the various pharmaceutical dosage forms and their manufacturing techniques.
- Know various considerations in development of pharmaceutical dosage forms
- Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Pre-formulation Studies:** Introduction to pre-formulation, goals and objectives, study of physicochemical characteristics of drug substances. a. Physical properties: Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism b. Chemical Properties: Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant Application of pre-formulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.	**07**	CO1
[2]	**Tablets:** a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems, equipments and tablet tooling. b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating. c. Quality control tests: In process and finished product tests **Liquid orals:** Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia	**10**	CO2 CO3
[3]	**Capsules:** a. Hard gelatin capsules: Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules. b. soft gelatin capsules: Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications. **Pellets:** Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets	**08**	CO2 CO3

[4]	**Parenteral Products:** a. Definition, types, advantages and limitations. Pre-formulation factors and essential requirements, vehicles, additives, importance of isotonicity b. Production procedure, production facilities and controls, aseptic processing c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products. d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products. Ophthalmic Preparations: Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labelling, containers; evaluation of ophthalmic preparations	**10**	CO2 CO3
[5]	**Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens. **Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies. **Packaging Materials Science:** Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.	**10**	CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Lachman, L.; Liebermann, H. A. The Theory and Practice of Industrial Pharmacy; Cbs Publishers & Distributors Pvt. Ltd: New Delhi, 2013.

D. REFERENCE BOOKS

1. Lieberman, H. A. Pharmaceutical Dosage Forms. Tablets, Vol. 1; New York, Ny Dekker, 1989.
2. Lieberman, H. A.; Lachmann, L.; Kenneth Edwards Avis. Pharmaceutical Dosage Forms : Parenteral Medications;Vol-1-3; M. Dekker: New York, 1984.
3. Lieberman, H. A.; Rieger, M. M.; Banker, G. S. Pharmaceutical Dosage Forms-- Disperse Systems. Volume 1- 3; Dekker: New York, 1998.
4. Banker, G. S.; Rhodes, C. T. Modern Pharmaceutics; Marcel Dekker: New York, 2002.
5. Beringer, P. Remington : The Science and Practice of Pharmacy.; Lippincott Williams & Wilkins: Philadelphia ; London, 2011.
6. Aulton, M. E. Pharmaceutics : The Science of Dosage Form Design; Churchill Livingstone: Edinburgh Etc., 2003.
7. Ansel, H. C. Introduction to Pharmaceutical Dosage Forms; Lea & Febiger: Philadelphia, 1985.
8. Rhodes, C. T.; Jens Thurø Carstensen. Drug Stability : Principles and Practices; Marcel Dekker: New York, 2000.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Analyse	To understand pre-formulation considerations in development of pharmaceutical dosage forms.
CO2	Remember, Understand and Evaluate	To get knowledge of various pharmaceutical dosage forms and their manufacturing techniques.
CO3	Understand Apply and Evaluate	To understand various quality control test for pharmaceutical dosage forms and apply it to maintain quality drug product.
CO4	Understand and Remember	To know packaging requirements and evaluate various packaging materials for pharmaceutical dosage forms.
CO5	Understand	To understand formulation and preparation of cosmetic products.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	1	-	1	1	-	2	3	3	3	2	1	1
CO2	3	3	3	3	1	2	1	1	3	1	3	3	3	1	1	1
CO3	3	1	3	3	1	3	1	1	1	-	3	3	3	2	2	2
CO4	3	1	3	3	1	3	1	1	3	-	3	3	3	1	2	2
CO5	3	3	2	3	1	2	1	1	3	2	3	3	3	1	1	1
Avg	3	2.2	3	3	1	2	1	1	2	1	3	3	3	1.4	1.4	1.4

B. PHARM. SEMESTER – V (BPH)
SUBJECT: PHARMACOLOGY-II–THEORY (BP503T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.

Objectives: Upon completion of this course the student should be able to

- Understand the mechanism of drug action and its relevance in the treatment of different diseases
- Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
- Demonstrate the various receptor actions using isolated tissue preparation
- Appreciate correlation of pharmacology with related medical sciences

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Pharmacology of drugs acting on cardio vascular system** a. Introduction to hemodynamic and electrophysiology of heart. b. Drugs used in congestive heart failure c. Anti-hypertensive drugs. d. Anti-anginal drugs. e. Anti-arrhythmic drugs. f. Anti-hyperlipidaemia drugs.	**10**	CO1, CO2, CO4.
[2]	**Pharmacology of drugs acting on cardio vascular system** a. Drug used in the therapy of shock. b. Haematinics, coagulants and anticoagulants. c.Fibrinolytics and anti-platelet drugs d. Plasma volume expanders **Pharmacology of drugs acting on urinary system** a. Diuretics b. Anti-diuretics.	**10**	CO1, CO2, CO4.
[3]	**Autacoids and related drugs** a.Introduction to autacoids and classification b. Histamine, 5-HTandtheirantagonists. c. Prostaglandins, Thromboxane's and Leukotrienes. d. Angiotensin, Bradykinin and Substance P. e. Non-steroidal anti-inflammatory agents f.Anti-goutdrugs g. Anti-rheumatic drugs	**10**	CO1, CO3, CO5.
[4]	**Pharmacology of drugs acting on endocrine system** a. Basic concepts in endocrine pharmacology. b. Anterior Pituitary hormones-analogues and their inhibitors. c. Thyroid hormones-analogues and their inhibitors.	**08**	CO1, CO3, CO4.

	d. Hormones regulating plasma calcium level-Parathormone, Calcitonin and Vitamin-D. e. Insulin, Oral Hypoglycaemic agents and glucagon. f. ACTH and corticosteroids.		
[5]	**Pharmacology of drugs acting on endocrine system** a. Androgens and Anabolic steroids. b. Estrogens, progesterone and oral contraceptives. c. Drugs acting on the uterus. **Bioassay** a. Principles and applications of bioassay. b. Types of bioassay c. Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT.	**07**	CO3, CO4, CO5.

C. TEXT BOOKS

1. Tripathi, K. D. *Essentials of Medical Pharmacology*; Jaypee Brothers Medical Publishers: New Delhi, 2019.

D. REFERENCE BOOKS

1. Ritter, J.; Flower, R. J.; Henderson, G.; Yoon Kong Loke; Rang, H. P. *Rang and Dale's Pharmacology*, 9th ed.; Elsevier: Endinburgh, 2020.
2. Katzung, B. G. *Basic & Clinical Pharmacology*, 14th ed.; Mcgraw-Hill Education, Copyright: New York I 11 Pozostałych, 2018.
3. Louis Sanford Goodman; Gilman, A.; Brunton, L. L.; Chabner, B. A.; KnollmannB. C. *Goodman & Gilman's the Pharmacological Basis of Therapeutics*; Mcgraw-Hill Medical: New York, 2011.
4. Al, E. *Applied Therapeutics: The Clinical Use of Drugs*; Wolters Kluwer Health - Lippincott Williams & Wilkins, Cop: Philadelphia, 2013.
5. *Lippincott's Illustrated Reviews Bundle Lippincott's Illustrated Reviews: Biochemistry, 4th Ed + Lippincott's Illustrated Reviews, Pharmacology, North American Edition, 4th Ed + Lippincott's.*; Lippincott Williams & Wilkins, 2009.
6. Hl Sharma; Kk Sharma. *Principles of Pharmacology*; Paras: New Delhi, 2011.
7. Craig, C. R.; Stitzel, R. E. *Modern Pharmacology with Clinical Applications*; Lippincott Williams & Wilkins: Philadelphia, 2004.
8. *Fundamentals of Experimental Pharmacology*; Hilton & Company: Kolkata, 2015.
9. Kulkarni, S. *Handbook of Experimental Pharmacology*, 3rd Edition. Vallabh Prakashan: Delhi, 2005.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and apply	Understand the mechanism of drug action and its relevance in the treatment of different diseases.
CO2	Understand and apply	Correlate the pathophysiology and mechanism of drug action of drugs and is application in treatment of the disease.
CO3	Create, Remember and Evaluate	Create the choice of medicine based on various receptor actions using isolated tissue preparation.
CO4	Understand and Remember	Appreciate correlation of pharmacology with related medical sciences.
CO5	Understand, analyse and Evaluate	Apply clinical skills in ethical practice in pharmacy practice.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	3	3	-	3	3	2	3	-	3	3	3	3	2	3
CO2	3	-	3	3	-	3	3	1	3	-	3	3	3	3	2	3
CO3	3	-	3	3	-	3	3	2	3	-	3	3	3	3	2	3
CO4	3	-	3	3	-	3	3	1	3	-	3	3	3	3	2	3
CO5	3	-	3	3	-	3	3	-	3	-	3	2	3	3	2	3
Avg	3	-	3	3	-	3	3	1.2	3	-	3	2.8	3	3	2	3

B. PHARM. SEMESTER – V (BPH)
SUBJECT: PHARMACOGNOSY & PHYTOCHEMISTRY-II -THEORY (BP504T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and Phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine

Objectives: Upon completion of the course, the student shall be able

- To know the modern extraction techniques, characterization and identification of the herbal drugs and Phytoconstituents.
- To understand the preparation and development of herbal formulation.
- To understand the herbal drug interactions.
- To carryout isolation and identification of phytoconstituents.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Metabolic pathways in higher plants and their determination** a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.	**07**	CO1
[2]	General introduction, composition, chemistry & chemical classes, biological source, therapeutic uses and commercial applications of following secondary metabolites: **Alkaloids:** Vinca, Rauwolfia, Belladonna, Opium, **Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta **Steroids, Cardiac Glycosides & Triterpenoids**: Liquorice, Dioscorea, Digitalis **Volatile oils**: Mentha, Clove, Cinnamon, Fennel, Coriander, **Tannins:** Catechu, Pterocarpus **Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony **Glycosides:** Senna, Aloes, Bitter Almond **Iridoids, Other terpenoids & Naphthaquinones:** Gentian, Artemisia, taxus, carotenoids.	**14**	CO5
[3]	**Isolation, Identification and Analysis of Phytoconstituents** a) Terpenoids: Menthol, Citral, Artemisin b) Glycosides: Glycyrhetinic acid & Rutin c) Alkaloids: Atropine,Quinine,Reserpine,Caffeine d) Resins: Podophyllotoxin, Curcumin.	**06**	CO2 CO3
[4]	**Industrial production, estimation and utilization of the following phytoconstituents:** Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine.	**10**	CO4

[5]	**Basics of Phytochemistry** Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.	**08**	CO2

C. TEXT BOOKS

1. Dr. Shukla P., Dr. Shashi, A. & Dr. Shukla P., "Pharmacognosy & Phytochemistry-II" NiraliPrakashan, 1st Edition, 2019.
2. Kabra, A., Dr. Ashok PK. & Setia, S., A textbook of "Pharmacognosy & Phytochemistry-II", Pee Vee, S. Vikas & Company Medical Publishers, 2019.

D. REFERENCE BOOKS

1. Shah, B., & Seth, AK., "Textbook of Pharmacognosy & Phytochemistry", 2nd Edition, CBS Publishers & Distributors PVT. Ltd., 2017.
2. Quadry, JS., "Textbook of Pharmacognosy (Theory & Practical)" 17th Edition, CBS Publishers & Distributors PVT. Ltd., 2020.
3. Rangari VD., "Pharmacognosy & Phytochemistry" Volume-I 3rd Edition, Career Publications, 2017.
4. Rangari VD., "Pharmacognosy & Phytochemistry" Volume-II 3rd Edition, Career Publications, 2017.
5. Jarald EE. &Jarald SE., "Textbook of Pharmacognosy & Phytochemistry" 1st edition, CBS Publishers & Distributors PVT. Ltd., 2007.
6. Dr. Sudha T., Mrs. Rajeshwari, R.,Dr. Ravikumar VR. & Dr. Nimbakar TP., Current trend in "Pharmacognosy & Phytochemistry-II" Part-2, PV Publication, 2019.
7. Dr. Das K., "Pharmacognosy & Phytochemistry-II" 1st Edition, NiraliPrakashan, 2019.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To describe various metabolic pathways and formation of different metabolites
CO2	Understand and apply	To explain conventional and modern extraction techniques for phytoconstituents and apply analytical techniques.
CO3	Apply and evaluate	To evaluate phytoconstituents by Isolation, identification and estimation.
CO4	Analyse	To analyse industrial production and estimate of important phytoconstituents.
CO5	Remember and understand	To discuss the chemistry and commercial applications of natural crude drugs.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	-	1	-	1	2	1	3	3	2	3	1	1
CO2	3	2	2	3	-	2	1	2	2	2	2	3	2	3	2	1
CO3	3	2	3	3	-	2	1	2	2	2	2	3	2	3	2	1
CO4	3	2	2	3	-	2	2	2	3	3	3	3	3	3	2	1
CO5	3	2	2	3	-	3	2	2	3	3	3	3	3	3	3	1
Avg	3	2	2	3	0	2	1.2	1.8	2.4	2.2	2.6	3	2.4	3	2	1

B.PHARM. SEMESTER – V (BPH)
SUBJECT: PHARMACEUTICAL JURISPRUDENCE–THEORY (BP505T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.

Objectives: Upon completion of the course, the student shall be able to understand:

- The Pharmaceutical legislations and their implications in the development and marketing of Pharmaceuticals.
- Various Indian pharmaceutical Acts and Laws.
- The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.
- The code of ethics during the pharmaceutical practice.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Drugs and Cosmetics Act, 1940 and its rules 1945:** Objectives, Definitions, Legal definitions of schedules to the Act and Rules **Import of drugs –** Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties**.** **Manufacture of drugs –** Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.	**10**	CO3 CO4
[2]	**Drugs and Cosmetics Act, 1940 and its rules 1945.** Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA) **Sale of Drugs –** Wholesale, Retail sale and Restricted license. Offences and penalties **Labeling &Packing of drugs-** General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties. **Administration of the Act and Rules –** Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors.	**10**	CO3 CO4
[3]	**Pharmacy Act –1948**: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences andPenalties **Medicinal and Toilet Preparation Act –1955**: Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties.	**10**	CO3 CO4 CO5

	Narcotic Drugs and Psychotropic substances Act-1985 and Rules: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties.		
[4]	**Study of Salient Features of Drugs and Magic Remedies Act and its rules:** Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties. **Prevention of Cruelty to animals Act-1960:** Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties. **National Pharmaceutical Pricing Authority:** Drugs Price Control Order (DPCO)- 2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM).	**08**	CO3 CO4
[5]	**Pharmaceutical Legislations –** A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee. **Code of Pharmaceutical ethics:** Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath **Medical Termination of Pregnancy Act :** **Right to Information Act:** **Introduction to Intellectual Property Rights (IPR):**	**07**	CO1 CO2 CO3

C. TEXT BOOKS

1. Dua, J. and Sharma, S., "Pharmaceutical Jurisprudence", S Vikas and Company, Pee vee publishers, India, 2019.
2. Jani, GK., "Pharmaceutical Jurisprudence, Forensic Pharmacy", Atul Prakashan, India, 2019

D. REFERENCE BOOKS

1. Jain, NK., "A text book of Forensic Pharmacy" Second edition-Reprint, Vallabh Prakashan, 2007.
2. Mithal, BM., "Text book of Forensic Pharmacy" first edition, Vallabh Prakashan, 1988.
3. Suresh, B.,A text book of "Forensic Pharmacy" 20th edition, Birla publication PVT. LTD., 2019.
4. Governmentf India, Ministry of Health and Family Welfare, "Drugs and Cosmetics Act and Rules" 2016.
5. Dr. Agrawal, SP. And Dr. Khanna, R., " Pharmaceutical Jurisprudence And Ethics" 5th edition, Birla publication PVT. LTD.,2008.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and apply	Describe and apply the Pharmaceutical legislations in the development and marketing of pharmaceuticals.
CO2	Understand, Remember and Apply	Discuss the code of ethics during the pharmaceutical practice.
CO3	Understand and remember	Explain basic principle of Indian pharmaceutical Acts and Laws.
CO4	Understand and remember	Describe the concept of the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.
CO5	Understand, Remember and Apply	Explain and apply Pharmacy act.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	-	2	2	3	2	2	-	3	3	2	1	3	1
CO2	3	1	2	-	2	2	3	2	2	-	3	3	2	1	3	1
CO3	3	2	2	-	2	2	3	2	2	-	3	3	2	2	3	1
CO4	3	2	2	-	2	2	3	2	2	-	3	3	2	2	3	1
CO5	3	2	2	-	2	2	3	2	2	-	3	3	2	2	3	1
Avg	3	1.6	2	-	2	2	3	2	2	-	3	3	2	1.6	3	1

B. PHARM. SEMESTER – V (BPH)
SUBJECT: INDUSTRIAL PHARMACY I -PRACTICAL (BP506P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: Course enables the student to understand and apply various manufacturing techniques to formulate different pharmaceutical dosage forms.

Objectives: Upon completion of the course the student shall be able to

- To design pre-formulation protocol and evaluation of various preformulation parameters for drugs.
- To prepare and evaluate different dosage forms like tablets, capsules, liquids, semisolids, sterile etc.
- To formulate cosmetic products.

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Preformulation studies on paracetamol/aspirin/or any other drug 2. Preparation and evaluation of Paracetamol tablets 3. Preparation and evaluation of Aspirin tablets 4. Coating of tablets- film coating of tables/granules 5. Preparation and evaluation of Tetracycline capsules 6. Preparation of Calcium Gluconate injection 7. Preparation of Ascorbic Acid injection 8. Quality control test of (as per IP) marketed tablets and capsules 9. Preparation of Eye drops/ and Eye ointments 10. Preparation of Creams (cold / vanishing cream) 11. Evaluation of Glass containers (as per IP)	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Goudanavar, Prakash. Practical Manual for Industrial Pharmacy I: As per Syllabus Prescribed by PCI for B. Pharm v Sem; Orange Books Publication, 2020.
2. Patil, Ketan., Patil, Paresh., Patil, Narendra., Kshirsagar, Sandip. The Theory and Practical Book of Industrial Pharmacy-I; Ip Innovative Publication Pvt. Ltd: New Delhi, 2020.

D. REFERENCE BOOKS

1. Kohli, D. P. S.; Shah, D. H. Drug Formulations Manual; Business Horizons: New Delhi, 2012.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply and Create	To apply knowledge of preformulation in designing preformulation protocol and designing dosage forms.
CO2	Create and Evaluate	To prepare and evaluate tablet, capsules, of different APIs
CO3	Create and Evaluate	To prepare and evaluate sterile dosage form like injections and ophthalmic products.
CO4	Create	To prepare cosmetic products.
CO5	Evaluate	Evaluation of packaging materials for dosage forms as per pharmacopoeial standards.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	1	3	2	3	3	3	3	3	3	1
CO2	3	3	3	3	1	2	3	3	3	3	3	3	3	3	3	2
CO3	3	3	3	3	1	2	3	3	3	3	3	3	3	3	3	2
CO4	3	3	3	3	1	3	1	3	3	3	3	3	3	3	3	2
CO5	3	3	3	3	1	2	3	3	3	3	3	3	3	3	3	3
Avg	3	3	3	3	1.2	2.6	2.2	3	3	3	3	3	3	3	3	3

B.PHARM. SEMESTER – V (BPH)
SUBJECT: PHARMACOLOGY-II–PRACTICAL (BP507P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.

Objectives: Upon completion of this course the student should be able to

- Perform different types of bioassay.
- Isolate different organs/tissues from the laboratory animals by simulated experiments.
- Analyse various receptor actions using isolated tissue preparation.
- Evaluate and analyse different types of analgesic and anti-inflammatory drugs
- To evaluate the drugs on different organs/tissues from the laboratory animals by in vivo/in vitro analysis.

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1) Introduction to in-vitro pharmacology and physiological salt solutions. 2) Effect of drugs on isolated frog heart. 3) Effect of drugs on blood pressure and heart rate of dog. 4) Study of diuretic activity of drugs using rats/mice. 5) DRC of acetylcholine using frog rectus abdominis muscle. 6) Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis-muscle and rat ileum respectively. 7) Bioassay of histamine using guinea pig ileum by matching method 8) Bioassay of oxytocin using rat uterine horn by interpolation method. 9) Bioassay of serotonin using rat fundus strip by three point bioassay. 10) Bioassay of acetylcholine using rat ileum/colon by four point bioassay. 11) Determination of PA2value of prazosin using rat anococcygeus muscle (by Schilds plot method). 12) Determination of PD2 value using guinea pig ileum. 13) Effect of spasmogens and spasmolytic using rabbit jejunum. 14) Anti-inflammatory activity of drugs using carrageenan induced paw-oedema model. 15) Analgesic activity of drug using central and peripheral methods.	**60**	CO1, CO2, CO3, CO4, CO5.

C. TEXT BOOKS

1. Tripathi, K. D. *Essentials of Medical Pharmacology*; Jaypee Brothers Medical Publishers: New Delhi, 2019.

D. REFERENCE BOOKS

1. Ritter, J.; Flower, R. J.; Henderson, G.; Yoon Kong Loke; Rang, H. P. *Rang and Dale's Pharmacology*, 9th ed.; Elsevier: Endinburgh, 2020.
2. Katzung, B. G. *Basic & Clinical Pharmacology*, 14th ed.; Mcgraw-Hill Education, Copyright: New York I 11 Pozostałych, 2018.
3. Louis Sanford Goodman; Gilman, A.; Brunton, L. L.; Chabner, B. A.; KnollmannB. C. *Goodman & Gilman's the Pharmacological Basis of Therapeutics*; Mcgraw-Hill Medical: New York, 2011.
4. Al, E. *Applied Therapeutics: The Clinical Use of Drugs*; Wolters Kluwer Health - Lippincott Williams & Wilkins, Cop: Philadelphia, 2013.
5. *Lippincott's Illustrated Reviews Bundle Lippincott's Illustrated Reviews: Biochemistry, 4th Ed + Lippincott's Illustrated Reviews, Pharmacology, North American Edition, 4th Ed + Lippincott's.*; Lippincott Williams & Wilkins, 2009.
6. Hl Sharma; Kk Sharma. *Principles of Pharmacology*; Paras: New Delhi, 2011.
7. Craig, C. R.; Stitzel, R. E. *Modern Pharmacology with Clinical Applications*; Lippincott Williams & Wilkins: Philadelphia, 2004.
8. *Fundamentals of Experimental Pharmacology*; Hilton & Company: Kolkata, 2015.
9. Kulkarni, S. *Handbook of Experimental Pharmacology*, 3rd Edition. Vallabh Prakashan: Delhi, 2005.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Perform, Apply and Quantify.	Perform different types of bioassay.
CO2	Understand and Isolate	Isolate different organs/tissues from the laboratory animals by simulated experiments.
CO3	Analyse	Analyse various receptor actions using isolated tissue preparation.
CO4	Analyse an Evaluate.	Evaluate and analyse different types of analgesic and anti-inflammatory drugs
CO5	Evaluate and analyse	To evaluate the drugs on different organs/tissues from the laboratory animals by in vivo/in vitro analysis.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3	3	3	3	3	3	2	3	3	3	3	3
CO2	3	2	3	3	3	3	2	3	3	3	3	3	2	2	3	3
CO3	3	2	3	3	3	3	2	3	3	2	2	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	2	2	3	1	3	2	3
CO5	3	2	3	3	3	3	3	3	3	2	2	3	2	3	2	3
Avg	3	2	3	3	3	3	2.4	3	3	2.4	2.8	3	2.4	2.8	2.6	3

B. PHARM. SEMESTER – V (BPH)
SUBJECT: PHARMACOLOGY-II–PRACTICAL (BP507P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.

Objectives: Upon completion of this course the student should be able to

- Understand the mechanism of drug action and its relevance in the treatment of different diseases
- Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
- Demonstrate the various receptor actions using isolated tissue preparation
- Appreciate correlation of pharmacology with related medical sciences

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	1) Introduction to in-vitro pharmacology and physiological salt solutions. 2) Effect of drugs on isolated frog heart. 3) Effect of drugs on blood pressure and heart rate of dog. 4) Study of diuretic activity of drugs using rats/mice. 5) DRC of acetylcholine using frog rectus abdominis muscle. 6) Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis-muscle and rat ileum respectively. 7) Bioassay of histamine using guinea pig ileum by matching method 8) Bioassay of oxytocin using rat uterine horn by interpolation method. 9) Bioassay of serotonin using rat fundus strip by three point bioassay. 10) Bioassay of acetylcholine using rat ileum/colon by four point bioassay. 11) Determination of PA2value of prazosin using rat anococcygeus muscle (by Schilds plot method). 12) Determination of PD2 value using guinea pig ileum. 13) Effect of spasmogens and spasmolytic using rabbit jejunum. 14) Anti-inflammatory activity of drugs using carrageenan induced paw-oedema model. 15) Analgesic activity of drug using central and peripheral methods.	**45**	CO1, CO2, CO3, CO4, CO5.

C. TEXT BOOKS

1. Tripathi, K. D. *Essentials of Medical Pharmacology*; Jaypee Brothers Medical Publishers: New Delhi, 2019.

D. REFERENCE BOOKS

1. Ritter, J.; Flower, R. J.; Henderson, G.; Yoon Kong Loke; Rang, H. P. *Rang and Dale's Pharmacology*, 9th ed.; Elsevier: Endinburgh, 2020.
2. Katzung, B. G. *Basic & Clinical Pharmacology*, 14th ed.; Mcgraw-Hill Education, Copyright: New York I 11 Pozostałych, 2018.
3. Louis Sanford Goodman; Gilman, A.; Brunton, L. L.; Chabner, B. A.; KnollmannB. C. *Goodman & Gilman's the Pharmacological Basis of Therapeutics*; Mcgraw-Hill Medical: New York, 2011.
4. Al, E. *Applied Therapeutics: The Clinical Use of Drugs*; Wolters Kluwer Health - Lippincott Williams & Wilkins, Cop: Philadelphia, 2013.
5. *Lippincott's Illustrated Reviews Bundle Lippincott's Illustrated Reviews: Biochemistry, 4th Ed + Lippincott's Illustrated Reviews, Pharmacology, North American Edition, 4th Ed + Lippincott's.*; Lippincott Williams & Wilkins, 2009.
6. Hl Sharma; Kk Sharma. *Principles of Pharmacology*; Paras: New Delhi, 2011.
7. Craig, C. R.; Stitzel, R. E. *Modern Pharmacology with Clinical Applications*; Lippincott Williams & Wilkins: Philadelphia, 2004.
8. *Fundamentals of Experimental Pharmacology*; Hilton & Company: Kolkata, 2015.
9. Kulkarni, S. *Handbook of Experimental Pharmacology*, 3rd Edition. Vallabh Prakashan: Delhi, 2005.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Perform, Apply and Quantify.	Perform different types of bioassay.
CO2	Understand and Isolate	Isolate different organs/tissues from the laboratory animals by simulated experiments.
CO3	Analyse	Analyse various receptor actions using isolated tissue preparation.
CO4	Analyse an Evaluate.	Evaluate and analyse different types of analgesic and anti-inflammatory drugs
CO5	Evaluate and analyse	To evaluate the drugs on different organs/tissues from the laboratory animals by in vivo/in vitro analysis.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	3	3	-	-	3	3	3	-	-	3	3	3	3	3
CO2	3	-	3	3	-	-	3	3	3	-	-	3	2	2	3	3
CO3	3	-	3	3	-	-	3	3	3	-	-	3	3	3	3	3
CO4	3	-	3	3	-	-	3	3	3	-	-	3	1	3	2	3
CO5	3	1	3	3	-	-	3	3	3	-	-	3	2	3	2	3
Avg	3	0.4	3	3	-	-	3	3	3	-	-	3	2.4	2.8	2.6	3

B. PHARM. SEMESTER – VI (BPH)
SUBJECT: MEDICINAL CHEMISTRY III -THEORY (BP601T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

Objectives: Upon completion of the course student shall be able to

- Understand the importance of drug design and different techniques of drug design.
- Understand the chemistry of drugs with respect to their biological activity.
- Know the metabolism, adverse effects and therapeutic value of drugs.
- Know the importance of SAR of drugs.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Classification, mechanism of action, uses, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*) of following class of drugs in all units.** **Antibiotics** Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. **β-Lactam antibiotics:** Penicillin, Cepholosporins, β- Lactamase inhibitors, Monobactams **Aminoglycosides:** Streptomycin, Neomycin, Kanamycin **Tetracyclines:** Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline	**10**	CO1 CO2 CO3 CO4
[2]	**Antibiotics** **Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.** **Macrolide:** Erythromycin Clarithromycin, Azithromycin **Miscellaneous:** Chloramphenicol*, Clindamycin **Prodrugs:** Basic concepts and application of prodrugs design **Antimalarials:** Etiology of malaria **Quinolines:** SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine **Biguanides and dihydro triazines:** Cycloguanil pamoate, Proguanil **Miscellaneous:** Pyrimethamine, Artesunete, Artemether, Atovoquone	**10**	CO1 CO2 CO3 CO4 CO5
[3]	**Anti-tubercular Agents**	**10**	CO1

	Synthetic anti tubercular agents: Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.* **Anti tubercular antibiotics:** Rifampicin, Rifabutin, Cycloserine Streptomycine, Capreomycin sulphate **Urinary tract anti-infective agents** **Quinolones:** SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin **Miscellaneous:** Furazolidine, Nitrofurantoin*, Methanamine **Antiviral agents:** Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirdine, Ribavirin, Saquinavir, Indinavir, Ritonavir		CO2 CO3 CO4 CO5
[4]	**Antifungal agents:** **Antifungal antibiotics:** Amphotericin-B, Nystatin, Natamycin, Griseofulvin. **Synthetic Antifungal agents:** Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*. **Anti-protozoal Agents:** Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine. **Anthelmintics:** Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin. **Sulphonamides and Sulfones** Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine **Folate reductase inhibitors:** Trimethoprim*, Cotrimoxazole **Sulfones:** Dapsone*	**08**	CO1 CO2 CO3 CO4 CO5
[5]	**Introduction to Drug Design** Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis. **Pharmacophore modeling and docking techniques**. **Combinatorial Chemistry:** Concept and applications chemistry: solid phase and solution phase synthesis.	**07**	CO1

C. TEXT BOOKS

1. Alagarsamy, V. Textbook of Medicinal Chemistry, Volume I and Volume II, 3rd ed.; CBS Publishers, India, 2016
2. Kadam, S.S., Mahadik, K.R., Bothara, K.G. Principles of Medicinal Chemistry, Volume I and II, 20th ed.; Nirali Prakashan, India, 2010

D. REFERENCE BOOKS

1. Hansch, C., Semmes, P.G., Taylor, J.B. Comprehensive Medicinal Chemistry, Volume I to VI, 1st ed.; Elsevier, India, 2005
2. Abraham, D.J. Burger's Medicinal Chemistry and Drug Discovery, Volume I to VI, 6th ed.; Wiley-Interscience, New Jersey, 2003
3. Lendnicer, D., Mitscher, L.A. The Organic Chemistry of Drug Synthesis, Volume I to VI, Wiley-Interscience, New Jersey, 2008
4. Johnson, D.S., Li, J.J. Art of Drug Synthesis, 1st ed,; Wiley-Interscience, New Jersey, 2007
5. Patrick, G.L. An Introduction to Medicinal Chemistry, 3rd ed.; Oxford University Press, Oxford, 2006
6. Silverman, R.B. The Organic Chemistry of Drug Design and Drug Action, 2nd ed,; Academic Press, Burlington, 2004
7. Lemke, T.L., Williams, D.A. FOYE'S Principles of Medicinal Chemistry, 7th ed.; Lippincott Williams & Wilkins, Baltimore, 2013
8. Baele, J.M., Block J. H. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 12th ed.; Lippincott Williams & Wilkins; Baltimore, 2011
9. Smith, J.H., Williams, H. Smith and Williamson's Introduction to the Principles of Drug Design and Action, 3rd ed; CRC Press, The Netherlands, 2005
10. Vardanyan, R., Hruby, V. Synthesis of Essential Drugs, Volume I & II, 1st ed.; Elsevier, The Netherlands, 2006

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To explain the fundamentals of drug design, different techniques of drug design and combinatorial chemistry
CO2	Understand and remember	To describe classification and chemistry of drugs
CO3	Understand and remember	To discuss action of drugs, their metabolism, adverse effects and therapeutic value of drugs
CO4	Analysis	To explain structural activity relationship of different class of drugs
CO5	Apply	To describe synthesis of selected drugs

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	1	2	-	-	-	-	-	-	3	2	2	3	2	1
CO2	3	-	2	1	-	-	-	-	-	-	3	2	3	2	1	1
CO3	3	-	2	2	-	-	-	-	-	-	3	2	2	3	1	1
CO4	3	-	2	1	-	-	-	-	-	-	3	2	1	3	2	1
CO5	3	3	3	3	3	-	-	-	-	3	3	2	2	3	2	3
Avg	3	0.6	2	1.8	0.6	-	-	-	-	0.6	3	2	2	2.8	1.6	1.4

B. PHARM. SEMESTER – VI (BPH)
SUBJECT: PHARMACOLOGY-III–THEORY (BP602T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition, emphasis on the principles of toxicology and Chrono pharmacology.

Objectives: Upon completion of this course the student should be able to:

- understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
- comprehend the principles of toxicology and treatment of various poisonings and
- appreciate correlation of pharmacology with related medical sciences

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Pharmacology of drugs acting on Respiratory system** a.Anti-asthmatic drugs b.Drugs used in the management of COPD c.Expectorants and antitussives d.Nasal decongestants e.Respiratory stimulants **Pharmacology of drugs acting on the Gastrointestinal Tract** a. Antiulcer agents. b. Drugs for constipation and diarrhoea. c. Appetite stimulants and suppressants. d. Digestants and carminatives. e. Emetics and anti-emetics.	**10**	CO1, CO2, CO3.
[2]	**Chemotherapy** a. General principles of chemotherapy. b. Sulphonamides and cotrimoxazole. c. Antibiotics- Penicillin's, cephalosporin's, chloramphenicol, macrolides, quinolones and fluoroquinolones, tetracycline and aminoglycosides	**10**	CO1, CO2, CO3.
[3]	**Chemotherapy** a. Anti-tubercular agents b. Anti-leprotic agents c. Anti-fungal agents d. Antiviral drugs e. Anthelmintics f. Antimalarial drugs g. Anti-amoebic agents	**10**	CO1, CO2, CO3.
[4]	**Chemotherapy** Urinary tract infections and sexually transmitted diseases. Chemotherapy of malignancy.	**08**	CO4, CO5.

	Immunopharmacology a.Immunostimulants b. Immunosuppressant Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilar.		
[5]	**Principles of toxicology** a. Definition and basic knowledge of acute, subacute and chronic toxicity. b.Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity c. General principles of treatment of poisoning. d.Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning. **Chronopharmacology** a.Definition of rhythm and cycles. b.Biological clock and their significance leading to chronotherapy.	**07**	CO4, CO5.

C. TEXT BOOKS

1. Tripathi, K. D. *Essentials of Medical Pharmacology*; Jaypee Brothers Medical Publishers: New Delhi, 2019.

D. REFERENCE BOOKS

1. Ritter, J.; Flower, R. J.; Henderson, G.; Yoon Kong Loke; Rang, H. P. *Rang and Dale's Pharmacology*, 9th ed.; Elsevier: Endinburgh, 2020.
2. Katzung, B. G. *Basic & Clinical Pharmacology*, 14th ed.; Mcgraw-Hill Education, Copyright: New York I 11 Pozostałych, 2018.
3. Louis Sanford Goodman; Gilman, A.; Brunton, L. L.; Chabner, B. A.; KnollmannB. C. *Goodman & Gilman's the Pharmacological Basis of Therapeutics*; Mcgraw-Hill Medical: New York, 2011.
4. Al, E. *Applied Therapeutics: The Clinical Use of Drugs*; Wolters Kluwer Health - Lippincott Williams & Wilkins, Cop: Philadelphia, 2013.
5. *Lippincott's Illustrated Reviews Bundle Lippincott's Illustrated Reviews: Biochemistry, 4th Ed + Lippincott's Illustrated Reviews, Pharmacology, North American Edition, 4th Ed + Lippincott's.*; Lippincott Williams & Wilkins, 2009.
6. Hl Sharma; Kk Sharma. *Principles of Pharmacology*; Paras: New Delhi, 2011.
7. Craig, C. R.; Stitzel, R. E. *Modern Pharmacology with Clinical Applications*; Lippincott Williams & Wilkins: Philadelphia, 2004.
8. *Fundamentals of Experimental Pharmacology*; Hilton & Company: Kolkata, 2015.
9. Kulkarni, S. *Handbook of Experimental Pharmacology*, 3rd Edition. Vallabh Prakashan: Delhi, 2005.
10. N Udupa; Gupta, P. D. *Concepts in Chronopharmacology*; Shyam Prakashan: Jaipur, 2009.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Apply	Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases.
CO2	Understand and Apply	Understand the resistance mechanism of drug action in the treatment of different infectious diseases.
CO3	Remember, Evaluate and Apply	Select the drug, its necessity, frequency, duration, prophylaxis and test for cure of the treatment of infectious diseases.
CO4	Understand, Remember and Apply	Appreciate correlation of pharmacology with related medical sciences and Chrono-pharmacology.
CO5	Understand, Evaluate and analyse	Comprehend the principles of toxicology and treatment of various poisonings.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	3	3	3	2	3	1	3	1	3	3	-	3	3	3
CO2	3	-	3	3	3	1	3	1	3	3	2	3	-	3	3	3
CO3	3	1	3	3	2	2	3	2	3	2	2	3	-	3	3	3
CO4	3	1	3	3	3	1	3	3	3	3	3	3	-	3	3	3
CO5	3	1	3	3	3	2	3	1	3	1	3	3	-	3	3	3
Avg	3	0.6	3	3	2.8	1.6	3	1.6	3	2.2	2.6	3	-	3	3	3

B. PHARM. SEMESTER – VI (BPH)
SUBJECT: HERBAL DRUG TECHNOLOGY–THEORY (BP603T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing
Practices (GMP), patenting and regulatory issues of herbal drugs
Objectives: Upon completion of this course the student should be able to:

- Understand raw material as source of herbal drugs from cultivation to herbal drug product
- Know the WHO and ICH guidelines for evaluation of herbal drugs
- Know the herbal cosmetics, natural sweeteners, nutraceuticals
- Appreciate patenting of herbal drugs, GMP.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Herbs as raw materials** Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation. Source of Herbs, Selection, identification and authentication of herbal materials Processing of herbal raw material **Biodynamic Agriculture** Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides. **Indian Systems of Medicine** a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asavas, Ghutika,Churna, Lehya and Bhasma.	**11**	CO1 CO5
[2]	**Nutraceuticals** General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. Study of following herbs as health food: Alfalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina **Herbal-Drug and Herb-Food Interactions:** General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.	**07**	CO3
[3]	**Herbal Cosmetics** Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products. **Herbal excipients:**	**10**	CO3 CO5

	Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes. **Herbal formulations :** Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes		
[4]	**Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. **Patenting and Regulatory requirements of natural products:** a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. **Regulatory Issues** - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.	**10**	CO2 CO4
[5]	**General Introduction to Herbal Industry** Herbal drugs industry: Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India. **Schedule T–Good Manufacturing Practice of Indian systems of medicine** Components of GMP (Schedule–T) and its objectives, Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.	**07**	CO3 CO4

C. TEXT BOOKS

1. Dr. Arora, P. &Dr. Arora, V., A text book of "Herbal Drug Technology" Pee Vee Books, S. Vikas & Company (Medical Publishers) ,2019.
2. Dr. Lodhi, S., Dr. Usman, R. Md ., Dr. Deshmukh Ta., Darvekar, VM. &Dr. Kori ML., "Herbal Drug Technology", 1st Edition, Nirali Prakashan, 2019.

D. REFERENCE BOOKS

1. Dr. Mukherjee, PK. &Dr.Verpoorte, R., "GMP for Botanicals" 1st Edition, Business Horizons Pharmaceutical Publishers, 2003.
2. Dr. Mukherjee, PK."Quality Control of Herbal Drugs: An Approach to Evaluation of botanicals" 1st Edition reprint, Elsevier Science Publication, 2017.
3. Agrawal, SS. &Paridhavi M., "Herbal Drug Technology" 2nd edition, Orient Blackswan , 2012.
4. Shah, B., & Seth, AK., "Textbook of Pharmacognosy & Phytochemistry" , 2nd Edition, CBS Publishers & Distributors PVT. Ltd., 2017.
5. Rangari VD., "Pharmacognosy & Phytochemistry" Volume-I 3rd Edition, Career Publications, 2017.
6. Rangari VD., "Pharmacognosy & Phytochemistry" Volume-II 3rd Edition, Career Publications, 2017.
7. Quadry, JS., "Textbook of Pharmacognosy (Theory & Practical)" 17th Edition, CBS Publishers & Distributors PVT. Ltd., 2020.
8. Dr. Shinde, VM. & Mrs. Bodas-yadav, KS., "Herbal Drug Technology", 2nd edition, Nirali Prakashan, 2020.
9. Dr. Tiwari V., "Herbal Drug Technology", 1st edition, Nirali Prakashan, 2020.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Remember	Describe concept of raw material as source of herbal drugs from cultivation for herbal drug production.
CO2	Understand, Remember and Apply	Application of WHO and ICH guidelines for standardisation of herbal drugs.
CO3	Understand and Remember	Explain the concept of herbal medicines, Herbal cosmetics and neutraceuticals and herbal industry.
CO4	Understand and Apply	Describe Good manufacturing practice, Patenting and Regulatory requirements of natural products.
CO5	Understand and Analyse	Detail description and analysis of various ayurvedic formulations.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	-	2	2	1	2	1	3	3	2	2	-	1
CO2	3	2	2	2	-	2	3	1	2	1	3	3	2	2	3	1
CO3	3	2	2	2	-	2	2	1	3	1	3	3	2	2	-	1
CO4	3	2	2	2	-	2	3	1	3	1	3	3	2	2	3	1
CO5	3	2	2	2	-	2	2	1	2	1	3	3	2	2	3	1
Avg	3	2	2	2	-	2	2.4	1	2.4	1	3	3	2	2	1.8	1

B. PHARM. SEMESTER – VI (BPH)

SUBJECT: BIOPHARMACEUTICS AND PHARMACOKINETICS-THEORY (BP604T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arised therein.

Objectives: Upon completion of the course student shall be able to:

- Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
- Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
- To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
- Understand various pharmacokinetic parameters, their significance & applications.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Introduction to Biopharmaceutics** **Absorption**; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non-per oral extra-vascular routes. **Distribution** Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs	**10**	CO1
[2]	**Elimination:** Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non-renal routes of drug excretion of drugs **Bioavailability and Bioequivalence:** Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.	**10**	CO1 CO5
[3]	**Pharmacokinetics:** Definition and introduction to Pharmacokinetics, Compartment models, Non-compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - KE ,t1/2,Vd,AUC,Ka, Clt and CLR- definitions methods of eliminations, understanding of their significance and application.	**08**	CO1 CO2 CO5
[4]	**Multicompartment models:** Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and mainetnance doses and their significance in clinical settins.	**8**	CO2 CO4
[5]	**Nonlinear Pharmacokinetics:**	**7**	CO2

	a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.		CO4

C. TEXT BOOKS

1. Brahankar, D. M.; Jaiswal, S. B. *Biopharmaceutics and Pharmacokinetics : A Treatise*; Vallabh Prakashan: Delhi, 2014.

D. REFERENCE BOOKS

1. Abdou, H. M. Dissolution, Bioavailability and Bioequivalence; Mack Publishing Company: Easton, 1989.
2. Gibaldi, M. Biopharmaceutics and Clinical Pharmacokinetics; Lea & Febiger: Philadelphia, 1984.
3. Gibaldi, M.; Perrier, D. Pharmacokinetics; Infroma Healthcare: New York, 2007.
4. Notari, R. E. Biopharmaceutics and Pharmacokinetics : An Introduction; M. Dekker: New York, 1975.
5. Notari, R. E. Biopharmaceutics and Clinical Pharmacokinetics : An Introduction; M. Dekker: New York, 1987.
6. Remington, J. P.; Gennaro, A. R. Remington's Pharmaceutical Sciences; Mack Pub. Co: Easton, Pa., 1990.
7. Rowland, M.; Tozer, T. N. Clinical Pharmacokinetics and Pharmacodynamics : Concepts and Applications; Wolters Kluwer-Lippincott William & Wilkins: Philadelphia, 2011.
8. Shargel, L.; Yu, A. B. C. Applied Biopharmaceutics & Pharmacokinetics; Mcgraw-Hill Education: Singapore, 2016.
9. Gibaldi M and Prescott L, Hand Book of Clinical Pharmacokinetics, ADIS Health Science Press, 1989
10. Swarbrick, Biopharmaceutics, Lea & Febiger,U.S.,1971

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remember and Understand	Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
CO2	Understand and Apply	To understand and apply plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
CO3	Understand	To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
CO4	Understand and Remember	To understand various pharmacokinetic parameters and their significance.
CO5	Apply and evaluate	To apply the IVIVC co-relation for different dosage forms.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2	1	2	1	2	2	3	3	3	3	2	2
CO2	3	2	3	3	1	2	-	2	2	1	2	3	3	3	2	2
CO3	3	2	2	3	2	2	2	2	-	1	3	3	3	3	2	2
CO4	3	2	2	3	1	1	-	3	-	2	3	3	2	2	2	2
CO5	3	3	3	3	2	1	2	3	2	2	2	3	3	3	1	2
Avg	3	2.2	2.6	3	1.6	1.4	1.2	2.2	1.2	1.6	2.6	3	2.8	2.8	1.8	2

B. PHARM. SEMESTER – VI (BPH)
SUBJECT: PHARMACEUTICAL BIOTECHNOLOGY-THEORY (BP605T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: Course enables the student to learn biotechnology, long promise to revolutionize the biological sciences and technology. Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technology makes the subject interesting. Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs. Biotechnology has already produced transgenic crops and animals and the future promises a lot more. It is basically a research-based subject.
Objectives: Upon completion of the course the student shall be able to understand Enzymes, Genetic engineering and fermentation technology and importance of biotechnology in industry.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences. b) Enzyme Biotechnology- Methods of enzyme immobilization and applications. c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries. d) Brief introduction to Protein Engineering. e) Use of microbes in industry. Production of Enzymes- General consideration Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase. f) Basic principles of genetic engineering.	**10**	CO1
[2]	a) Study of cloning vectors, restriction endonucleases and DNA ligase. b) Recombinant DNA technology. Application of genetic engineering in medicine. c) Application of r DNA technology and genetic engineering in the production of: i) Interferon ii) Vaccines- hepatitis- B iii) Hormones- Insulin. d) Brief introduction to PCR	**10**	CO2 CO3
[3]	Types of immunity- humoral immunity, cellular immunity a) Structure of Immunoglobulins b) Structure and Function of MHC c) Hypersensitivity reactions, Immune stimulation and Immune suppressions. d) General method of the preparation of bacterial vaccines, toxoids, viral vaccines, antitoxins, serum-immune blood derivatives and other products relative to immunity. e) Storage conditions and stability of official vaccines f) Hybridoma technology- Production, Purification and Applications	**10**	CO5
[4]	a) Immunoblotting techniques- ELISA, Western blotting, Southern blotting. b) Genetic organization of Eukaryotes and Prokaryotes	**08**	CO2 CO5

	c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons. d) Introduction to Microbial biotransformation and applications. **e)** Mutation: Types of mutation/mutants.		
[5]	a) Fermentation methods and general requirements, study of media, equipment, sterilization methods, aeration process, stirring. b) Large scale production fermenter design and its various controls. c) Study of the production of - penicillin, citric acid, Vitamin B12, Glutamic acid, Griseofulvin, d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma substitutes.	**07**	CO4

C. TEXT BOOKS

1. Primrose, S. B. *Molecular Biotechnology*; Blackwell Scientific Publications: Oxford ; Boston, 2001.
2. Stanbury, P. F.; Whitaker, A.; Hall, S. J. *Principles of Fermentation Technology*; 2017.

D. REFERENCE BOOKS

1. Glick, B. R.; Patten, C. L. *Molecular Biotechnology: Principles and Applications of Recombinant DNA*; Asm Press: Washington, Dc, 2017.
2. Kindt, T. J.; Goldsby, R. A.; Anne, B. *Kuby Immunology*; W.H. Freeman and Company: New York, 2007.
3. Goding, J. W. *Monoclonal Antibodies: Principles and Practice: Production and Application of Monoclonal Antibodies in Cell Biology, Biochemistry and Immunology.*; Academic Press: London, 1996.
4. Walker, J. M.; Gingold, E. B. *Molecular Biology and Biotechnology*; Royal Society of Chemistry: London, 1993.
5. Zaborsky, O. R. *Immobilized Enzymes*; Krieger: Malabar, Fla., 1984.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remember and Understand	To Understand the importance of Immobilized enzymes in Pharmaceutical Industries.
CO2	Remember and Understand	To learn genetic engineering applications in relation to production of pharmaceuticals
CO3	Understand and Apply	To learn Importance of Monoclonal antibodies in Industries
CO4	Understand and Remember	To learn the use of microorganisms in fermentation technology
CO5	Understand	To learn antigen-antibody reaction and immunity of Human system

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	–	1	3	–	-	1	1	1	3	3	3	3	3	2	3
CO2	2	–	2	3	–	1	1	1	2	3	3	2	3	3	3	3
CO3	2	–	2	3	–	-	1	1	2	3	3	3	3	3	3	3
CO4	2	–	2	3	–	2	1	1	2	3	3	3	3	3	2	3
CO5	2	–	2	2	–	2	2	1	1	2	2	1	2	3	1	1
Avg	2	–	1.8	2.8	–	1	1.2	1	1.6	2.8	2.8	2.4	2.8	3	2.2	2.6

B. PHARM. SEMESTER – VI (BPH)
SUBJECT: INSTRUMENTAL METHODS OF ANALYSIS - THEORY (BP606T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.

Objectives: Upon completion of the course student shall be able to:

- understand the cGMP aspects in a pharmaceutical industry
- appreciate the importance of documentation
- understand the scope of quality certifications applicable to pharmaceutical industries
- understand the responsibilities of QA & QC departments

B. COURSE CONTENT

NO	TOPIC	L Hrs)	COs
[1]	**Quality Assurance and Quality Management concepts:** Definition and concept of Quality control, Quality assurance and GMP **Total Quality Management (TQM):** Definition, elements, philosophies **ICH Guidelines**: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines **Quality by design (QbD)**: Definition, overview, elements of QbD program, tools **ISO 9000 & ISO14000**: Overview, Benefits, Elements, steps for registration **NABL accreditation:** Principles and procedures	**10**	CO1 CO3
[2]	**Organization and personnel:** Personnel responsibilities, training, hygiene and personal records. **Premises:** Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination. **Equipments and raw materials:** Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.	**10**	CO1 CO3 CO4
[3]	**Quality Control:** Quality control test for containers, rubber closures and secondary packing materials. **Good Laboratory Practices:** General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities	**10**	CO3 CO4
[4]	**Complaints:** Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal. **Document maintenance in pharmaceutical industry:** Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.	**08**	CO2
[5]	**Calibration and Validation:** Introduction, definition and general principles of calibration, qualification and validation, importance and	**07**	CO5

	scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation. **Warehousing:** Good warehousing practice, materials management		

C. TEXT BOOKS

1. P P Sharma. *How to Practice GMPs*, 6th ed.; vandana publications Pvt. Ltd.: Delhi, 2010.
2. Hirsch, A. F. *Good Laboratory Practice Regulations*; M. Dekker: New York ; Basel, 1989.

D. REFERENCE BOOKS

1. Weinberg, S. *Good Laboratory Practice Regulations*; M. Dekker: New York, 1995.
2. World Health Organization. *Quality Assurance of Pharmaceuticals. 2: A Compendium of Guidelines and Related Materials*; 1999.
3. World Health Organization. Pharmaceuticals Programme. The International pharmacopoeia = Pharmacopoeia Internationalis. Vol. 4, Tests, methods and general requirements: quality specifications for pharmaceutical substances, excipients and dosage forms
4. ICH Official web site: ICH http://www.ich.org/.
5. ISO. ISO 14000 Environmental management https://www.iso.org/iso-14001-environmental-management.html.
6. Ghosh S K; Maitra K. *A Guide to Total Quality Management*, 4th ed.; Oxford Publishing House, 2005.
7. S K Ghosh. *Introduction to ISO 9000 and Total Quality Management*, 4th ed.; Oxford Publishing House, 2007.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To understand the cGMP, GLP and ICH aspects in a pharmaceutical industry
CO2	Understand Apply and Evaluate	To understand and appreciate the importance of QbD and documentation
CO3	Understand and remember	To understand the scope of quality certifications applicable to pharmaceutical industries
CO4	Understand and remember	To understand the responsibilities of QA & QC departments
CO5	Understand Apply and Evaluate	To learn the aspects of calibration, validation and Material management

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	-	-	3	3	2	2	-	3	3	3	1	2	3
CO2	3	2	2	2	-	3	3	2	2	-	3	3	3	1	2	3
CO3	3	2	1	-	-	3	3	2	2	2	3	3	3	1	2	3
CO4	3	2	1	-	2	3	3	2	2	-	3	3	3	1	2	3
CO5	3	2	1	-	-	2	2	2	2	2	3	3	3	1	2	2
Avg	3	2	1.2	0.4	0.4	2.8	2.8	2	2	0.8	3	3	3	1	2	2.8

B. PHARM. SEMESTER – VI (BPH)
SUBJECT: MEDICINAL CHEMISTRY III -PRACTICAL (BP607P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	-	05	10	50

A. COURSE OVERVIEW

Medicinal Chemistry III practical subject imparts practical knowledge regarding synthesis and analysis of drugs by various methods via experiments in laboratory. The subject also focuses on chemical structure, reaction and mechanism drawing experiment using various offline and online tools. Experiments involving prediction of various physicochemical properties-drug likeness properties would help to understand important aspect of drug design.

Objectives: Upon completion of the course student shall be able to

- Use ChemDraw for chemical structure and reaction drawing
- Synthesize and purify organic compounds
- Perform analysis of drugs using various analytical methods

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	**Preparation of drugs and intermediates** 1 Sulphanilamide 2 7-Hydroxy, 4-methyl coumarin 3 Chlorobutanol 4 Triphenyl imidazole 5 Tolbutamide 6 Hexamine **Assay of drugs** 1 Isonicotinic acid hydrazide 2 Chloroquine 3 Metronidazole 4 Dapsone 5 Chlorpheniramine maleate 6 Benzyl penicillin **Preparation of medicinally important compounds or intermediates by Microwave irradiation technique** **Drawing structures and reactions using chem draw** **Determination of physicochemical properties** such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinski's RO5)	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Kar, A. Advanced Practical Medicinal Chemistry, 3rd ed.; New Age International Publishers, India, 2020
2. Vogel, A.I., Tatchell, A.R., Furniss, B.S., Smith, P.W.G. Text book of practical organic chemistry, 5th ed.; Longman Scientific and Technical; New York, 2011

C. REFERENCE BOOKS

1. Lendnicer, D., Mitscher, L.A. The Organic Chemistry of Drug Synthesis, Volume I to VI, Wiley-Interscience, New Jersey, 2008
2. Mann, F.G., Saunders, B.G., Practical Organic Chemistry, 4th ed.; Pearson, India, 2009

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply, analysis and evaluate	To assess the drug-likeness properties of drugs using various online tools
CO2	Understand and apply	To draw chemical structure, reaction and mechanism drawing using offline and online tools
CO3	Apply	To synthesize some drugs and intermediates by conventional synthesis
CO4	Apply	To perform synthesis of selected drugs by microwave assisted organic synthesis technique
CO5	Apply and evaluate	To carry out analysis of various drugs

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	2	3	1	-	-	-	-	-	3	2	2	3	2	1
CO2	2	1	1	3	-	-	-	-	-	-	3	1	2	1	1	1
CO3	3	2	3	3	1	-	-	-	-	3	3	3	3	2	2	3
CO4	3	2	3	3	1	-	-	-	-	3	3	3	3	2	2	3
CO5	3	2	3	3	1	-	-	-	-	3	3	3	3	2	2	1
Avg	2.8	1.4	2.4	3	0.8	-	-	-	-	1.2	3	2.4	2.6	2	1.8	1.8

B. PHARM. SEMESTER – VI (BPH)
SUBJECT: PHARMACOLOGY-III–PRACTICAL (BP608P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition, emphasis on the principles of toxicology and Chrono pharmacology.

Objectives: Upon completion of this course the student should be able to:

- Evaluate different types of toxicity studies.
- Apply different types of statistical analysis in different pharmacological experiments.
- Analyse and evaluate various receptor actions using isolated tissue preparation.
- Create the observation data and correlate them using statistical analysis.
- To evaluate the drugs on different organs/tissues from the laboratory animals by in vivo/in vitro analysis.

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1) Dose calculation in pharmacological experiments. 2) Anti-allergic activity by mast-cell stabilization assay. 3) Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model. 4) Study of effect of drugs on gastrointestinal motility. 5) Effect of agonist and antagonists on guinea pig ileum. 6) Estimation of serum biochemical parameters by using semi- auto analyser. 7) Effect of saline purgative on frog intestine. 8) Insulin hypoglycaemic effect tin rabbit. 9) Test for pyrogens (rabbit method). 10) Determination of acute oral toxicity (LD50) of a drug from a given data. 11) Determination of acute skin irritation / corrosion of a test substance. 12) Determination of acute eye irritation /corrosion of a test substance. 13) Calculation of pharmacokinetic parameters from a given data. 14) Biostatistics methods in experimental pharmacology (student's t test, ANOVA) 15) Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)	**60**	CO1, CO2, CO3, CO4, CO5.

C. TEXT BOOKS

1. Tripathi, K. D. *Essentials of Medical Pharmacology*; Jaypee Brothers Medical Publishers: New Delhi, 2019.

D. REFERENCE BOOKS

1. Ritter, J.; Flower, R. J.; Henderson, G.; Yoon Kong Loke; Rang, H. P. *Rang and Dale's Pharmacology*, 9th ed.; Elsevier: Endinburgh, 2020.
2. Katzung, B. G. *Basic & Clinical Pharmacology*, 14th ed.; Mcgraw-Hill Education, Copyright: New York I 11 Pozostałych, 2018.
3. Louis Sanford Goodman; Gilman, A.; Brunton, L. L.; Chabner, B. A.; KnollmannB. C. *Goodman & Gilman's the Pharmacological Basis of Therapeutics*; Mcgraw-Hill Medical: New York, 2011.
4. Al, E. *Applied Therapeutics: The Clinical Use of Drugs*; Wolters Kluwer Health - Lippincott Williams & Wilkins, Cop: Philadelphia, 2013.
5. *Lippincott's Illustrated Reviews Bundle Lippincott's Illustrated Reviews: Biochemistry, 4th Ed + Lippincott's Illustrated Reviews, Pharmacology, North American Edition, 4th Ed + Lippincott's.*; Lippincott Williams & Wilkins, 2009.
6. Hl Sharma; Kk Sharma. *Principles of Pharmacology*; Paras: New Delhi, 2011.
7. Craig, C. R.; Stitzel, R. E. *Modern Pharmacology with Clinical Applications*; Lippincott Williams & Wilkins: Philadelphia, 2004.
8. *Fundamentals of Experimental Pharmacology*; Hilton & Company: Kolkata, 2015.
9. Kulkarni, S. *Handbook of Experimental Pharmacology*, 3rd Edition. Vallabh Prakashan: Delhi, 2005.
10. N Udupa; Gupta, P. D. *Concepts in Chronopharmacology*; Shyam Prakashan: Jaipur, 2009.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remember and Evaluate.	Evaluate different types of toxicity studies.
CO2	Apply and Analyse	Apply different types of statistical analysis in different pharmacological experiments.
CO3	Analyse an Evaluate.	Analyse and evaluate various receptor actions using isolated tissue preparation.
CO4	Create and Correlate	Create the observation data and correlate them using statistical analysis.
CO5	Evaluate and analyse	To evaluate the drugs on different organs/tissues from the laboratory animals by in vivo/in vitro analysis.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3	3	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3	3
CO3	3	2	3	3	3	3	2	3	3	2	2	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	2	2	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	2	2	3	3	3	2	3
Avg	3	2.4	3	3	3	3	2.4	3	3	2.4	2.2	3	2.6	3	2.8	3

B. PHARM. SEMESTER – VI (BPH)
SUBJECT: HERBAL DRUG TECHNOLOGY - PRACTICAL (BP609P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	4	4	2	35	10	05	-	50

A. COURSE OVERVIEW

Scope: This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing
Practices (GMP), patenting and regulatory issues of herbal drugs
Objectives: Upon completion of this course the student should be able to:

- Understand raw material as source of herbal drugs from cultivation to herbal drug product
- Know the WHO and ICH guidelines for evaluation of herbal drugs
- Know the herbal cosmetics, natural sweeteners, nutraceuticals
- Appreciate patenting of herbal drugs, GMP.

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. To perform preliminary phytochemical screening of crude drugs. 2. Determination of the alcohol content of Asava and Arista 3. Evaluation of excipients of natural origin 4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation. 5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeia requirements. 6. Monograph analysis of herbal drugs from recent Pharmacopoeias 7. Determination of Aldehyde content. 8. Determination of Phenol content 9. Determination of total alkaloids.	**60**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Dr. Usman, R. Md., Darvhekar, VM., Dr.Akhila, S. &Dr. Kumar, V., A practical Book of "Herbal Drug Technology" 1st edition, NiraliPrakashan, 2019.
2. Dr. Lodhi, S. A practical Book fo "Herbal Drug Technology" Pee Vee Books, S. Vikas & Company (Medical Publishers) ,2020.
3.

D. REFERENCE BOOKS

1. Dr.Khadabadi, SS., Dr.Deore, SL. & Mr. Baviskar, BA., "Experimental Phytopharmacognosy" A comprehensive Guide, 1st edition, Nirali Prakashan, 2011.
2. Dr. Mukherjee, PK. &Dr.Verpoorte, R., "GMP for Botanicals" 1st Edition, Business Horizons Pharmaceutical Publishers, 2003.
3. Dr. Mukherjee, PK."Quality Control of Herbal Drugs: An Approach to Evaluation of botanicals" 1st Edition reprint, Elsevier Science Publication, 2017.

4. Agrawal, SS. & Paridhavi M., "Herbal Drug Technology" 2nd edition, Orient Blackswan , 2012.
5. Shah, B., & Seth, AK., "Textbook of Pharmacognosy & Phytochemistry" , 2nd Edition, CBS Publishers & Distributors PVT. Ltd., 2017.
6. Rangari VD., "Pharmacognosy & Phytochemistry" Volume-I 3rd Edition, Career Publications, 2017.
7. Rangari VD., "Pharmacognosy & Phytochemistry" Volume-II 3rd Edition, Career Publications, 2017.
8. Quadry, JS., "Textbook of Pharmacognosy (Theory & Practical)" 17th Edition, CBS Publishers & Distributors PVT. Ltd., 2020.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Analyse	Analysis of Natural excipients.
CO2	create and standardise	Preparation and standardisation of herbal Products, herbal cosmetics and Ayurvedic formulations.
CO3	understand and apply	Description and application of phytochemical screening of crude drugs.
CO4	Understand and Analysis	Monograph Analysis of herbal drugs as per the Pharmacopoeial standard.
CO5	Understand and Analysis	To perform Quantitative analysis of phytoconstituents present in crude drugs.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	-	2	2	1	2	1	3	3	3	3	2	-
CO2	3	2	2	3	-	2	2	1	2	1	3	3	3	3	1	-
CO3	3	2	2	3	-	2	2	1	2	1	3	3	3	3	1	-
CO4	3	2	2	3	-	2	2	1	2	1	3	3	3	3	2	-
CO5	3	2	2	3	-	2	2	1	2	1	3	3	3	3	2	-
Avg	3	2	2	3	-	2	2	1	2	1	3	3	3	3	1.6	-

B. PHARM. SEMESTER – VII (BPH)
SUBJECT: INSTRUMENTAL METHODS OF ANALYSIS - THEORY (BP701T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives: Upon completion of the course the student shall be able to

- Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
- Understand the chromatographic separation and analysis of drugs.
- Perform quantitative & qualitative analysis of drugs using various analytical instruments.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**UV Visible spectroscopy** Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations. Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode. Applications - Spectrophotometric titrations, Single component and multi component analysis **Fluorimetry** Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications	**10**	CO1 CO2 CO5
[2]	**IR spectroscopy** Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications **Flame Photometry**-Principle, interferences, instrumentation and applications **Atomic absorption spectroscopy**- Principle, interferences, instrumentation and applications **Nepheloturbidometry**- Principle, instrumentation and applications	**10**	CO1 CO2 CO5
[3]	**Introduction to chromatography** **Adsorption and partition column chromatography**-Methodology, advantages, disadvantages and applications. **Thin layer chromatography**- Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications. **Paper chromatography**-Introduction, methodology, development techniques, advantages, disadvantages and applications **Electrophoresis**– Introduction, factors affecting electrophoretic mobility,	**10**	CO3 CO4 CO5

	Techniques of paper, gel, capillary electrophoresis, applications		
[4]	**Gas chromatography -** Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications **High performance liquid chromatography (HPLC)-**Introduction, theory, instrumentation, advantages and applications.	**08**	CO3 CO4 CO5
[5]	**Ion exchange chromatography-** Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications **Gel chromatography-** Introduction, theory, instrumentation and applications **Affinity chromatography-** Introduction, theory, instrumentation and applications	**07**	CO3 CO4 CO5

C. TEXT BOOKS

1. Mendham, A. *Vogel's Textbook of Quantitative Chemical Analysis.*; Pearson: New Delhi, 2009.
2. Connors, K. A. *A Textbook of Pharmaceutical Analysis*; Wiley: New York, 1982..

D. REFERENCE BOOKS

1. JW Munson. *Pharmaceutical Analysis - Modern Methods Part-B*; Marcel. Dekker Series.; Vol. 11.
2. Kalsi, P. S. *Spectroscopy of Organic Compounds.*; New Age International Pvt, 2016.
3. Silverstein, R. M.; Webster, F. X.; Kiemle, D. J.; Bryce, D. L. *Spectrometric Identification of Organic Compounds*; Wiley: Hoboken, Nj, 2015.
4. Skoog, D. A.; F James Holler; Crouch, S. R. *Principles of Instrumental Analysis*; Thomson, Brooks/Cole: Belmont, Ca, 2007.
5. Hobart Hurd Willard. *Instrumental Methods of Analysis*; Wadsworth: Belmont, 1993.
6. Kemp, W. *Organic Spectroscopy*; Palgrave: Basingstoke, 2001.
7. Sethi, P. D. *Quantitative Analysis of Drugs in Pharmaceutical Formulations*; Cbs Publishers & Distritutors: New Delhi, 2005.
8. Sharma B K. *Instrumental Methods of Chemical Analysis*, 27th edition.; Goel Publishing House: Meerut, 2011.
9. Sharma, Y. R. *Elementary Organic Spectroscopy : Principles and Chemical Applications*; S. Chand & Company: New Delhi, 2007.
10. Garratt, D. C. *The Quantitative Analysis of Drugs : Assisted by L. Brealey Etc.*; Chapman & Hall: London, 1964.
11. Finar, I. L. *Organic Chemistry.*; Pearson Education, (9Th Impression: Delhi, 2011.
12. Beckett, A. H.; Stenlake, J. B. *Practical Pharmaceutical Chemistry*; Athlone Press: London, 1988.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To understand the interaction of matter with electromagnetic radiations
CO2	Understand Apply and Evaluate	To apply the fundamentals of spectroscopy in drug analysis
CO3	Understand	To understand the chromatographic separation fundamentals
CO4	Understand Apply and Evaluate	To apply the fundamentals of various chromatographic techniques in drug analysis
CO5	Understand Apply and Evaluate	To learn quantitative & qualitative analysis of drugs using various analytical instruments.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	1	1	-	1	-	1	-	-	3	3	3	1	1	-
CO2	3	2	3	2	-	2	1	1	2	-	3	3	3	2	2	1
CO3	3	-	1	1	-	1	-	1	-	-	3	3	3	1	1	-
CO4	3	2	3	2	-	2	1	1	2	-	3	3	3	2	2	1
CO5	3	2	1	1	-	2	1	1	1	-	3	3	3	2	2	1
Avg	3	1.2	1.8	1.4	-	1.6	0.6	1	1	-	3	3	3	1.6	1.6	0.6

B. PHARM. SEMESTER – VII (BPH)
SUBJECT: INDUSTRIAL PHARMACY II -THEORY (BP702T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market

Objectives: Upon completion of the course the student shall be able to

- Know the process of pilot plant and scale up of pharmaceutical dosage forms
- Understand the process of technology transfer from lab scale to commercial batch
- Know different Laws and Acts that regulate pharmaceutical industry
- Understand the approval process and regulatory requirements for drug products

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Pilot plant scale up techniques:** General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology	**10**	CO1
[2]	**Technology development and transfer:** WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues	**10**	CO2
[3]	**Regulatory affairs:** Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals **Regulatory requirements for drug approval:** Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies.	**10**	CO3 CO4
[4]	**Quality management systems:** Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP	**08**	CO5
[5]	**Indian Regulatory Requirements:** Central Drug Standard Control	**07**	CO3

	Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.		CO4

C. TEXT BOOKS

1. B Nagarani. Industrial pharmacy-II. Blue Rose Publishers, New Delhi2021.

D. REFERENCE BOOKS

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http,//en.wikipedia.org/wiki/Regulatory_ Affairs.
2. International Regulatory Affairs Updates, 2005. available athttp://www.iraup.com/about.php
3. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guidefor Prescription Drugs, Medical Devices, and Biologics' Second Edition.
4. Regulatory Affairs brought by learning plus, inc. available athttp.//www.cgmp.com/ra.htm.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and apply	Understand and apply process of pilot plant and scale up of pharmaceutical dosage forms
CO2	Understand and remember	Understand and remember process of technology transfer from lab scale to commercial batch
CO3	Remember and apply	Remember and apply different Laws and Acts that regulate pharmaceutical industry
CO4	Understand, Remember and apply	Understand, Remember and apply approval process and regulatory requirements for drug products
CO5	Understand, apply and evaluate	Understand, apply and evaluate various aspects of quality and quality management

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	-	-	-	-	-	-	-	3	3	1	-	-
CO2	3	1	2	1	-	-	-	-	-	-	-	3	3	3	-	-
CO3	3	-	1	-	-	-	2	-	-	-	-	3	3	-	-	-
CO4	3	1	1	-	-	-	2	-	-	-	-	3	3	-	-	-
CO5	3	3	2	-	3	-	1	-	-	-	2	3	3	-	3	-
Avg	3	1.4	1.4	0.4	0.6	-	1	-	-	-	0.4	3	3	0.8	0.6	-

B. PHARM. SEMESTER – VII (BPH)
SUBJECT: PHARMACY PRACTICE -THEORY (BP703T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. In community pharmacy, students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up.

Objectives: Upon completion of the course the student shall be able to

- know various drug distribution methods in a hospital
- appreciate the pharmacy stores management and inventory control
- monitor drug therapy of patient through medication chart review and clinical review
- obtain medication history interview and counsel the patients
- identify drug related problems
- detect and assess adverse drug reactions
- interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states
- know pharmaceutical care services
- do patient counselling in community pharmacy
- appreciate the concept of Rational drug therapy

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**a) Hospital and it's organization** Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions. **b) Hospital pharmacy and its organization** Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists. **c) Adverse drug reaction** Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management. **d) Community Pharmacy** Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.	**10**	CO1 CO2

[2]	**a) Drug distribution system in a hospital** Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs. **b) Hospital formulary** Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary. **c) Therapeutic drug monitoring** Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring. **d) Medication adherence** Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence. **e) Patient medication history interview** Need for the patient medication history interview, medication interview forms. **f) Community pharmacy management** Financial, materials, staff, and infrastructure requirements.	**10**	CO2
[3]	**a) Pharmacy and therapeutic committee** Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation. **b) Drug information services** Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information. **c) Patient counselling** Definition of patient counselling; steps involved in patient counselling, and Special cases that require the pharmacist **d) Education and training program in the hospital** Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education. **e) Prescribed medication order and communication skills** Prescribed medication order- interpretation and legal requirements, Communication skills- communication with prescribers and patients.	**10**	CO1 CO2 CO3
[4]	**a) Budget preparation and implementation** Budget preparation and implementation **b) Clinical Pharmacy** Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern. **c) Over the counter (OTC) sales** Introduction and sale of over the counter, and Rational use of common over the counter medications.	**8**	CO4
[5]	**a) Drug store management and inventory control** Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure,	**7**	CO4 CO5

	purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure **b) Investigational use of drugs** Description, principals involved, classification, control, identification, role of hospital pharmacist, advisory committee. **c) Interpretation of Clinical Laboratory Tests** Blood chemistry, hematology, and urinalysis		

C. TEXT BOOKS

1. Tipnis Bajaj. Hospital Pharmacy, 1st ed. Maharashtra: Career Publications; 2008.
2. Merchant S.H. and Dr. J.S.Quadry. *A textbook of hospital pharmacy*, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.

D. REFERENCE BOOKS & JOURNALS

1. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. *A textbook of Clinical Pharmacy Practice- essential concepts and skills,* 1st ed. Chennai: Orient Longman Private Limited; 2004.
2. William E. Hassan. *Hospital pharmacy*, 5th ed. Philadelphia: Lea & Febiger; 1986.
3. Tipnis Bajaj. *Hospital Pharmacy*, 1st ed. Maharashtra: Career Publications; 2008.
4. Scott LT. *Basic skills in interpreting laboratory data*, 4thed. American Society of Health System Pharmacists Inc; 2009.
5. Parmar N.S. *Health Education and Community Pharmacy*, 18th ed. India: CBS Publishers & Distributers; 2008.

JOURNALS

1. Therapeutic drug monitoring. ISSN: 0163-4356(https://journals.lww.com/drug-monitoring/pages/default.aspx)
2. Journal of pharmacy practice. ISSN: 0974-8326 (https://ijopp.org/)
3. American journal of health system pharmacy. ISSN: 1535-2900 (online) (https://academic.oup.com/ajhp)
4. Pharmacy times (Monthly magazine) (https://www.pharmacytimes.com/)

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Analyse	To understand the structure of healthcare system like hospital and community pharmacy and analyze adverse drug reactions
CO2	Remember, Understand and Evaluate	To get knowledge of various procedures carried out in the hospital and pharmacy and management of the pharmacy
CO3	Understand and remember	To know various committees and training programs in the hospitals and understand about communication skills
CO4	Understand and Remember	To understand basic clinical pharmacy practice and to know about financial management
CO5	Understand and evaluate	To understand the managemental practices of the drug store and know about interpretation of various biochemical laboratory tests

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	3	1	3	1	2	3	2	1	3	3	3	1	3
CO2	3	1	1	3	3	3	1	2	3	1	2	3	2	1	1	3
CO3	3	3	3	1	3	3	3	3	3	1	3	3	2	1	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2
CO5	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	2
Avg	3	2.2	2.2	2.6	2.6	3	2.2	2.6	3	1.6	2.4	3	2.6	2.2	2.2	2.6

B. PHARM. SEMESTER – VII (BPH)
SUBJECT: NOVEL DRUG DELIVERY SYSTEMS -THEORY (BP704T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is designed to impart basic knowledge on the area of novel drug delivery systems.
Objectives: Upon completion of the course student shall be able

- To understand various approaches for development of novel drug delivery systems.
- To understand the criteria for selection of drugs and polymers for the development of novel drug delivery systems, their formulation and evaluation

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Controlled drug delivery systems:** Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations **Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.	**10**	CO4 CO2
[2]	**Microencapsulation:** Definition, advantages and disadvantages, microspheres/microcapsules, microparticles, methods of microencapsulation, applications **Mucosal Drug Delivery system:** Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems **Implantable Drug Delivery Systems**: Introduction, advantages and disadvantages, concept of implants and osmotic pump	**10**	CO1 CO3 CO5
[3]	**Transdermal Drug Delivery Systems:** Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches **Gastroretentive drug delivery systems:** Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications **Nasopulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers	**10**	CO1 CO3 CO5
[4]	**Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications	**08**	CO3 CO5
[5]	**Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts **Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications	**07**	CO3 CO5

C. TEXT BOOKS

1. Jain, N. K. *Controlled and Novel Drug Delivery*; CBS Publishers & Distributors: New Delhi, India, 1997.
2. Vyas, S. P.; Khar, R. K. *Controlled Drug Delivery -Concepts and Advances,*; Vallabh Prakashan: New Delhi, 2002.

D. REFERENCE BOOKS

1. Chien, Y. W. *Novel Drug Delivery Systems, Second Edition*, 2nd ed.; CRC Press: Boca Raton, FL, 1991.
2. Robinson, J. R.; Lee, V. H. *Controlled Drug Delivery Systems*; Marcel Dekker, Inc: New York, 1992.
3. *Encyclopedia of Controlled Drug Delivery, 2 Volume Set*; Mathiowitz, E., Ed.; John Wiley & Sons: Nashville, TN, 1999.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To understand various approaches for development of novel drug delivery systems
CO2	Understand	To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems
CO3	learn	Learn Aspects related to formulation and evaluation of various novel drug delivery systems
CO4	Understand and remember	Explain the principles and technology used in the design of sustained release and controlled release drug delivery systems
CO5	Analyse	Analyse various evaluation parameters for oral, parenteral, topical etc. drug delivery systems

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	-	2	-	2	2	3	2	3	3	3	3	2
CO2	3	2	2	3	-	2	-	2	3	2	1	2	3	3	3	1
CO3	3	3	3	3	-	2	-	2	3	3	2	2	3	3	3	2
CO4	3	2	3	2	-	2	-	2	3	2	2	3	3	3	2	2
CO5	3	3	3	3	-	2	-	2	2	1	1	2	3	3	3	1
Avg	3	2.6	2.6	2.6	-	2	-	2	2.6	2.2	1.6	2.4	3	3	2.8	1.6

B. PHARM. SEMESTER – VII (BPH)

SUBJECT: INSTRUMENTAL METHODS OF ANALYSIS - PRACTICAL (BP705P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM		Total
-	-	4	4	2	35	10	5		50

A. COURSE OVERVIEW

Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives: Upon completion of the course the student shall be able to

- Understand spectroscopy and chromatographic techniques and their applications in drug analysis
- Perform quantitative & qualitative analysis of drugs using various analytical instruments.

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds Estimation of dextrose by colorimetry Estimation of sulfanilamide by colorimetry Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy Assay of paracetamol by UV- Spectrophotometry Estimation of quinine sulfate by fluorimetry Study of quenching of fluorescence	**30**	CO1 CO2 CO5
[2]	Determination of sodium by flame photometry Determination of potassium by flame photometry Determination of chlorides and sulphates by nephelo turbidometry Separation of amino acids by paper chromatography Separation of sugars by thin layer chromatography Separation of plant pigments by column chromatography Demonstration experiment on HPLC Demonstration experiment on Gas Chromatography	**30**	CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. *Practical book of instrumental methods of analysis – Final Year BPharm – Semester 7*, first.; Abhishek Tiwari, Ed.; Nirali Prakashan, 2020.
2. Beckett, A. H.; Stenlake, J. B. *Practical Pharmaceutical Chemistry*; Athlone Press: London, 1988.

D. REFERENCE BOOKS

1. JW Munson. *Pharmaceutical Analysis - Modern Methods Part-B*; Marcel. Dekker Series.; Vol. 11.
2. Kalsi, P. S. *Spectroscopy of Organic Compounds.*; New Age International Pvt, 2016.
3. Silverstein, R. M.; Webster, F. X.; Kiemle, D. J.; Bryce, D. L. *Spectrometric Identification of Organic Compounds*; Wiley: Hoboken, Nj, 2015.

4. Skoog, D. A.; F James Holler; Crouch, S. R. *Principles of Instrumental Analysis*; Thomson, Brooks/Cole: Belmont, Ca, 2007.
5. Hobart Hurd Willard. *Instrumental Methods of Analysis*; Wadsworth: Belmont, 1993.
6. Kemp, W. *Organic Spectroscopy*; Palgrave: Basingstoke, 2001.
7. Sethi, P. D. *Quantitative Analysis of Drugs in Pharmaceutical Formulations*; Cbs Publishers & Distritutors: New Delhi, 2005.
8. Sharma B K. *Instrumental Methods of Chemical Analysis*, 27th edition.; Goel Publishing House: Meerut, 2011.
9. Sharma, Y. R. *Elementary Organic Spectroscopy : Principles and Chemical Applications*; S. Chand & Company: New Delhi, 2007.
10. Garratt, D. C. *The Quantitative Analysis of Drugs : Assisted by L. Brealey Etc.*; Chapman & Hall: London, 1964.
11. Finar, I. L. *Organic Chemistry.*; Pearson Education, (9Th Impression: Delhi, 2011.
12. Connors, K. A. *A Textbook of Pharmaceutical Analysis*; Wiley: New York, 1982.
13. Mendham, A. *Vogel's Textbook of Quantitative Chemical Analysis.*; Pearson: New Delhi, 2009.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To understand the fundamentals of spectroscopy in drug analysis
CO2	Understand Apply and Evaluate	To apply the fundamentals of spectroscopy in qualitative and quantitative drug analysis
CO3	Understand and remeber	To understand the fundamentals of chromatography in drug analysis
CO4	Understand Apply and Evaluate	To apply the fundamentals of chromatography in qualitative and quantitative drug analysis
CO5	Understand Apply and Evaluate	To understand working and handling of various analytical instruments.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	1	1	-	1	-	1	-	-	3	3	3	1	1	-
CO2	3	3	3	2	-	2	1	1	2	-	3	3	3	2	2	1
CO3	3	-	1	1	-	1	-	1	-	-	3	3	3	1	1	-
CO4	3	3	3	2	-	2	1	1	2	-	3	3	3	2	2	1
CO5	3	3	-	-	-	2	1	1	1	-	3	3	3	2	2	1
Avg	3	1.8	1.6	1.2	-	1.6	0.6	1	1	-	3	3	3	1.6	1.6	0.6

B. PHARM. SEMESTER – VII (BPH)
SUBJECT: PRACTICE SCHOOL (BP706PS)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM		Total
-	-	12	6	6	125	-	25		150

A. COURSE OVERVIEW

In the VII semester, every candidate shall undergo practice school for a period of 150 hours evenly distributed throughout the semester. The student shall opt any one of the domains for practice school declared by the program committee from time to time.

At the end of the practice school, every student shall submit a printed report (in triplicate) on the practice school he/she attended (not more than 25 pages). Along with the exams of semester VII, the report submitted by the student, knowledge and skills acquired by the student through practice school shall be evaluated by the subject experts at college Level and grade point shall be awarded.

B. PHARM. SEMESTER – VIII (BPH)

SUBJECT: BIOSTATISTICS AND RESEARCH METHODOLOGY -THEORY (BP801T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: To understand the applications of Biostatics in Pharmacy. This subject deals with descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, Non-Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R and MINITAB statistical software's, analysing the statistical data using Excel.

Objectives: Upon completion of the course the student shall be able to

- Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)
- Know the various statistical techniques to solve statistical problems
- Appreciate statistical techniques in solving the problems.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Introduction:** Statistics, Biostatistics, Frequency distribution **Measures of central tendency:** Mean, Median, Mode- Pharmaceutical examples Measures of dispersion: Dispersion, Range, standard deviation, Pharmaceutical problems **Correlation:** Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples	**10**	CO1 CO2
[2]	**Regression:** Curve fitting by the method of least squares, fitting the lines y= a + bx and x = a + by, Multiple regression, standard error of regression– Pharmaceutical Examples **Probability:** Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties - problems Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples **Parametric test:** t-test (Sample, Pooled or Unpaired and Paired), ANOVA, (One way and Two way), Least Significance difference	**10**	CO1 CO2
[3]	**Non-Parametric tests:** Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test. **Introduction to Research:** Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism **Graphs:** Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph **Designing the methodology:** Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.	**10**	CO2 CO3 CO4

[4]	Blocking and confounding system for Two-level factorials **Regression modeling:** Hypothesis testing in Simple and Multiple regression models. **Introduction to Practical components of Industrial and Clinical Trials Problems:** Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach	**08**	CO2 CO3 CO5
[5]	**Design and Analysis of experiments:** **Factorial Design:** Definition, 22, 23design. Advantage of factorial design **Response Surface methodology:** Central composite design, Historical design, Optimization Techniques	**07**	CO4 CO5

C. TEXT BOOKS

1. Bolton, Stanford. Pharmaceutical statistics: Practical and clinical applications; 2nd Ed; Marcel Dekker Inc: New York, 1997
2. Panneerselvam, R. Design and Analysis of Experiments; PHI: India, 2012

D. REFERENCE BOOKS

1. Gupta, SC. Fundamentals of Statistics;7th Ed; Himalaya Publishing House: India, 2018
2. Montgomery, DC. Design and Analysis of Experiments;10th Ed (student edition); John Wiley & Sons, 2019

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Apply	To understand statistical techniques and apply to solve statistical problem
CO2	Remember, Understand and Apply	To understand various hypothesis testing techniques and application to pharmaceutical experiments.
CO3	Understand	To learn research methodology for pharmaceutical experiments
CO4	Understand and Remember	To understand optimization and design of experiments (DoE) for pharmaceutical experiments.
CO5	Understand and Apply	To know operation and application of different statistical software for statistical optimization of experiments.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	3	3	-	-	2	-	1	-	3	3	3	2	3	2
CO2	3	-	3	3	-	-	2	-	1	-	3	3	3	2	1	2
CO3	3	-	3	3	-	-	3	-	3	-	3	3	3	2	3	2
CO4	3	-	3	3	-	-	2	-	2	-	3	3	3	2	2	2
CO5	3	-	3	3	-	-	1	-	3	-	3	3	3	2	1	2
Avg	3	-	3	3	-	-	2		2	-	3	3	3	2	2	2

B. PHARM. SEMESTER – VIII (BPH)
SUBJECT: SOCIAL AND PREVENTIVE PHARMACY (BP802T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmes. The roles of the pharmacist in these contexts are also discussed.

Objectives: After the successful completion of this course, the student shall be able to:

- Acquire high consciousness/realization of current issues related to health and Pharmaceutical problems within the country and worldwide.
- Have a critical way of thinking based on current healthcare development.
- Evaluate alternative ways of solving problems related to health and pharmaceutical issues.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	a. Concept of health and disease: Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick. b. Social and health education: Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention. c. Sociology and health: Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health d. Hygiene and health: personal hygiene and health care; avoidable habits	**10**	CO1 CO2
[2]	**Preventive medicine:** General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chikungunya, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse	**10**	CO2
[3]	**National health programs, its objectives, functioning and outcome of the following:** HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.	**10**	CO3 CO4 CO5
[4]	National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program	**08**	CO3 CO4 CO5
[5]	Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.	**07**	CO3 CO4 CO5

C. TEXT BOOKS

1. Prabhakara, G. N. Short Textbook of Preventive and Social Medicine; Jaypee Brothers Medical Publishers: Bengaluru ; St. Louis (USA), 2010.
2. Rabindra, R.; Jaypee Brothers (Jaypeedigital. Mahajan & Gupta Textbook of Preventive and Social Medicine; Jaypee Brothers Medical Publisher (P) Ltd, 2013.

D. REFERENCE BOOKS & JOURNAL

1. Jain, V. Review of Preventive and Social Medicine (Including Biostatistics); 6th Edn. Jaypee Publication, New Delhi, 2014.
2. Lalita, H. D.; Dhananjaya, H. A. Essentials of Community Medicine—A Practical Approach; 2nd Edn. Jaypee Publications, New Delhi, 2012.
3. Park, K. Park's Textbook of Preventive and Social Medicine; 21st Edn. Bhanot Publishers: India, 2015.
4. Adepu, R. Community Pharmacy Practice; PharmaMed Press/BSP Books, Telangana, India, 2022.

JOURNAL:

1. Research in Social and Administrative Pharmacy, Elsevier, Ireland (https://www.sciencedirect.com/journal/research-in-social-and-administrative-pharmacy)

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Analyse	To understand basic concept of health and effect of various social, mental and hygienic aspects on health
CO2	Remember, Understand and Evaluate	To get knowledge of various communicable and non-communicable diseases and its preventive measures
CO3	Understand Apply and Evaluate	To get knowledge about various state and central government health programs on various health problems
CO4	Understand and remember	To know government efforts on various critical health issues
CO5	Understand and remember	To know about health infrastructure and role of government in the development of infrastructure as well as importance of hygine

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO2	3	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	2	1	2	1	3	3	3	3	3	1	2	3	3	2	2	3
CO4	2	1	2	1	3	3	3	3	3	1	2	1	3	2	2	3
CO5	3	1	2	1	3	3	3	3	3	1	2	2	3	2	2	3
Avg	2.6	1	2.4	1.8	3	3	3	3	3	1.8	2.4	2.2	3	2.4	2.4	3

B. PHARM. SEMESTER – VIII (BPH)
SUBJECT: PHARMA MARKETING MANAGEMENT (Theory) (BP803ET)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: The pharmaceutical industry not only needs highly qualified researchers, chemists and, technical people, but also requires skilled managers who can take the industry forward by managing and taking the complex decisions which are imperative for the growth of the industry. The Knowledge and Know-how of marketing management groom the people for taking a challenging role in Sales and Product management.

Objectives: The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Marketing:** Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior. **Pharmaceutical market:** Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation& targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.	**10**	CO1
[2]	**Product decision:** Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.	**08**	CO2
[3]	**Promotion:** Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.	**07**	CO3
[4]	**Pharmaceutical marketing channels:** Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management. **Professional sales representative (PSR):** Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.	**10**	CO4
[5]	**Pricing:** Meaning, importance, objectives, determinants of price; pricing methods	**10**	CO5

	and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority). **Emerging concepts in marketing:** Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.		

C. TEXT BOOKS:

1. Patil, PA. & Thakare, HN., "Text book of Pharmaceutical marketing management" 1st edition, White Falcon Publishing, 2020.
2. Dr. Bhambere, DS., Dr. Ahirrao, SP., Dr. Kankate, RS. & Dr. Laddha UD., "Pharma Marketing Management", 1st edition, Bhumi Publishing 2021.

D. REFERENCE BOOKS:

1. Walker, OC., Boy, H. & Larreche, JC., "Marketing Strategy- Planning and Implementation", 1st edition, Tata MC Graw Hill Education, New Delhi., 1999.
2. Grewal, D., & Levy, M.,"Marketing", Indian Edition, Tata MC Graw Hill India. 2017.
3. Kumar A. & Meenakshi N. "Marketing Management", 3rd edition, Vikas Publishing House Pvt. Ltd., India., 2017.
4. Saxena, R., "Marketing Management", 6th edition, Tata MC Graw-Hill, 2019.
5. Ramaswamy, US & Nanakamari, S., "Marketing Managemnt" 5th edition, MC Graw Hill Education, New Delhi, 2017.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Analyse	Describe the concept of pharmaceutical marketing in research area.
CO2	Create and Apply	Create and apply the idea of new product development in pharmaceutical Industry.
CO3	Understand, Remember and Analyse	Discuss the components of promotion of pharmaceutical products.
CO4	Remember, apply , understand and Evaluate	Explain pharmaceutical marketing channels. To evaluate the responsibility of professional sales representative.
CO5	Identify, Apply & Evaluate	Discuss responsibilities of pricing authorities in India.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	3	2	-	2	2	-	2	3	3	2	3	-
CO2	3	2	2	2	-	2	-	2	2	-	2	3	3	2	2	-
CO3	3	2	2	2	3	2	-	2	2	-	2	3	3	2	3	-
CO4	3	2	2	2	3	2	-	2	2	-	2	3	3	2	3	-
CO5	3	2	2	2	-	2	-	2	2	-	2	3	3	2	2	-
Avg	3	2	2	2	1.8	2	-	2	2	-	2	3	3	2	2.6	-

B. PHARM. SEMESTER – VIII (BPH)
SUBJECT: PHARMACEUTICAL REGULATORY SCIENCE - THEORY (BP804T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like US, EU, Japan, Australia, UK etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

Objectives: Upon completion of the subject student shall be able to;

- Know about the process of drug discovery and development
- Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
- Know the regulatory approval process and their registration in Indian and international markets

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**New Drug Discovery and development** Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.	**10**	CO1
[2]	**Regulatory Approval Process** Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA. **Regulatory authorities and agencies** Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)	**10**	CO2 CO3 CO4
[3]	**Registration of Indian drug product in overseas market** Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD)research.	**10**	CO3
[4]	**Clinical trials** Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials	**08**	CO5
[5]	**Regulatory Concepts** Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book	**07**	CO5

C. TEXT BOOKS

1. Itkar, S.; Vyawahare, N. S. *Drug Regulatory Affaira*, Kindle.; Nirali Prakashan, 2019.
2. Berry, I. R.; Martin, R. P. *The Pharmaceutical Regulatory Process*; Informa Healthcare: New York, 2008.

D. REFERENCE BOOKS

1. Guarino, R. A. *New Drug Approval Process*; Informa Healthcare, Cop: New York, 2009.
2. Weinberg, S. *Guidebook for Drug Regulatory Submissions*; Wiley: Hoboken, N.J., 2009.
3. Pisano, D. J. *FDA Regulatory Affairs : A Guide for Prescription Drugs, Medical Devices, and Biologics*; Informa Healthcare Usa: New York, 2008.
4. Kanfer, I.; Shargel, L. *Generic Drug Product Development : Solid Oral Dosage Forms*; Marcel Dekker: New York, 2005.
5. Rozovsky, F. A.; Adams, R. K. *Clinical Trials and Human Research : A Practical Guide to Regulatory Compliance*; Jossey-Bass: San Francisco, 2003.
6. Gallin, J. I.; Ognibene, F. P.; Laura Lee Johnson. *Principles and Practice of Clinical Research*; Elsevier/Academic Press: London ; San Diego, Ca, 2018.
7. Ng, R. *Drugs : From Discovery to Approval*; Wiley-Blackwell: Chichester, 2009.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To understand the process of drug discovery and development
CO2	Understand and remember	To understand the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
CO3	Understand and remember	To understand the regulatory approval process and their registration in international markets
CO4	Understand and remember	To understand the regulatory approval process and their registration in Indian markets
CO5	Understand remember and Apply	To Understand the regulatory concepts and clinical trial aspects

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	1	2	2	3	3	-	3	3	3	2	3	3
CO2	3	-	-	-	-	1	2	3	2	-	3	3	3	1	2	2
CO3	3	-	-	1	-	1	2	3	2	-	3	3	3	1	2	2
CO4	3	-	-	1	-	1	2	3	2	-	3	3	3	1	2	2
CO5	3	2	2	2	1	2	2	3	3	-	3	3	3	2	3	3
Avg	3	0.8	0.8	1.2	0.4	1.4	2	3	2.4	-	3	3	3	1.4	2.4	2.4

B. PHARM. SEMESTER – VIII (BPH)
SUBJECT: PHARMACOVIGILANCE (BP805ET)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This paper will provide an opportunity for the student to learn about development of pharmacovigilance as a science, basic terminologies used in pharmacovigilance, global scenario of Pharmacovigilance, train students on establishing pharmacovigilance programme in an organization, various methods that can be used to generate safety data and signal detection. This paper also develops the skills of classifying drugs, diseases and adverse drug reactions. The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmes. The roles of the pharmacist in these contexts are also discussed.

Objectives: At completion of this paper it is expected that students will be able to (know, do, and appreciate):

- Why drug safety monitoring is important?
- History and development of pharmacovigilance
- National and international scenario of pharmacovigilance
- Dictionaries, coding and terminologies used in pharmacovigilance
- Detection of new adverse drug reactions and their assessment
- International standards for classification of diseases and drugs
- Adverse drug reaction reporting systems and communication in pharmacovigilance
- Methods to generate safety data during pre-clinical, clinical and post approval phases of drugs' life cycle
- Drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation
- Pharmacovigilance Program of India (PvPI) requirement for ADR reporting in India
- ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning
- CIOMS requirements for ADR reporting
- Writing case narratives of adverse events and their quality.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Introduction to Pharmacovigilance** • History and development of Pharmacovigilance • Importance of safety monitoring of Medicine • WHO international drug monitoring programme • Pharmacovigilance Program of India(PvPI) **Introduction to adverse drug reactions** • Definitions and classification of ADRs • Detection and reporting • Methods in Causality assessment • Severity and seriousness assessment • Predictability and preventability assessment • Management of adverse drug reactions **Basic terminologies used in pharmacovigilance**	**10**	CO1 CO2

	• Terminologies of adverse medication related events • Regulatory terminologies		
[2]	**Drug and disease classification** • Anatomical, therapeutic and chemical classification of drugs • International classification of diseases • Daily defined doses • International Non-proprietary Names for drugs **Drug dictionaries and coding in pharmacovigilance** • WHO adverse reaction terminologies • MedDRA and Standardised MedDRA queries • WHO drug dictionary • Eudravigilance medicinal product dictionary **Information resources in pharmacovigilance** • Basic drug information resources • Specialised resources for ADRs **Establishing pharmacovigilance programme** • Establishing in a hospital • Establishment & operation of drug safety department in industry • Contract Research Organisations (CROs) • Establishing a national programme	**10**	CO2
[3]	**Vaccine safety surveillance** • Vaccine Pharmacovigilance • Vaccination failure • Adverse events following immunization **Pharmacovigilance methods** • Passive surveillance – Spontaneous reports and case series • Stimulated reporting • Active surveillance – Sentinel sites, drug event monitoring and registries • Comparative observational studies – Cross sectional study, case control study and cohort study • Targeted clinical investigations **Communication in pharmacovigilance** • Effective communication in Pharmacovigilance • Communication in Drug Safety Crisis management • Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media	**10**	CO2 CO3
[4]	**Safety data generation** • Pre-clinical phase • Clinical phase • Post approval phase (PMS) **ICH Guidelines for Pharmacovigilance** • Organization and objectives of ICH • Expedited reporting • Individual case safety reports • Periodic safety update reports • Post approval expedited reporting • Pharmacovigilance planning • Good clinical practice in pharmacovigilance studies	**08**	CO4
[5]	**Pharmacogenomics of adverse drug reactions** • Genetics related ADR with example focusing PK parameters.	**07**	CO5

	Drug safety evaluation in special population • Paediatrics • Pregnancy and lactation • Geriatrics **CIOMS** • CIOMS Working Groups • CIOMS Form **CDSCO (India) and Pharmacovigilance** • D&C Act and Schedule Y • Differences in Indian and global pharmacovigilance requirements		

C. TEXT BOOKS

1. Gupta, S. K.; India. Textbook of Pharmacovigilance; Jaypee Brothers Medical Publishers: New Delhi, 2011.
2. Mohanta, G. P.; Manna, P. K. Text book of Pharmacovigilance: concept and practice; PharmaMed Press: Hydrabad, India, 2016.

D. REFERENCE BOOKS & WEBSITES

1. Cobert, B. L.; Biron, P. Practical Drug Safety from A to Z; Sudbury, Mass Jones and Bartlett, 2009.
2. Andrews, E. B.; Moore, N. Mann's Pharmacovigilance; John Wiley & Sons Inc: Chichester, West Sussex, Uk, 2014.
3. Stephens, M. D. B.; Talbot, J. C.C.; Waller, P. Stephens' Detection of New Adverse Drug Reactions; Wiley: Chichester; Hoboken, NJ, 2004.
4. Waller, P.; Harrison-Woolrych, M. An Introduction to Pharmacovigilance; Wiley Blackwell/John Wiley & Sons Inc: Chichester, West Sussex, Uk ; Hoboken, Nj, 2017.
5. Cobert, B. Cobert's Manual of Drug Safety and Pharmacovigilance; Jones And Bartlett Publishers: 1997, 2011.
6. Strom, B. L. Textbook of Pharmacoepidemiology.; Wiley-Blackwell: S.L., 2022.
7. Parthasarathi, G.; Nyfort-Hansen, K.; Nahata, M. C.; Elliott, R. A.; George, J.; Nation, R. L.; Rayner, C. R. A Text Book of Clinical Pharmacy Practice: Essential Concepts and Skills; Orient Longman Ltd: Hyderabad, 2004.
8. National Formulary of India
9. http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=7297
10. https://www.ich.org/
11. http://www.cioms.ch/
12. http://cdsco.nic.in/
13. http://www.who.int/vaccine_safety/en/
14. http://www.ipc.gov.in/PvPI/pv_home.html

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Analyse	To know about basic aspects of Pharmacovigilance and Adverse Drug Reactions
CO2	Remember, Understand and Evaluate	To understand various terminologies related to drugs, coding and Adverse Drug Reactions and to know about organization of pharmacovigilance programs
CO3	Understand Apply and Evaluate	To get knowledge about various methods and communication techniques in Pharmacovigilance
CO4	Understand and remember	To know about various ICH guidelines related to Pharmacovigilance
CO5	Understand and remember	To understand basics of Pharmacogenomics and to know the rules and regulations related to Pharmacovigilance in India

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2	3	2	3	3	3	3	3	3	3	2	2
CO2	3	3	2	3	3	3	1	3	3	1	3	3	3	3	3	2
CO3	3	3	3	3	3	3	1	3	3	1	3	3	3	3	3	2
CO4	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	1	3	3	3	3	3	3	3	3	3	2	3
Avg	3	2.6	2.8	3	2.4	3	2	3	3	2.2	3	3	3	3	2.6	2.4

B. PHARM. SEMESTER – VIII (BPH)

SUBJECT: QUALITY CONTROL AND STANDARDIZATION OF HERBALS – THEORY (BP806ET)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	--	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: In this subject the student learns about the various methods and guidelines for evaluation and standardization of herbs and herbal drugs. The subject also provides an opportunity for the student to learn cGMP, GAP and GLP in traditional system of medicines.

Objectives: Upon completion of the subject student shall be able to;

- know WHO guidelines for quality control of herbal drugs
- know Quality assurance in herbal drug industry
- know the regulatory approval process and their registration in Indian and international markets
- appreciate EU and ICH guidelines for quality control of herbal drugs

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use	**10**	CO1
[2]	**Quality assurance in herbal drug industry** of cGMP, GAP, GMP and GLP in traditional system of medicine. WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants.	**10**	CO2
[3]	EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines	**10**	CO3 CO4
[4]	Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions.	**08**	CO5
[5]	Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems Comparison of various Herbal Pharmacopoeias. Role of chemical and biological markers in standardization of herbal products	**07**	CO4 CO5

B. TEXT BOOKS

1. Dr. Pankaj Pradhan and Dr. Dillip Kumar Jena, "Quality Control and Standardization of Herbals", Thakur Publication PVT. LTD., Lucknow, 2021.
2. Dr. Antara Choudhury, "Quality control and standardization of herbals", Nirali Prakashan, India, 2021.

C. REFERENCE BOOKS

1. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
2. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.
3. WHO Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998.
4. WHO Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.
5. WHO The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981.
6. WHO Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.
7. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.
8. WHO Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and evaluate	To evaluate crude drugs as per WHO guidelines.
CO2	Understand and apply	Discuss Quality assurance and techniques in herbal drug industry and herbal products.
CO3	Remember and evaluate	EU and ICH guidelines for quality control of herbal drugs and for Evaluating the Safety and Efficacy of Herbal Medicines.
CO4	Understand, remember and apply	Explain Regulatory requirements for herbal medicines.
CO5	Create and apply	To prepare documents for new drug application and apply GMP requirements and Drugs & Cosmetics Act provisions.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	0	1	3	1	2	1	2	3	3	3	2	2
CO2	3	2	2	3	0	2	2	2	2	2	3	3	3	3	2	2
CO3	3	2	3	3	1	2	3	2	2	2	2	3	2	3	2	2
CO4	3	2	2	3	2	2	2	2	2	3	3	3	3	3	2	2
CO5	3	2	2	3	2	3	2	2	2	2	2	3	3	3	3	2
Avg	3	2	2	3	1	2	2.4	1.8	2	2	2.4	3	2.8	3	2.2	2

B. PHARM. SEMESTER – VIII (BPH)
SUBJECT: COMPUTER AIDED DRUG DESIGN-THEORY (BP807ET)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.

Objectives: Upon completion of the course, the student shall be able to understand

- Design and discovery of lead molecules
- The role of drug design in drug discovery process
- The concept of QSAR and docking
- Various strategies to develop new drug like molecules.
- The design of new drug molecules using molecular modelling software

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Introduction to Drug Discovery and Development** Stages of drug discovery and development **Lead discovery and Analog Based Drug Design** Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation. **Analog Based Drug Design:** Bioisosterism, Classification, Bioisosteric replacement. Any three case studies	**10**	CO1
[2]	**Quantitative Structure Activity Relationship (QSAR)** SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA	**10**	CO1 CO2
[3]	**Molecular Modeling and virtual screening techniques** **Virtual Screening techniques:** Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening, **Molecular docking**: Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design.	**10**	CO1 CO2 CO3
[4]	**Informatics & Methods in drug design** Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases	**08**	CO1 CO4
[5]	**Molecular Modeling:** Introduction to molecular mechanics and quantum mechanics.Energy Minimization methods and Conformational Analysis, global conformational minima determination.	**07**	CO1 CO5

C. TEXT BOOKS

1. Mehta, S.K., Singh, R.K. A Text Book of Computer Aided Drug Design, 1st ed.; S. Vikas and Company, India, 2018
2. Siddiqui, A.A, Kumar, H., Khisal S. Computer-Aided Drug Design. 1st ed.; CBS Publishers, India, 2019

D. REFERENCE BOOKS

1. Hansch, C., Semmes, P.G., Taylor, J.B. Comprehensive Medicinal Chemistry, Volume I to VI, 1st ed.; Elsevier, India, 2005
2. Abraham, D.J. Burger's Medicinal Chemistry and Drug Discovery, Volume I to VI, 6th ed.; Wiley-Interscience, New Jersey, 2003
3. Patrick, G.L. An Introduction to Medicinal Chemistry, 3rd ed.; Oxford University Press, Oxford, 2006
4. Silverman, R.B. The Organic Chemistry of Drug Design and Drug Action, 2nd ed,; Academic Press, Burlington, 2004
5. Singh D.B. Computer-Aided Drug Design, 1st ed.; Springer, Singapore, 2020
6. Lemke, T.L., Williams, D.A. FOYE'S Principles of Medicinal Chemistry, 7th ed.; Lippincott Williams & Wilkins, Baltimore, 2013
7. Baele, J.M., Block J. H. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 12th ed.; Lippincott Williams & Wilkins; Baltimore, 2011
8. Smith, J.H., Williams, H. Smith and Williamson's Introduction to the Principles of Drug Design and Action, 3rd ed; CRC Press, The Netherlands, 2005
9. Patrick, G.L. An Introduction to Medicinal Chemistry, 3rd ed.; Oxford University Press, Oxford, 2006

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To explain the process of drug discovery to development and different approaches of drug design and discovery
CO2	Understand and remember	To describe importance of Quantitative Structure Activity Relationship (QSAR) and various methods of QSAR in rational drug design
CO3	Understand and apply	To explain structure-based and ligand-based virtual screening approaches of drug design
CO4	Understand and apply	To discuss principles of bioinformatics and cheminformatics and their role in drug design and discovery
CO5	Understand and apply	To understand role of molecular modelling techniques in computer-aided drug design

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	3	-	-	-	-	-	-	3	2	3	3	1	-
CO2	3	-	-	3	-	-	-	-	-	-	3	2	3	3	1	-
CO3	3	-	2	3	-	-	-	-	-	-	3	2	3	3	1	-
CO4	3	-	2	3	-	-	-	-	-	-	3	2	3	3	1	-
CO5	3	-	1	3	-	-	-	-	-	-	3	2	3	3	1	-
Avg	3	-	1	3	-	-	-	-	-	-	3	2	3	3	1	-

B. PHARM. SEMESTER – VIII (BPH)
SUBJECT: CELL AND MOLECULAR BIOLOGGY (B808ET)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	---	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: Cell biology is a branch of biology that studies cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function. This is done both on a microscopic and molecular level. Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organisms such as humans, plants, and sponges

Objectives: Upon completion of the course the student shall be able to

- Summarize cell and molecular biology history.
- Summarize cellular functioning and composition.
- Describe the chemical foundations of cell biology.
- Summarize the DNA properties of cell biology.
- Describe protein structure and function.
- Describe cellular membrane structure and function.
- Describe basic molecular genetic mechanisms.
- Summarize the Cell Cycle

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	a) Cell And Molecular Biology: Definitions Theory and Basics and Applications. b) Cell And Molecular Biology: History and Summation. c) Properties Of Cells and Cell Membrane. d) Prokaryotic Versus Eukaryotic e) Cellular Reproduction f) Chemical Foundations – An Introduction and Reactions (Types)	**10**	CO1
[2]	a) DNA and the Flow of Molecular Information b) DNA Functioning c) DNA and RNA d) Types of RNA e) Transcription and Translation	**10**	CO2
[3]	a) Proteins: Defined and Amino Acids b) Protein Structure c) Regularities in Protein Pathways d) Cellular Processes e) Positive Control and significance of Protein Synthesis	**10**	CO1 CO2 CO3
[4]	a) Science of Genetics b) Transgenics and Genomic Analysis c) Cell Cycle analysis d) Mitosis and Meiosis e) Cellular Activities and Checkpoints	**08**	CO1 CO2 CO3 CO4 CO5

[5]	a) Cell Signals: Introduction b) Receptors for Cell Signals c) Signalling Pathways: Overview d) Misregulation of Signalling Pathways e) Protein-Kinases: Functioning	**07**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Cooper, J. W.; Gunn, C.; Sidney James Carter. Cooper and Gunn's Tutorial Pharmacy; Cbs Publishers: Editorial: New Delhi, 2005.
2. Hondermarck, H. Proteomics : Biomedical and Pharmaceutical Applications; Kluwer Academic Publishers: Dordrecht ; Boston, 2004.

D. REFERENCE BOOKS

1. Pelczar, M. J.; Chan, E. C. S.; Kreig, N. R. Laboratory Exercises in Microbiology; Mcgraw-Hill: New York, 1986.
3. Glick, B. R.; Thompson, J. E. Methods in Plant Molecular Biology and Biotechnology; Crc Press: Boca Raton, 1993.
4. Samuel Cate Prescott; Dunn, C. G.; Reed, G. Industrial Microbiology; Macmillan: New York, 1982.
5. Rose, A. H. Industrial Microbiology; Butterworths: London, 1961.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To know about the basics of cell, types of cells its basic functions, the structure and all the details
CO2	Remember, Understand and Apply	To get knowledge about DNA, RNA, Structure, function, translation and transcription
CO3	Understand Apply and Evaluate and remember	To understand about the protein structure, its synthesis and its regulations
CO4	Understand	To get knowledge about genomics, genomics analysis, cell cycle analysis, mitosis and Meiosis
CO5	Remember	To understand about cell signals, receptors for cell signals its functioning and misregulation

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	3	1	3	3	3	3	3	2	2	3	3	3	3
CO2	2	2	2	3	2	3	2	3	3	3	3	2	3	3	3	3
CO3	3	2	3	3	2	3	2	3	3	2	2	3	3	3	3	2
CO4	3	2	3	3	2	3	2	3	3	2	2	2	3	3	3	3
CO5	3	2	2	3	2	3	3	3	3	2	2	2	3	3	3	2
Avg	2.6	1.8	2.4	3	1.8	3	2.4	3	3	2.4	2.2	2.2	3	3	3	2.6

B. PHARM. SEMESTER – VIII (BPH)
SUBJECT: COSMETIC SCIENCE- THEORY (BP809ET)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope

This course is designed to impart knowledge and skills necessary for the fundamental need for cosmetic and cosmeceutical products.

Objectives

Upon completion of the course, the students shall be able to understand

- Key ingredients used in cosmetics and cosmeceuticals.
- Key building blocks for various formulations.
- Current technologies in the market
- Various key ingredients and basic science to develop cosmetics and cosmeceuticals
- Scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	Classification of cosmetic and cosmeceutical products, Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs **Cosmetic excipients:** Surfactants, rheologymodifiers, humectants, emollients, preservatives. Classification and application **Skin:** Basic structure and function of skin. **Hair:** Basic structure of hair. Hair growth cycle. **Oral Cavity:** Common problem associated with teeth and gums**.**	**10**	CO1 CO2 CO3
[2]	**Principles of formulation and building blocks of skin care products:** Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages.Application of these products in formulation of cosmecuticals. **Antiperspants & deodorants**- Actives & mechanism of action. **Principles of formulation and building blocks of Hair care products:** Conditioning shampoo, Hair conditioner,anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phylene diamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.	**10**	CO1 CO2 CO3 CO4
[3]	Sun protection, Classification of Sunscreens and SPF. **Role of herbs in cosmetics:** Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove **Analytical cosmetics:** BIS specification and analytical methods for shampoo, skincream and toothpaste**.**	**10**	CO1 CO5

[4]	Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties Soaps,and syndet bars. Evolution and skin benfits.	**8**	CO5 CO4
[5]	Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis. Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat andbody odor. Antiperspirants and Deodorants- Actives and mechanism of action	**7**	CO4 CO5

C. TEXT BOOKS

1. Sharma, P. P.; Vandana Publications. *Cosmetics : Formulation, Manufacturing & Quality Control*; Vandama Publications: Delhi, 2018.
2. Nanda S and Khar R, Text book of cosmelicology Tata Publishers.

D. REFERENCE BOOKS

1. Ralph Gordon Harry; Wilkinson, J. B.; Moore, R. J. *Cosmetología de Harry*; Díaz De Santos: España, 1990.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Analyse	To uderstand and remember the key ingredients used in cosmetics and cosmeceuticals
CO2	Remember	To remeber the Key building blocks for various formulations.
CO3	Understand and remember	To apply current technologies in the market.
CO4	Understand and Remember	To understand various key ingredients and basic science to develop cosmetics and cosmeceuticals
CO5	understand and evaluate	To apply the scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	2	-	1	1	2	2	1	3	3	2	3	1	2
CO2	3	1	1	2	-	1	-	2	2	-	2	3	2	1	1	2
CO3	3	2	3	3	2	2	2	3	3	-	3	3	3	1	3	3
CO4	3	2	3	3	2	-	-	2	3	2	2	3	3	3	3	2
CO5	3	2	3	3	1	2	-	2	3	2	3	3	3	3	3	2
Avg	3	1.6	2.2	2.6	1	1.2	0.6	2.2	2.6	1	2.6	3	2.6	2.2	2.2	2.2

B. PHARM. SEMESTER – VIII (BPH)
SUBJECT: PHARMACOLOGICAL SCREENING METHODS (BP810ET)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.

Objectives: Upon completion of the course the student shall be able to

- Appreciate the applications of various commonly used laboratory animals.
- Appreciate and demonstrate the various screening methods used in pre-clinical research.
- Appreciate and demonstrate the importance of biostatistics and research methodology.
- Design and execute a research hypothesis independently.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Laboratory Animals:** Study of CPCSEA and OECD guidelines form maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.	**8**	CO1, CO4, CO5.
[2]	**Preclinical screening models** a. Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. b. Study of screening animal models for Diuretics, nootropics, anti-Parkinson's, anti-asthmatics, Preclinical screening models :for CNS activity-analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, anti-parkinsonism, Alzheimer's disease	**12**	CO2, CO3, CO4.
[3]	**Pre-clinical screening models:** for ANS activity, sympathomimetic, sympatholytic, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics.	**10**	CO2, CO3, CO4.
[4]	**Preclinical screening models:** for CVS activity-antihypertensive, diuretics, antiarrhythmic, antidyslepidemic, anti-aggregatory, coagulants, and anticoagulants Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and anti-asthmatics.	**10**	CO2, CO3, CO4.
[5]	**Research methodology and Bio-statistics** Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretation using Students't' test and One-way ANOVA. Graphical representation of data	**05**	CO3.

C. TEXT BOOKS

1. Hans Gerhard Vogel. *Drug Discovery and Evaluation: Pharmacological Assays; Including a CD-ROM*; Springer: Berlin, 2002.

D. REFERENCE BOOKS

1. *Fundamentals of Experimental Pharmacology*; Hilton & Company: Kolkata, 2015.
2. Kulkarni, S. *Handbook of Experimental Pharmacology*, 3rd Edition. Vallabh Prakashan: Delhi, 2005.
3. Home: Committee for the Purpose of Control and Supervision of Experiments on Animals http://cpcsea.nic.in (accessed 2022 -04 -04).
4. Gupta, S. *Drug Screening Methods*; Sk Gupta, 2016.
5. Sundar, S.; Richard, J. *An Introduction to Biostatistics: A Manual for Students in Health Sciences*; Prentice/Hall Of India: New Delhi, 1996.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and apply	Appreciate the applications of various commonly used laboratory animals.
	Understand, analyse and evaluate	Understand, analyse and evaluate new and existing drugs in various screening methods used in preclinical research
CO3	Apply and Remember	Apply and Remember importance of biostatistics and research methodology
CO4	Create, hypothesis and apply	Design and execute a research hypothesis independently.
CO5	Understand and apply	Understand and maintain guidelines of CPCSEA and OECD.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2	3	3	3	1	3	3	3	3	3	3	3
CO2	3	2	3	3	2	2	3	2	2	2	3	3	2	3	3	3
CO3	3	2	3	3	1	2	3	2	1	3	3	3	2	3	3	3
CO4	3	3	3	3	1	3	3	3	2	3	3	3	3	3	3	3
CO5	3	2	3	3	1	3	3	2	0	3	3	3	3	3	3	3
Avg	3	2.2	3	3	1.4	2.6	3	2.4	1.2	2.8	3	3	2.6	3	3	3

B. PHARM. SEMESTER – VIII (BPH)

SUBJECT: ADVANCED INSTRUMENTATION TECHNIQUES - THEORY (BP811T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic hyphenated techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives: Upon completion of the course the student shall be able to

- understand the advanced instruments used and its applications in drug analysis
- understand the chromatographic separation and analysis of drugs.
- understand the calibration of various analytical instruments
- know analysis of drugs using various analytical instruments.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Nuclear Magnetic Resonance spectroscopy** Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications **Mass Spectrometry**- Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications s	**10**	CO1 CO2 CO5
[2]	**Thermal Methods of Analysis**: Principles, instrumentation and applications of ThermogravimetricAnalysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) **X-Ray Diffraction Methods:** Origin of X-rays, basic aspects of crystals, X- ray Crystallography, rotating crystal technique, single crystal diffraction,powder diffraction, structural elucidation and applications.	**10**	CO2 CO5
[3]	**Calibration and validation**-as per ICH and USFDA guidelines **Calibration of following Instruments** Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC	**10**	CO4 CO5
[4]	**Radio immune assay:**Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay **Extraction techniques**:General principle and procedure involved in the solid phase extraction and liquid-liquid extraction	**08**	CO1
[5]	**Hyphenated techniques**-LC-MS/MS, GC-MS/MS, HPTLC-MS.	**07**	CO1 CO2 CO3 CO5

C. TEXT BOOKS

1. Mendham, A. *Vogel's Textbook of Quantitative Chemical Analysis.*; Pearson: New Delhi, 2009.
2. Connors, K. A. *A Textbook of Pharmaceutical Analysis*; Wiley: New York, 1982..

D. REFERENCE BOOKS

1. JW Munson. *Pharmaceutical Analysis - Modern Methods Part-B*; Marcel. Dekker Series.; Vol. 11.
2. Kalsi, P. S. *Spectroscopy of Organic Compounds.*; New Age International Pvt, 2016.
3. Silverstein, R. M.; Webster, F. X.; Kiemle, D. J.; Bryce, D. L. *Spectrometric Identification of Organic Compounds*; Wiley: Hoboken, Nj, 2015.
4. Skoog, D. A.; F James Holler; Crouch, S. R. *Principles of Instrumental Analysis*; Thomson, Brooks/Cole: Belmont, Ca, 2007.
5. Hobart Hurd Willard. *Instrumental Methods of Analysis*; Wadsworth: Belmont, 1993.
6. Kemp, W. *Organic Spectroscopy*; Palgrave: Basingstoke, 2001.
7. Sethi, P. D. *Quantitative Analysis of Drugs in Pharmaceutical Formulations*; Cbs Publishers & Distritutors: New Delhi, 2005.
8. Sharma B K. *Instrumental Methods of Chemical Analysis*, 27th edition.; Goel Publishing House: Meerut, 2011.
9. Sharma, Y. R. *Elementary Organic Spectroscopy : Principles and Chemical Applications*; S. Chand & Company: New Delhi, 2007.
10. Garratt, D. C. *The Quantitative Analysis of Drugs : Assisted by L. Brealey Etc.*; Chapman & Hall: London, 1964.
11. Finar, I. L. *Organic Chemistry.*; Pearson Education, (9Th Impression: Delhi, 2011.
12. Beckett, A. H.; Stenlake, J. B. *Practical Pharmaceutical Chemistry*; Athlone Press: London, 1988.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To understand the advanced instruments used and its applications in drug analysis
CO2	Understand Apply and Evaluate	To apply the fundamentals of spectroscopy in drug analysis
CO3	Understand	To understand the chromatographic separation fundamentals and analysis of drugs
CO4	Understand and Apply	To understand the calibration of various analytical instruments
CO5	Understand Apply and Evaluate	To learn quantitative & qualitative analysis of drugs using various analytical instruments.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	-	2	1	1	2	-	3	3	3	2	2	1
CO2	3	2	3	2	-	2	1	1	2	-	3	3	3	2	2	1
CO3	3	-	1	-	-	1	-	1	-	-	3	3	3	1	1	-
CO4	3	2	3	2	-	2	1	1	2	-	3	3	3	2	2	1
CO5	3	2	1	1	-	2	1	1	1	-	3	3	3	2	2	1
Avg	3	1.4	2	1.6	-	1.8	0.8	1	1.4	-	3	3	3	1.8	1.8	0.8

B. PHARM. SEMESTER – VIII (BPH)

SUBJECT: DIETARY SUPPLEMENTS AND NUTRACEUTICALS – THEORY (BP812ET)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	--	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.

Objective: This module aims to provide an understanding of the concepts behind the theoretical applications of dietary supplements. By the end of the course, students should be able to:

- Understand the need of supplements by the different group of people to maintain healthy life.
- Understand the outcome of deficiencies in dietary supplements.
- Appreciate the components in dietary supplements and the application.
- Appreciate the regulatory and commercial aspects of dietary supplements including health claims.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e., weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc. b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community. c. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds	7	CO1 CO5
[2]	Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature medicinal benefits) of following a) Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, leutin b) Sulfides: Diallyl sulfides, Allyl trisulfide. c) Polyphenolics: Reservetrol d) Flavonoids- Rutin, Naringin, Quercitin, Anthocyanidins, catechins, Flavones e) Prebiotics / Probiotics.: Fructo oligosaccharides, Lacto bacillum f) Phyto estrogens : Isoflavones, daidzein, Geebustin, lignans g) Tocopherols h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.	15	CO1 CO3
[3]	a) Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals	07	CO1 CO2

	on lipids, proteins, Carbohydrates, nucleic acids. b) Dietary fibres and complex carbohydrates as functional food ingredients.		CO3
[4]	a) Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing. b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α- Lipoic acid, melatonin, Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole. c) Functional foods for chronic disease prevention	**10**	CO1 CO2 CO3
[5]	a) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals. b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods. c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.	**06**	CO4 CO5

C. TEXT BOOKS

1. Dr. Tapan Behl, Dr. Sukhbir Singh, & Dr. Neelam Sharma Dietary Supplements & Nutraceuticals, R. Narain Publishers & Distributors, Agra, 2021.

D. REFERENCE BOOKS

1. K.T Agusti and P. Faizal, Role of dietary fibres and neutraceuticals in preventing diseases, B S Publication, 2019.
2. Cooper. K.A, Advanced Nutritional Therapies, Thomas Nelson Inc publisher, 1997.
3. Jean Carper The Food Pharmacy, Simon & Schuster publisher, UK Ltd., 2000.
4. James F. Balch and Phyllis A. Balch, Prescription for Nutritional Healing, 2nd Edn., Avery Publishing Group, NY, 1997.
5. G. Gibson and C.williams Editors 2000 Functional foods Woodhead Publ. Co. London.
6. Goldberg, I. Functional Foods, Chapman and Hall, New York, 1994
7. Labuza, T.P. Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf-Life Testing in Essentials of Functional Foods M.K. Sachmidl and T.P. Labuza eds. Aspen Press, 2000.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	Discuss the need and requirements of supplements by the different group of people to maintain healthy life.
CO2	Understand and evaluate	Describe the outcome of deficiencies in dietary supplements and evaluate it.
CO3	Remember and analyse	To analyse the components in dietary supplements and the application.
CO4	Apply	To apply regulatory and commercial aspects of dietary supplements including health claims.
CO5	Create	Explain nutrition education.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2	2	1	3	2	3	2	3	3	3	2	2
CO2	3	3	2	2	2	2	1	3	2	2	3	3	3	3	2	2
CO3	3	2	3	2	2	2	1	3	2	2	2	3	2	3	2	2
CO4	3	2	3	2	2	2	2	3	2	3	3	3	3	3	2	2
CO5	3	2	2	2	2	2	1	3	2	2	2	3	3	3	3	2
Avg	3	2.4	2.4	2	2	2	1.2	3	2	2.4	2.4	3	2.8	3	2.2	2

B. PHARM. SEMESTER – VIII (BPH)
SUBJECT: PHARMACEUTICAL PRODUCT DEVELOPMENT (BP813ET)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject is designed to impart basic knowledge on pharmaceutical product development
Objectives: Upon completion of the course student shall be able

- Understand regulation related to pharmaceutical product development
- Understand selection and application of excipients in pharmaceutical formulations
- Understand QbD & optimization and its application in pharmaceutical product development
- Understand selection and quality control testing of packaging materials for pharmaceutical product development

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	Introduction to pharmaceutical product development, objectives, regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms	**10**	CO1
[2]	An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Solvents and solubilizers ii. Cyclodextrins and their applications iii. Non - ionic surfactants and their applications iv. Polyethylene glycols and sorbitols v. Suspending and emulsifying agents vi. Semi solid excipients	**10**	CO2 CO3
[3]	An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Tablet and capsule excipients ii. Directly compressible vehicles iii. Coat materials iv. Excipients in parenteral and aerosols products v. Excipients for formulation of NDDS Selection and application of excipients in pharmaceutical formulations with specific industrial applications	**10**	CO2 CO3
[4]	Optimization techniques in pharmaceutical product development. A study of various optimization techniques for pharmaceutical product development with specific examples. Optimization by factorial designs and their applications. A study of QbD and its application in pharmaceutical product development.	**08**	CO1 CO4
[5]	Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.	**07**	CO5

C. TEXT BOOKS

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D. REFERENCE BOOKS

1. Bolton, S.; Bon, C. *Pharmaceutical Statistics : Practical and Clinical Applications*; Informa Healthcare Usa: New York, 2010.
2. Swarbrick, J. *Encyclopedia of Pharmaceutical Technology*; Marcel Dekker: New York, Ny, 2004.
3. Lachman, L.; Liebermann, H. A. *The Theory and Practice of Industrial Pharmacy*; Cbs Publishers & Distributors Pvt. Ltd: New Delhi, 2013.
4. Lieberman, H. A. *Pharmaceutical Dosage Forms Tablets, Vol. 1-3*; New York, Dekker, 1990.
5. Lieberman, H. A.; Rieger, M. M.; Banker, G. S. *Pharmaceutical Dosage Forms-- Disperse Systems. Volume 1-2*; Dekker: New York, 1998.
6. Avis, K. E.; Lieberman, H. A.; Lachman, L. *Pharmaceutical Dosage Forms: Parenteral Medications VOL 1-3*; M. Dekker: New York, 1992.
7. Remington, J. P.; Gennaro, A. R. *Remington's Pharmaceutical Sciences*; Mack Pub. Co: Easton, Pa., 1990.
8. Ansel, H. C.; Allen, L. V.; Popovich, N. G. *Pharmaceutical Dosage Forms and Drug Delivery Systems*; Philadelphia, Pa Lippincott-Williams & Wilkins, 1999.
9. Vyas, S. P.; Khar, R. K. *Targeted & Controlled Drug Delivery : Novel Carrier Systems*; Cbs Publishers & Distributors Pvt. Ltd: New Delhi, 2010.
10. Aulton, M. E.; Taylor, K. *Aulton's Pharmaceutics : The Design and Manufacture of Medicines*, 5th ed.; Elsevier: London, 2018.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand regulation related to pharmaceutical product development
CO2	Study	Study of Pharmaceutical Excipients in pharmaceutical product development
CO3	Understand	Understand selection and application of excipients in pharmaceutical formulations
CO4	Understand and Remember	Understand QbD & optimization and its application in pharmaceutical product development
CO5	Understand and analyse	Understand selection and quality control testing of packaging materials for pharmaceutical product development

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	1	2	3	2	2	3	2	3	2	2	3	3
CO2	3	2	2	3	1	2	1	2	3	2	2	3	3	3	3	2
CO3	3	1	3	3	1	2	1	2	3	3	2	2	3	3	3	2
CO4	3	2	3	3	1	2	1	2	3	2	2	3	3	3	2	2
CO5	3	3	3	3	1	2	2	2	2	2	2	2	3	3	3	1
Avg	3	2	2.6	3	1	2	1.6	2	2.6	2.4	2	2.6	2.8	2.8	2.8	2

B. PHARM. SEMESTER – VIII (BPH)
SUBJECT: PROJECT WORK (BP813PW)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	12	6	6	150	-	-	-	150

A. COURSE OVERVIEW

All the students shall undertake a project under the supervision of a teacher and submit a report. The area of the project shall directly relate any one of the elective subjects opted by the student in semester VIII. The project shall be carried out in group not exceeding 5 in number. The project report shall be submitted in triplicate (typed & bound copy not less than 25 pages).

The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). Students shall be evaluated in groups for four hours (i.e., about half an hour for a group of five students).

M. PHARM. SEMESTER – I (MPH)
SUBJECT: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES – THEORY (MPH101T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	--	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives: After completion of course student is able to know about

- Chemicals and excipients
- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**a. UV-Visible spectroscopy**: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy. **b. IR spectroscopy**: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier -Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation. **c. Spectrofluorimetric**: Theory of Fluorescence, Factors affecting fluorescence (Characteristics of drugs that can be analysed by fluorimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **d. Flame emission spectroscopy and Atomic absorption spectroscopy**: Principle, Instrumentation, Interferences and Applications.	**11**	CO1 CO2 CO5
[2]	**NMR spectroscopy**: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy	**11**	CO1 CO2 CO5
[3]	**Mass Spectroscopy**: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.	**11**	CO1 CO2 CO5
[4]	**Chromatography**: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following: ● Thin Layer chromatography ● Paper Chromatography	**11**	CO3 CO4 CO5

	● Ion exchange chromatography ● Column chromatography ● Gas chromatography ● High Performance Liquid chromatography ● Affinity chromatography		
[5]	**a. Electrophoresis**: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **b. X ray Crystallography**: Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.	**11**	CO5
[6]	Immunological assays : RIA (Radio immuno assay), ELISA, Bioluminescence assays.	**05**	CO5

C. TEXT BOOKS

1. Connors, K. A. *A Textbook of Pharmaceutical Analysis*; Wiley: New York, 1982..
2. Mendham, A. *Vogel's Textbook of Quantitative Chemical Analysis.*; Pearson: New Delhi, 2009.

D. REFERENCE BOOKS

1. JW Munson. *Pharmaceutical Analysis - Modern Methods Part-B*; Marcel. Dekker Series.; Vol. 11.
2. Kalsi, P. S. *Spectroscopy of Organic Compounds.*; New Age International Pvt, 2016.
3. Silverstein, R. M.; Webster, F. X.; Kiemle, D. J.; Bryce, D. L. *Spectrometric Identification of Organic Compounds*; Wiley: Hoboken, Nj, 2015.
4. Skoog, D. A.; F James Holler; Crouch, S. R. *Principles of Instrumental Analysis*; Thomson, Brooks/Cole: Belmont, Ca, 2007.
5. Hobart Hurd Willard. *Instrumental Methods of Analysis*; Wadsworth: Belmont, 1993.
6. Kemp, W. *Organic Spectroscopy*; Palgrave: Basingstoke, 2001.
7. Sethi, P. D. *Quantitative Analysis of Drugs in Pharmaceutical Formulations*; Cbs Publishers & Distritutors: New Delhi, 2005.
8. Sharma B K. *Instrumental Methods of Chemical Analysis*, 27th edition.; Goel Publishing House: Meerut, 2011.
9. Sharma, Y. R. *Elementary Organic Spectroscopy : Principles and Chemical Applications*; S. Chand & Company: New Delhi, 2007.
10. Beckett, A. H.; Stenlake, J. B. *Practical Pharmaceutical Chemistry*; Athlone Press: London, 1988.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To understand the fundamentals of various spectroscopic techniques
CO2	Understand Apply and Evaluate	To apply the fundamentals of spectroscopy in single and combination drug analysis
CO3	Understand and remember	To understand the chromatographic separation fundamentals
CO4	Understand Apply and Evaluate	To apply the fundamentals of various chromatographic techniques in single and combination drug analysis
CO5	Understand Apply and Evaluate	To learn theoretical and practical aspects of various analytical instruments.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	-	1	1	-	1	-	1	-	-	3	2	-	-	-
CO2	3	2	3	2	-	2	1	1	2	-	3	3	1	1	-
CO3	3	-	1	1	-	1	-	1	-	-	3	2	-	-	-
CO4	3	2	3	2	-	2	1	1	2	-	3	3	1	1	-
CO5	3	2	1	1	-	2	1	1	1	-	3	3	1	1	-
Avg	3	1.2	1.8	1.4	-	1.6	0.6	1	1	-	3	2.6	0.6	0.6	-

M. PHARM. SEMESTER – I (MPH)
SUBJECT: DRUG DELIVERY SYSTEMS (MPH102T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	-	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

Objectives: Upon completion of the course, student shall be able to understand

- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of delivering system
- The formulation and evaluation of Novel drug delivery systems

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	Sustained Release (SR) and Controlled Release (CR) formulations: Introduction & basic concepts, advantages/ disadvantages, factors influencing, Physicochemical & biological approaches for SR/CR formulation, Mechanism of Drug Delivery from SR/CR formulation. Polymers: introduction, definition, classification, properties and application Dosage Forms for Personalized Medicine: Introduction, Definition, Pharmacogenetics, And Categories of Patients for Personalized Medicines: Customized drug delivery systems, Bioelectronic Medicines, 3D printing of pharmaceuticals, Telepharmacy.	**10**	CO5 CO2
[2]	Rate Controlled Drug Delivery Systems: Principles & Fundamentals, Types, Activation; Modulated Drug Delivery Systems; Mechanically activated, pH activated, Enzyme activated, and Osmotic activated Drug Delivery Systems Feedback regulated Drug Delivery Systems; Principles & Fundamentals.	**10**	CO5 CO2
[3]	Gastro-Retentive Drug Delivery Systems: Principle, concepts advantages and disadvantages, Modulation of GI transit time approaches to extend GI transit. Buccal Drug Delivery Systems: Principle of muco adhesion, advantages and disadvantages, Mechanism of drug permeation, Methods of formulation and its evaluations.	**10**	CO1 CO3 CO4
[4]	Occular Drug Delivery Systems: Barriers of drug permeation, Methods to overcome barriers.	**06**	CO1 CO3 CO4
[5]	Transdermal Drug Delivery Systems: Structure of skin and barriers, Penetration enhancers, Transdermal Drug Delivery Systems, Formulation and evaluation.	**10**	CO1 CO3 CO4
[6]	Protein and Peptide Delivery: Barriers for protein delivery. Formulation and Evaluation of delivery systems of proteins and other macromolecules.	**08**	CO1 CO3 CO4
[7]	Vaccine delivery systems: Vaccines, uptake of antigens, single shot vaccines, mucosal and transdermal delivery of vaccines.	**06**	CO1 CO3 CO4

C. TEXT BOOKS

1. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
2. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002

D. REFERENCE BOOKS

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker,Inc., New York, 1992.
3. Encyclopedia of controlled delivery, Editor- Edith Mathiowitz, Published by WileyInterscience Publication, John Wiley and Sons, Inc, New York, Chichester/Weinheim

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To understand the various approaches for development of novel drug delivery system
CO2	Learn	To learn the criteria for selection of drugs and polymers for the development of delivery system
CO3	Learn	To learn the formulation and evaluation of Novel drug delivery systems.
CO4	Analyse	Analyse various evaluation parameters for oral, parenteral, topical etc. drug delivery systems
CO5	Understand and analyse	Explain the principles and technology used in the design of sustained release and controlled release drug delivery systems

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	-	2	-	2	2	3	1	3	3	2	2
CO2	3	2	2	2	-	3	-	2	2	2	2	2	3	2	2
CO3	3	2	3	3	-	2	-	3	2	2	3	3	3	2	2
CO4	3	2	3	3	-	2	-	2	2	2	2	3	3	3	3
CO5	3	2	2	2	-	2	-	3	2	3	3	3	3	2	3
Avg	3	2	2.4	2.4	-	2.2	-	2.4	2	2.4	2.2	2.8	3	2.2	2.4

M. PHARM. SEMESTER – I (MPH)
SUBJECT: MODERN PHARMACEUTICS (MPH103T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	-	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: Course designed to impart advanced knowledge and skills required to learn various aspects and concepts at pharmaceutical industries.

Objectives: Upon completion of the course, student shall be able to understand

- The elements of preformulation studies.
- The Active Pharmaceutical Ingredients and Generic drug Product development
- Industrial Management and GMP Considerations.
- Optimization Techniques & Pilot Plant Scale Up Techniques
- Stability Testing, sterilization process & packaging of dosage forms.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	a. Preformation Concepts – Drug Excipient interactions - different methods, kinetics of stability, Stability testing. Theories of dispersion and pharmaceutical Dispersion (Emulsion and Suspension, SMEDDS) preparation and stability Large and small volume parental – physiological and formulation consideration, Manufacturing and evaluation. b. Optimization techniques in Pharmaceutical Formulation: Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Statistical design, Response surface method, Contour designs, Factorial designs and application in formulation	**20**	CO1 CO4
[2]	Validation: Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration and validation of equipments, Validation of specific dosage form, Types of validation. Government regulation, Manufacturing Process Model, URS, DQ, IQ, OQ & P.Q. of facilities.	**10**	CO2 CO3
[3]	cGMP & Industrial Management: Objectives and policies of current good manufacturing practices, layout of buildings, services, equipments and their maintenance Production management: Production organization, , materials management, handling and transportation, inventory management and control, production and planning control, Sales forecasting, budget and cost control, industrial and personal relationship. Concept of Total Quality Management.	**10**	CO2 CO3
[4]	Compression and compaction: Physics of tablet compression, compression, consolidation, effect of friction, distribution of forces, compaction profiles.	**10**	CO5
[5]	Study of Solubility parameters, Diffusion parameters, Dissolution parameters and Pharmacokinetic parameters, Heckle plots, Similarity factors – f2 and f1, Higuchi and Peppas plot, Linearity Concept of significance, Standard deviation, Chi square test, students T-test, ANOVA test.	**10**	CO5

C. TEXT BOOKS

1. Lachman, L.; Liebermann, H. A. The Theory and Practice of Industrial Pharmacy; Cbs Publishers & Distributors Pvt. Ltd: New Delhi, 2013

D. REFERENCE BOOKS

1. Lieberman, H. A. *Pharmaceutical Dosage Forms Tablets, Vol. 1-3*; New York, Dekker, 1990.
2. Lieberman, H. A.; Rieger, M. M.; Banker, G. S. *Pharmaceutical Dosage Forms-- Disperse Systems. Volume 1-2*; Dekker: New York, 1998.
3. Avis, K. E.; Lieberman, H. A.; Lachman, L. *Pharmaceutical Dosage Forms: Parenteral Medications VOL 1-3*; M. Dekker: New York, 1992.
4. Banker, G. S.; Rhodes, C. T. *Modern Pharmaceutics*; Dekker: New York, 1996.
5. Remington, J. P.; Gennaro, A. R. *Remington's Pharmaceutical Sciences*; Mack Pub. Co: Easton, Pa., 1990.
6. Bean, H. S.; Carless, J. E.; Arnold Heyworth Beckett. *Advances in Pharmaceutical Sciences*; Academic Press: London, 1964.
7. Sinko, P. J.; Martin, A. N. *Martin's Physical Pharmacy Pharmaceutical Sciences: Physical Chemical Principles in the Pharmaceutical Sciences.*; Lippincott Williams & Wilkins: Philadelphia, 2006.
8. Arthur Owen Bentley; Ernest Alexander Rawlins. *Bentley's Textbook of Pharmaceutics.*; All India Traveller Book Seller: New Delhi, 2002.
9. Willig, S. H. *Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control from Manufacturer to Consumer*; Marcel Dekker, Inc: New York, N.Y., 2001.
10. Kohli, D. P. S.; Shah, D. H. *Drug Formulations Manual*; Business Horizons: New Delhi, 2012.
11. Sharma, P.P. *How to practice GMPs*. Vandana publication, 2001.
12. Berry, I. R.; Nash, R. A. *Pharmaceutical Process Validation*; Marcel Dekker: New York, 1993.
13. James Robert Evans. *Applied Production and Operations Management*; Info Access & Distribution: Singapore, 1994.
14. Swarbrick, J. *Encyclopedia of Pharmaceutical Technology*; Marcel Dekker: New York, Ny, 2004.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Learn	Learn the elements of preformulation studies.
CO2	Understand	Understand validations of processes and equipments used in Pharmaceutical Industry
CO3	Learn	Learn Industrial Management and GMP Considerations.
CO4	Understand and Remember	Understand and remember Optimization Techniques & Statistical designs
CO5	Understand and analyse	Understand physics of tablet compression and analyse dissolution & diffusion parameters

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	-	2	-	2	2	2	1	3	2	1	1
CO2	3	2	2	3	-	2	-	2	2	3	2	3	3	3	2
CO3	3	1	2	2	-	3	-	3	2	3	2	3	3	3	2
CO4	3	2	3	3	-	2	-	2	2	2	3	3	2	3	3
CO5	3	3	3	3	-	2	-	2	2	2	2	3	1	3	3
Avg	3	2	2.4	2.6	-	2.2	-	2.2	2	2.4	2	3	2.2	2.6	2.2

M. PHARM. SEMESTER – I (MPH)
SUBJECT: REGULATORY AFFAIRS - THEORY (MPH104T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	--	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: Course designed to impart advanced knowledge and skills required to learn the concept of generic drug and their development, various regulatory filings in different countries, different phases of clinical trials and submitting regulatory documents: filing process of IND, NDA and ANDA

Objectives: Upon completion of the course, it is expected that the students will be able to understand

- The Concepts of innovator and generic drugs, drug development process
- The Regulatory guidance's and guidelines for filing and approval process
- Preparation of Dossiers and their submission to regulatory agencies in different countries
- Post approval regulatory requirements for actives and drug products
- Submission of global documents in CTD/ eCTD formats
- Clinical trials requirements for approvals for conducting clinical trials
- Pharmacovigilance and process of monitoring in clinical trials.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**a. Documentation in Pharmaceutical industry**: Master formula record, DMF (Drug Master File), distribution records. Generic drugs product development Introduction , Hatch- Waxman act and amendments, CFR (CODE OF FEDERAL REGULATION) ,drug product performance, in-vitro, ANDA regulatory approval process, NDA approval process, BE and drug product assessment, in –vivo, scale up process approval changes, post marketing surveillance, outsourcing BA and BE to CRO. **b. Regulatory requirement for product approval**: API, biologics, novel, therapies obtaining NDA, ANDA for generic drugs ways and means of US registration for foreign drugs	**15**	CO1 CO2 CO3 CO4
[2]	CMC, post approval regulatory affairs. Regulation for combination products and medical devices.CTD and ECTD format, industry and FDA liaison. ICH - Guidelines of ICH-Q, S E, M. Regulatory requirements of EU, MHRA, TGA and ROW countries.	**15**	CO2 CO3
[3]	**Non clinical drug development**: Global submission of IND, NDA, ANDA. Investigation of medicinal products dossier, dossier (IMPD) and investigator brochure (IB).	**15**	CO2 CO5
[4]	**Clinical trials**: Developing clinical trial protocols. Institutional review board/ independent ethics committee Formulation and working procedures informed Consent process and procedures. HIPAA- new, requirement to clinical study process, ● pharmacovigilance safety monitoring in clinical trials.	**15**	CO2 CO5

C. TEXT BOOKS

1. Berry, I. R.; Martin, R. P. *The Pharmaceutical Regulatory Process*; Informa Healthcare: New York, 2008.
2. Guarino, R. A. *New Drug Approval Process*; Informa Healthcare, Cop: New York, 2009.

D. REFERENCE BOOKS

1. Kanfer, I.; Shargel, L. *Generic Drug Product Development : Solid Oral Dosage Forms*; Marcel Dekker: New York, 2005.
2. Weinberg, S. *Guidebook for Drug Regulatory Submissions*; Wiley: Hoboken, N.J., 2009.
3. Pisano, D. J. *FDA Regulatory Affairs : A Guide for Prescription Drugs, Medical Devices, and Biologics*; Informa Healthcare Usa: New York, 2008.
4. Rozovsky, F. A.; Adams, R. K. *Clinical Trials and Human Research : A Practical Guide to Regulatory Compliance*; Jossey-Bass: San Francisco, 2003.
5. Administration, A. G. D. of H. T. G. TGA basics http://www.tga.gov.au/tga-basics
6. Your gateway to the European Union http://europa.eu/index_en.htm.
7. ICH Official web site : ICH http://www.ich.org/.
8. Commissioner, O. of the. U.S. Food and Drug Administration http://www.fda.gov/.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remeber	To understand the Concepts of innovator and generic drugs, drug development process
CO2	Understand and Apply	To understand the Regulatory guidance and guidelines for filing and approval process
CO3	Understand and remeber	To understand Preparation of Dossiers and their submission to regulatory agencies in different countries in CTD/ eCTD formats
CO4	Understand and remember	To understand Post approval regulatory requirements for actives and drug products
CO5	Understand and remember	To acquire knowledge about Non-clinical development, Clinical trials requirements, Pharmacovigilance and process of monitoring in clinical trials.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	2	2	3	3	-	3	-	3	2	-
CO2	3	-	-	-	-	2	2	3	2	-	3	-	3	2	-
CO3	3	-	-	-	1	2	2	3	2	-	3	-	3	2	-
CO4	3	-	-	-	-	2	2	3	3	-	3	-	3	-	-
CO5	3	2	1	1	1	2	2	3	3	-	3	-	1	2	1
Avg	3	0.4	0.2	0.2	0.4	2	2	3	2.6	-	3	-	2.6	1.6	0.2

M. PHARM. SEMESTER – I (MPH)
SUBJECT: PHARMACEUTICS PRACTICAL – I (MPH105P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	12	12	6	100	30	20	-	150

A. COURSE OVERVIEW

Scope: This subject is designed to impart basic knowledge and skills on analytical techniques and development of various NDDS dosage forms

Objectives: objectives of the course is to make students able to

- Understand, learn and application of various spectrophotometric and chromatographic analytical methods in analysis of drugs and drug products.
- Application of preformulation concepts in Preparation, characterization and evaluation of conventional and novel drug delivery systems

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. Analysis of pharmacopoeial compounds and their formulations by UV Vis-spectrophotometer 1. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 2. Experiments based on HPLC 3. Experiments based on Gas Chromatography 4. Estimation of riboflavin/quinine sulphate by fluorimetry 5. Estimation of sodium/potassium by flame photometry	**90**	CO1 CO2
[2]	1. To perform In-vitro dissolution profile of CR/ SR marketed formulation 2. Formulation and evaluation of sustained release matrix tablets 3. Formulation and evaluation osmotically controlled DDS 4. Preparation and evaluation of Floating DDS- hydro dynamically balanced DDS 5. Formulation and evaluation of Muco adhesive tablets. 6. Formulation and evaluation of trans dermal patches. 7. To carry out preformulation studies of tablets. 8. To study the effect of compressional force on tablets disintegration time. 9. To study Micromeritic properties of powders and granulation. 10. To study the effect of particle size on dissolution of a tablet. 11. To study the effect of binders on dissolution of a tablet. 12. To plot Heckal plot, Higuchi and peppas plot and determine similarity factors.	**90**	CO2 CO3 CO4 CO5

C. TEXT BOOKS

D. REFERENCE BOOKS

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Assessment	Assessment of the drug/s using various spectroscopic and chromatographic techniques
CO2	Learn	Handling and operations of various analytical instruments
CO3	understand	Preparation and evaluation of modified release drug delivery systems
CO4	Understand and Remember	To understand effect of various excipients and process parameters on various dosage forms
CO5	Understand and apply	application of the various model dependent and model independent approaches for the assessment of dosage forms

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	1	2	1	2	2	2	1	3	1	1	1
CO2	3	3	2	2	2	3	2	3	2	3	2	3	2	2	2
CO3	3	3	3	2	2	2	1	3	2	3	2	3	3	2	2
CO4	3	3	3	3	1	2	1	2	2	2	3	3	3	3	3
CO5	3	3	3	3	1	2	1	2	2	3	2	3	3	3	3
Avg	3	3	2.6	2.6	1.4	2.2	1.2	2.4	2	2.6	2	3	2.4	2.2	2.2

M. PHARM. SEMESTER – II (MPH)
SUBJECT: MOLECULAR PHARMACEUTICS (NANO TECHNOLOGY & TARGETED DDS) (NTDS) (MPH201T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	-	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

Objectives: Upon completion of the course, student shall be able to understand

- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of delivering system
- The formulation and evaluation of novel drug delivery systems

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	Targeted Drug Delivery Systems: Concepts, Events and biological process involved in drug targeting. Tumor targeting and Brain specific delivery.	12	CO5
[2]	Targeting Methods: introduction preparation and evaluation. Nano Particles & Liposomes: Types, preparation and evaluation.	12	CO5 CO3
[3]	Micro Capsules / Micro Spheres: Types, preparation and evaluation, Monoclonal Antibodies; preparation and application, preparation and application of Niosomes, Aquasomes, Phytosomes, Electrosomes.	12	CO2 CO3
[4]	Pulmonary Drug Delivery Systems : Aerosols, propellents, Containers Types, preparation and evaluation, Intra Nasal Route Delivery systems; Types, preparation and evaluation.	12	CO1 CO2
[5]	Nucleic acid based therapeutic delivery system : Gene therapy, introduction (ex-vivo & in-vivo gene therapy). Potential target diseases for gene therapy (inherited disorder and cancer). Gene expression systems (viral and nonviral gene transfer). Liposomal gene delivery systems. Biodistribution and Pharmacokinetics. knowledge of therapeutic antisense molecules and aptamers as drugs of future.	12	CO4

C. TEXT BOOKS

1. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
2. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002

D. REFERENCE BOOKS

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker,Inc., New York, 1992.
3. Encyclopedia of controlled delivery, Editor- Edith Mathiowitz, Published by WileyInterscience Publication, John Wiley and Sons, Inc, New York, Chichester/Weinheim

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To understand the various approaches for development of novel drug delivery systems.
CO2	Learn	To learn the criteria for selection of drugs and polymers for the development of NDDS
CO3	Understand	To understand the concepts of formulation and evaluation of Nano carrier-based drug delivery systems.
CO4	learn	To learn the nucleic acid-based drug delivery systems.
CO5	Understand and analyse	To understand concepts and methods of targeted drug delivery systems.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	-	2	-	2	2	3	1	3	3	2	2
CO2	3	3	3	3	-	2	-	2	2	2	1	2	3	2	2
CO3	3	2	3	2	-	2	-	3	2	2	3	2	3	2	3
CO4	3	2	2	2	-	2	-	2	2	2	3	2	3	3	2
CO5	3	2	2	2	-	2	-	3	2	3	3	3	3	2	3
Avg	3	2.2	2.4	2.2	-	2	-	2.4	2	2.4	2.2	2.4	3	2.2	2.4

M. PHARM. SEMESTER – II (MPH)
SUBJECT: ADVANCED BIOPHARMACEUTICS & PHARMACOKINETICS (MPH202T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
3	1	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart knowledge and skills necessary for dose calculations, dose adjustments and to apply biopharmaceutics theories in practical problem solving. Basic theoretical discussions of the principles of biopharmaceutics and pharmacokinetics are provided to help the students to clarify the concepts.

Objectives: Upon completion of this course it is expected that students will be able understand,

- The basic concepts in biopharmaceutics and pharmacokinetics. The use raw data and derive the pharmacokinetic models and parameters the best describe the process of drug absorption, distribution, metabolism and elimination.
- The critical evaluation of biopharmaceutic studies involving drug product equivalency.
- The design and evaluation of dosage regimens of the drugs using pharmacokinetic and biopharmaceutic parameters.
- The potential clinical pharmacokinetic problems and application o basics of pharmacokinetic

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Drug Absorption from the Gastrointestinal Tract:** Gastrointestinal tract, Mechanism of drug absorption, Factors affecting drug absorption, pH–partition theory of drug absorption. Formulation and physicochemical factors: Dissolution rate, Dissolution process, Noyes–Whitney equation and drug dissolution, Factors affecting the dissolution rate. Gastrointestinal absorption: role of the dosage form: Solution (elixir, syrup and solution) as a dosage form, Suspension as a dosage form, Capsule as a dosage form, Tablet as a dosage form, Dissolution methods ,Formulation and processing factors, Correlation of in vivo data with in vitro dissolution data. Transport model: Permeability-Solubility-Charge State and the pH Partition Hypothesis, Properties of the Gastrointestinal Tract (GIT), pH Microclimate Intracellular pH Environment, Tight-Junction Complex.	**12**	CO1 CO2
[2]	**Biopharmaceutic considerations in drug product design and In Vitro Drug Product Performance:** Introduction, biopharmaceutic factors affecting drug bioavailability, rate-limiting steps in drug absorption, physicochemical nature of the drug formulation factors affecting drug product performance, in vitro: dissolution and drug release testing, compendial methods of dissolution, alternative methods of dissolution testing, meeting dissolution requirements, problems of variable control in dissolution testing performance of drug products. In vitro–in vivo correlation, dissolution profile comparisons, drug product stability, considerations in the design of a drug product.	**12**	CO1 CO2
[3]	**Pharmacokinetics:** Basic considerations, pharmacokinetic models, compartment modeling: one compartment model- IV bolus, IV infusion,	**12**	CO3

	extra-vascular. Multi compartment model: two compartment - model in brief, non-linear pharmacokinetics: cause of non-linearity, Michaelis – Menten equation, estimation of kmax and vmax. Drug interactions: introduction, the effect of protein binding interactions, the effect of tissue-binding interactions, cytochrome p450-based drug interactions, drug interactions linked to transporters.		
[4]	**Drug Product Performance, In Vivo:** Bioavailability and Bioequivalence: drug product performance, purpose of bioavailability studies, relative and absolute availability. Methods for assessing bioavailability, bioequivalence studies, design and evaluation of bioequivalence studies, study designs, crossover study designs, evaluation of the data, bioequivalence example, study submission and drug review process. Biopharmaceutics classification system, methods. Permeability: In-vitro, in-situ and In-vivo methods. Generic biologics (biosimilar drug products), clinical significance of bioequivalence studies, special concerns in bioavailability and bioequivalence studies, generic substitution.	**12**	CO4
[5]	**Application of Pharmacokinetics:** Modified-Release Drug Products, Targeted Drug Delivery Systems and Biotechnological Products. Introduction to Pharmacokinetics and pharmacodynamic, drug interactions. Pharmacokinetics and pharmacodynamics of biotechnology drugs. Introduction, Proteins and peptides, Monoclonal antibodies, Oligonucleotides, Vaccines (immunotherapy), Gene therapies.	**12**	CO5

C. TEXT BOOKS

1. Jaiswal, Sunil B., and Brahmankar, D. M.. Biopharmaceutics and Pharmacokinetics: A Treatise. India, Vallabh Prakashan, 2005.

D. REFERENCE BOOKS

1. Gibaldi, M. Biopharmaceutics and Clinical Pharmacokinetics. India: Pharmamed Press. 2005.
2. Yu, Andrew B.C., and Shargel, Leon. Applied Biopharmaceutics & Pharmacokinetics, Seventh Edition. Singapore, McGraw-Hill Education, 2015.
3. Gibaldi, Milo, and Perrier, Donald. Pharmacokinetics., 2nd edition, Marcel Dekker Inc., New York, 1982
4. Swarbrick. J. Current Concepts in the Pharmaceutical Sciences: Biopharmaceutics. United States: Lea & Febiger. 1970.
5. Malcolm Rowland and Thom N. Tozer. Clinical Pharmacokinetics, Concepts and Applications. 3rd edition. Lea and Febiger, Philadelphia, 1995
6. Abdou. H.M, Dissolution, Bioavailability and Bioequivalence, Mack Publishing Company, Pennsylvania 1989
7. Robert. E. Notari. Biopharmaceutics and Clinical Pharmacokinetics, An Introduction, 4th edition, Marcel Dekker Inc, New York and Basel,1987.
8. John. G Wagner and M. Pemarowski. Biopharmaceutics and Relevant Pharmacokinetics, 1st edition, Drug Intelligence Publications, Hamilton, Illinois, 1971.
9. James Swarbrick, James. G. Boylan. Encyclopedia of Pharmaceutical Technology, Vol 13, Marcel Dekker Inc, New York, 1996.
10. Sunil S Jambhekar and Philip J Breen. Basic Pharmacokinetics, 1st edition, pharmaceutical press, RPS Publishing, 2009.
11. Alex Avdeef. Absorption and Drug Development- Solubility, Permeability, and Charge State, John Wiley & Sons, Inc, 2003.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand basic concepts and factors affecting of absorption of drugs form GIT and bioavailability.
CO2	Understand and Apply	Understand and apply biopharmaceutic considerations and in-vitro dissolution in drug product design.
CO3	Understand and Utilize	Understand and utilize the pharmacokinetic models for the determination of pharmacokinetic parameters.
CO4	Understand, Analyze and Evaluate	Understand and analyze the bioavailability of a drug and evaluate the bioequivalence between drug products.
CO5	Remember and Understand	Remember and Understand applications of biopharmaceutics and apply in designing dosage forms

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2	1	2	1	1	3	2	2	3	2	3	2
CO2	3	2	3	2	1	3	2	2	2	2	3	3	3	3	2
CO3	2	1	2	3	1	2	2	2	1	1	2	2	3	3	3
CO4	3	2	2	2	1	2	1	1	3	2	3	3	2	3	2
CO5	3	2	3	3	1	2	2	2	2	2	2	3	3	3	2
Avg	2.8	1.6	2.4	2.4	1	2.2	1.6	1.6	2.2	1.8	2.4	2.8	2.6	3	2.2

M. PHARM. SEMESTER – II (MPH)
SUBJECT: COMPUTER AIDED DRUG DEVELOPMENT (MPH203T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	-	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart knowledge and skills necessary for computer Applications in pharmaceutical research and development who want to understand the application of computers across the entire drug research and development process. Basic theoretical discussions of the principles of more integrated and coherent use of computerized information (informatics) in the drug development process are provided to help the students to clarify the concepts.

Objectives: Upon completion of this course it is expected that students will be able to understand,

- History of Computers in Pharmaceutical Research and Development
- Computational Modeling of Drug Disposition
- Computers in Preclinical Development
- Optimization Techniques in Pharmaceutical Formulation
- Computers in Market Analysis
- Computers in Clinical Development
- Artificial Intelligence (AI) and Robotics
- Computational fluid dynamics (CFD)

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**a. Computers in Pharmaceutical Research and Development:** A General Overview: History of Computers in Pharmaceutical Research and Development. Statistical modeling in Pharmaceutical research and development: Descriptive versus Mechanistic Modeling, Statistical Parameters, Estimation, Confidence Regions, Nonlinearity at the Optimum, Sensitivity Analysis, Optimal Design, Population Modeling **b. Quality-by-Design in Pharmaceutical Development:** Introduction, ICH Q8 guideline, Regulatory and industry views on QbD, Scientifically based QbD - examples of application.	**12**	CO1 CO2
[2]	**Computational Modeling of Drug Disposition:** Introduction, Modeling Techniques: Drug Absorption, Solubility, Intestinal Permeation, Drug Distribution, Drug Excretion, Active Transport; P-gp, BCRP, Nucleoside Transporters, hPEPT1, ASBT, OCT, OATP, BBB-Choline Transporter.	**12**	CO3 CO4
[3]	**Computer-aided formulation development:** Concept of optimization, Optimization parameters, Factorial design, Optimization technology & Screening design. Computers in Pharmaceutical Formulation: Development of pharmaceutical emulsions, microemulsion drug carriers Legal Protection of Innovative Uses of Computers in R&D, The Ethics of Computing in Pharmaceutical Research, Computers in Market analysis	**12**	CO1 CO2

[4]	**a. Computer-aided biopharmaceutical characterization:** Gastrointestinal absorption simulation. Introduction, Theoretical background, Model construction, Parameter sensitivity analysis, Virtual trial, Fed vs. fasted state, In vitro dissolution and in-vitro-in-vivo correlation, Biowaiver considerations **b. Computer Simulations in Pharmacokinetics and Pharmacodynamics:** Introduction, Computer Simulation: Whole Organism, Isolated Tissues, Organs, Cell, Proteins and Genes. **c. Computers in Clinical Development:** Clinical Data Collection and Management, Regulation of Computer Systems	**12**	CO3 CO4
[5]	**Artificial Intelligence (AI), Robotics and Computational fluid dynamics:** General overview, Pharmaceutical Automation, Pharmaceutical applications, Advantages and Disadvantages. Current Challenges and Future Directions.	**12**	CO5

C. TEXT BOOKS

1. Ekins, S. Computer Applications in Pharmaceutical Research and Development Ekins/Computer Applications in Pharmaceutical Research and Development; Hoboken, Nj, USA John Wiley & Sons, Inc, 2006.

D. REFERENCE BOOKS

1. Jelena Djuris. Computer-Aided Applications in Pharmaceutical Technology; Woodhead Publishing: Oxford, 2013.
2. Swarbrick, J. Encyclopaedia of Pharmaceutical Technology; Vol 1-3; Marcel Dekker: New York, Ny, 2004.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Apply	To know role of computers and application of statistical modeling in pharmaceutical research.
CO2	Understand and Apply	To understand application of QbD and optimization techniques in pharmaceutical product development.
CO3	Understand	To know computational modeling techniques of drug disposition and biopharmaceutical process.
CO4	Understand and Remember	To know and understand application of computers modeling techniques in pharmacokinetic and pharmacodynamic of drugs.
CO5	Understand and Remember	To understand artificial intelligence in development of drug product.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	3	-	-	-	-	2	-	3	-	3	0	3
CO2	3	2	3	3	-	-	3	3	2	-	3	-	3	1	3
CO3	3	2	2	3	-	-	3	3	3	-	3	-	3	3	3
CO4	3	2	2	3	-	-	3	3	3	-	3	2	3	3	3
CO5	3	1	2	3	-	-	3	2	2	-	3	3	3	0	3
Avg	3	1.6	2	3	-	-	2.4	2.2	2.4	-	3	1	3	1.4	3

M. PHARM. SEMESTER – II (MPH)
SUBJECT: COSMETIC AND COSMECEUTICALS (MPH204T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	-	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart knowledge and skills necessary for the fundamental need for cosmetic and cosmeceutical products.

Objectives: Upon completion of the course the student shall be able to

- Key ingredients used in cosmetics and cosmeceuticals.
- Key building blocks for various formulations.
- Current technologies in the market
- Various key ingredients and basic science to develop cosmetics and cosmeceuticals.
- Scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	Cosmetics – Regulatory : Definition of cosmetic products as per Indian regulation. Indian regulatory requirements for labeling of cosmetics Regulatory provisions relating to import of cosmetics., Misbranded and spurious cosmetics. Regulatory provisions relating to manufacture of cosmetics – Conditions for obtaining license, prohibition of manufacture and sale of certain cosmetics, loan license, offences and penalties.	**12**	CO3
[2]	Cosmetics - Biological aspects : Structure of skin relating to problems like dry skin, acne, pigmentation, prickly heat, wrinkles and body odor. Structure of hair and hair growth cycle. Common problems associated with oral cavity. Cleansing and care needs for face, eye lids, lips, hands, feet, nail, scalp, neck, body and under-arm.	**12**	CO1 CO4 CO5
[3]	Formulation Building blocks: Building blocks for different product formulations of cosmetics/cosmeceuticals. Surfactants – Classification and application. Emollients, rheological additives: classification and application. Antimicrobial used as preservatives, their merits and demerits. Factors affecting microbial preservative efficacy. Building blocks for formulation of a moisturizing cream, vanishing cream, cold cream, shampoo and toothpaste. Soaps and syndet bars. Perfumes; Classification of perfumes. Perfume ingredients listed as allergens in EU regulation. Controversial ingredients: Parabens, formaldehyde liberators, dioxane.	**12**	CO1 CO2 CO3 CO4 CO5
[4]	Design of cosmeceutical products: Sun protection, sunscreens classification and regulatory aspects. Addressing dry skin, acne, sun-protection, pigmentation, prickly heat, wrinkles, body odor., dandruff, dental cavities, bleeding gums, mouth odor and sensitive teeth through cosmeceutical formulations.	**12**	CO1 CO2 CO4 CO5
[5]	Herbal Cosmetics: Herbal ingredients used in Hair care, skin care and oral care. Review of guidelines for herbal cosmetics by private bodies like cosmos with respect to preservatives, emollients, foaming agents, emulsifiers and rheology modifiers. Challenges in formulating herbal cosmetics.	**12**	CO1 CO2 CO4 CO5

C. TEXT BOOKS

1. Butler, H.; Poucher, W. A. Poucher's Perfumes, Cosmetics, and Soaps.; Kluwer Academic Publishers: Dordrecht ; Boston, 2000.

D. REFERENCE BOOKS

1. Ralph Gordon Harry; Rosen, M. R. *Harry's Cosmeticology*; Chemical Publishing Company: New York, 2015.

3. Sharma, P. P.; Vandana Publications. *Cosmetics : Formulation, Manufacturing & Quality Control*; Vandama Publications: Delhi, 2018.

4. Barel, A. O.; Paye, M.; Maibach, H. I. *Handbook of Cosmetic Science and Technology*; Taylor & Francis: Boca Raton, 2014.

5 And, T. *CTFA Membership Directory.*; Cosmetic, Toiletry And Fragrance Association, Inc: Washington, D.C., 1981.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remember, Understand and Evaluate	To understand the key ingredients used in cosmetics and cosmeceuticals.
CO2	Remember, Understand and Evaluate	To learn key building blocks for various formulations.
CO3	Understand Apply and Evaluate	To learn the current technologies and regulatory requirements of cosmetics in the market
CO4	Understand and Remember	To understand the various basic science to develop cosmetics and cosmeceuticals
CO5	Remember, Understand and Evaluate	To learn the scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	1	1	1	3	2	3	1	3	1	3	2
CO2	3	2	3	3	1	1	1	3	3	3	1	2	2	3	2
CO3	3	3	3	3	1	1	2	2	3	2	2	2	2	3	2
CO4	3	2	3	3	1	1	2	2	3	3	1	2	2	3	2
CO5	3	3	3	3	1	2	2	3	2	2	2	3	3	3	2
Avg	3	2.4	3	3	1	1.2	1.6	2.6	2.6	2.6	1.4	2.4	2	3	2

M. PHARM. SEMESTER – I (MPH)
SUBJECT: PHARMACEUTICS PRACTICAL – II (MPH205P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	12	12	6	100	30	20	-	100

A. COURSE OVERVIEW

Scope: This subject is designed to impart basic knowledge and skills on analytical techniques and development of various NDDS dosage forms

Objectives: Upon completion of the course student shall be able

- Formulation and evaluation of different novel drug delivery systems
- Application of QbD principles in designing dosage form.

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	1. To study the effect of temperature change , non solvent addition, 2. incompatible polymer addition in microcapsules preparation 3. Preparation and evaluation of Alginate beads 4. Formulation and evaluation of gelatin /albumin microspheres 5. Formulation and evaluation of liposomes/niosomes 6. Formulation and evaluation of spherules 7. Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique. 8. Comparison of dissolution of two different marketed products /brands 9. Development and evaluation of Creams 10. Development and evaluation of Shampoo and Toothpaste base 11. To incorporate herbal and chemical actives to develop products 12. To address Dry skin, acne, blemish, Wrinkles, bleeding gums and dandruff	**90**	CO1 CO3 CO5
[2]	1. Protein binding studies of a highly protein bound drug & poorly protein bound drug 2. Bioavailability studies of Paracetamol in animals. 3. Pharmacokinetic and IVIVC data analysis by WinnolineR software 4. In vitro cell studies for permeability and metabolism 5. DoE Using Design Expert® Software 6. Formulation data analysis Using Design Expert® Software 7. Quality-by-Design in Pharmaceutical Development 8. Computer Simulations in Pharmacokinetics and Pharmacodynamics 9. Computational Modeling Of Drug Disposition 10. To develop Clinical Data Collection manual 11. To carry out Sensitivity Analysis, and Population Modeling.	**90**	CO2 CO4

C. TEXT BOOKS

D. REFERENCE BOOKS

E. COURSE OUTCOMES

(Minimum 5 Cos are required)

CO Number	Skill	Statement
CO1	understand and analyse	Formulate and characterize various novel drug delivery systems
CO2	Learn	Pharmacokinetic and IVIVC data analysis, simulation of pharmacokinetic using appropriate computational program/s
CO3	Understand	Preparation and characterization of cosmetic preparations, herbal active containing products and toiletry items
CO4	Understand and Remember	Applications of design of experiment software/s and Quality-by Design in pharmaceutical development.
CO5	Understand and apply	Solubility improvement techniques & Dissolution profile comparison by various tools

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	1	2	2	2	2	2	1	3	3	1	1
CO2	3	3	2	2	2	3	2	3	2	3	2	2	3	3	3
CO3	3	3	3	2	2	2	2	3	2	3	2	3	3	2	1
CO4	3	3	3	3	1	2	1	2	2	2	3	2	3	2	3
CO5	3	3	3	3	1	2	2	2	2	3	2	2	3	3	3
Avg	3	3	2.6	2.6	1.4	2.2	1.8	2.4	2	2.6	2	2.4	3	2.2	2.2

M. PHARM. SEMESTER – II (MQA)
SUBJECT: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES - THEORY (MQA101T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	--	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives: After completion of course, student is able to know about

1. Chemicals and excipients
2. The analysis of various drugs in single and combination dosage forms
3. Theoretical and practical skills of the instruments

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**a. UV-Visible spectroscopy**: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy. **b. IR spectroscopy**: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier -Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation. **c. Spectroflourimetry**: Theory of Fluorescence, Factors affecting fluorescence (Characterestics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **d. Flame emission spectroscopy and Atomic absorption spectroscopy**: Principle, Instrumentation, Interferences and Applications.	**11**	CO1 CO2 CO5
[2]	**NMR spectroscopy**: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy	**11**	CO1 CO2 CO5
[3]	**Mass Spectroscopy**: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.	**11**	CO1 CO2 CO5
[4]	**Chromatography**: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following: ● Thin Layer chromatography ● High Performance Thin Layer Chromatography	**11**	CO3 CO4 CO5

	• Ion exchange chromatography • Column chromatography • Gas chromatography • High Performance Liquid chromatography • Ultra High Performance Liquid chromatography • Affinity chromatography • Gel Chromatography.		
[5]	**a. Electrophoresis**: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing **b. X ray Crystallography**: Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.	**11**	CO5
[6]	**a. Potentiometry**: Principle, working, Ion selective Electrodes and Application of potentiometry. **b. Thermal Techniques**: Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.	**05**	CO5

C. TEXT BOOKS

1. Connors, K. A. *A Textbook of Pharmaceutical Analysis*; Wiley: New York, 1982..
2. Mendham, A. *Vogel's Textbook of Quantitative Chemical Analysis.*; Pearson: New Delhi, 2009.

D. REFERENCE BOOKS

1. JW Munson. *Pharmaceutical Analysis - Modern Methods Part-B*; Marcel. Dekker Series.; Vol. 11.
2. Kalsi, P. S. *Spectroscopy of Organic Compounds.*; New Age International Pvt, 2016.
3. Silverstein, R. M.; Webster, F. X.; Kiemle, D. J.; Bryce, D. L. *Spectrometric Identification of Organic Compounds*; Wiley: Hoboken, Nj, 2015.
4. Skoog, D. A.; F James Holler; Crouch, S. R. *Principles of Instrumental Analysis*; Thomson, Brooks/Cole: Belmont, Ca, 2007.
5. Hobart Hurd Willard. *Instrumental Methods of Analysis*; Wadsworth: Belmont, 1993.
6. Kemp, W. *Organic Spectroscopy*; Palgrave: Basingstoke, 2001.
7. Sethi, P. D. *Quantitative Analysis of Drugs in Pharmaceutical Formulations*; Cbs Publishers & Distributors: New Delhi, 2005.
8. Beckett, A. H.; Stenlake, J. B. *Practical Pharmaceutical Chemistry*; Athlone Press: London, 1988.

9. Sharma B K. *Instrumental Methods of Chemical Analysis*, 27th edition.; Goel Publishing House: Meerut, 2011.
10. Sharma, Y. R. *Elementary Organic Spectroscopy : Principles and Chemical Applications*; S. Chand & Company: New Delhi, 2007.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To understand the fundamentals of various spectroscopic techniques
CO2	Understand Apply and Evaluate	To apply the fundamentals of spectroscopy in single and combination drug analysis
CO3	Understand and remember	To understand the chromatographic separation fundamentals
CO4	Understand Apply and Evaluate	To apply the fundamentals of various chromatographic techniques in single and combination drug analysis
CO5	Understand Apply and Evaluate	To learn theoretical and practical aspects of various analytical instruments.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	-	1	1	-	1	-	1	-	-	3	2	-	-	-
CO2	3	2	3	2	-	2	1	1	2	-	3	3	1	1	-
CO3	3	-	1	1	-	1	-	1	-	-	3	2	-	-	-
CO4	3	2	3	2	-	2	1	1	2	-	3	3	1	1	-
CO5	3	2	1	1	-	2	1	1	1	-	3	3	1	1	-
Avg	3	1.2	1.8	1.4	-	1.6	0.6	1	1	-	3	2.6	0.6	0.6	-

M. PHARM. SEMESTER – I (MQA)
SUBJECT: QUALITY MANAGEMENT SYSTEM-THEORY (MQA102T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	0	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart fundamental knowledge and concepts about various quality management principles and systems utilized in the manufacturing industry. It also aids in understanding the quality evaluation in the pharmaceutical industries.

Objectives: At completion of this course, it is expected that students will be able to understand-

- The importance of quality
- ISO management systems
- Tools for quality improvement
- Analysis of issues in quality
- Quality evaluation of pharmaceuticals
- Stability testing of drug and drug substances
- Statistical approaches for quality

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Introduction to Quality:** Evolution of Quality, Definition of Quality, Dimensions of Quality **Quality as a Strategic Decision:** Meaning of strategy and strategic quality management, mission and vision statements, quality policy, Quality objectives, strategic planning and implementation, McKinsey 7s model, Competitive analysis, Management commitment to quality **Customer Focus:** Meaning of customer and customer focus, Classification of customers, Customer focus, Customer perception of quality, Factors affecting customer perception, Customer requirements, Meeting customer needs and expectations, Customer satisfaction and Customer delight, Handling customer complaints, Understanding customer behavior, concept of internal and external customers. Case studies. **Cost of Quality:** Cost of quality, Categories of cost of Quality, Models of cost of quality, Optimising costs, Preventing cost of quality.	**12**	CO1 CO3
[2]	**Pharmaceutical quality Management:** Basics of Quality Management, Total Quality Management (TQM), Principles of Six sigma, ISO 9001:2008, 9001:2015, ISO 14001:2004, Pharmaceutical Quality Management – ICH Q10, Knowledge management, Quality Metrics, Operational Excellence and Quality Management Review. OSHAS guidelines, NABL certification and accreditation, CFR-21 part 11, WHO-GMP requirements.	**12**	CO1 CO2 CO3
[3]	**Six System Inspection model:** Quality Management system, Production system, Facility and Equipment system, Laboratory control system, Materials system, Packaging and labeling system. Concept of self inspection. Quality systems: Change Management/ Change control. Deviations, Out of Specifications (OOS), Out of Trend (OOT), Complaints - evaluation and handling, Investigation and determination of root cause,	**12**	CO4

	Corrective & Preventive Actions (CAPA), Returns and Recalls, Vendor Qualification, Annual Product Reviews, Batch Review and Batch Release. Concept of IPQC, area clearance/ Line clearance.		
[4]	**Drug Stability:** ICH guidelines for stability testing of drug substances and drug products. Study of ICH Q8, Quality by Design and Process development report Quality risk management: Introduction, risk assessment, risk control, risk review, risk management tools, HACCP, risk ranking and filtering according to ICH Q9 guidelines.	**12**	CO5
[5]	**Statistical Process control (SPC):** Definition and Importance of SPC, Quality measurement in manufacturing, Statistical control charts - concepts and general aspects, Advantages of statistical control, Process capability, Estimating Inherent or potential capability from a control chart analysis, Measuring process control and quality improvement, Pursuit of decreased process variability.	**08**	CO1 CO3 CO4
[6]	Regulatory Compliance through Quality Management and development of Quality Culture Benchmarking: Definition of benchmarking, Reasons for benchmarking, Types of Benchmarking, Benchmarking process, Advantages of benchmarking, Limitations of benchmarking.	**04**	CO1 CO3 CO4

C. TEXT BOOKS

1. Fairfield-Sonn, J. W. Corporate Culture and the Quality Organization; Quorum Books: Westport, Conn., 2001.

D. REFERENCE BOOKS

1. Endres, A. C. Implementing Juran's Road Map for Quality Leadership : Benchmarks and Results; Wiley: New York, 2000.
2. Antony J, David P, Routledge, Understanding, Managing and Implementing Quality: Frameworks, Techniques and Cases, 2002
3. Okes D, Root Cause Analysis, The Core of Problem Solving and Corrective Action, 2009, ASQ Publications.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Remember	To understand importance of quality and Tools for quality improvement
CO2	Understand	To study the ISO management systems
CO3	Understand and Apply	To understand the Analysis of issues in quality and Statistical approaches for quality
CO4	Understand and Remember	To study the Quality evaluation of pharmaceuticals
CO5	Understand and Apply	To understand the Stability testing of drug and drug substances

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1	2	1	2	2	1	2	2	2	2	2
CO2	3	3	3	3	1	3	0	2	1	2	3	3	3	3	3
CO3	3	2	2	2	1	2	0	2	2	1	2	2	2	2	2
CO4	3	3	3	3	1	3	1	2	1	2	3	3	3	3	3
CO5	3	3	3	3	1	3	0	2	2	2	3	3	3	3	3
Avg	3	2.6	2.6	2.6	1	2.6	0.4	2	1.6	1.6	2.6	2.6	2.6	2.6	2.6

M. PHARM. SEMESTER – I (MQA)
SUBJECT: QUALITY CONTROL AND QUALITY ASSURANCE (MQA103T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	0	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It covers the important aspects like cGMP, QC tests, documentation, quality certifications, GLP and regulatory affairs.

Objectives: Upon completion of this course the student should be able to

Understand the cGMP aspects in a pharmaceutical industry

- To appreciate the importance of documentation
- To understand the scope of quality certifications applicable to
- Pharmaceutical industries
- To understand the responsibilities of QA & QC departments.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Introduction:** Concept and evolution and scopes of Quality Control and Quality Assurance, Good Laboratory Practice, GMP, Overview of ICH Guidelines - QSEM, with special emphasis on Q-series guidelines. Good Laboratory Practices: Scope of GLP, Definitions, Quality assurance unit, protocol for conduct of non clinical testing, control on animal house, report preparation and documentation. CPCSEA guidelines.	**12**	CO1 CO2 CO5
[2]	cGMP guidelines according to schedule M, USFDA (inclusive of CDER and CBER) Pharmaceutical Inspection Convention(PIC), WHO and EMEA covering: Organization and personnel responsibilities, training, hygiene and personal records, drug industry location, design, construction and plant lay out, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination and Good Warehousing Practice.	**12**	CO1 CO2 CO5
[3]	Analysis of raw materials, finished products, packaging materials, in process quality control (IPQC), Developing specification (ICH Q6 and Q3), purchase specifications and maintenance of stores for raw materials. In process quality control and finished products quality control for following dosage forms in Pharma industry according to Indian, US and British pharmacopoeias: tablets, capsules, ointments, suppositories, creams, parenterals, ophthalmic and surgical products (How to refer pharmacopoeias).	**12**	CO1 CO2 CO4 CO5
[4]	Documentation in pharmaceutical industry: Three tier documentation, Policy, Procedures and Work instructions, and records (Formats), Basic principles- How to maintain, retention and retrieval etc. Standard operating procedures (How to write), Master Batch Record, Batch Manufacturing Record, Quality audit plan and reports. Specification and test procedures, Protocols and reports. Distribution records. Electronic data handling. Concepts of controlled and uncontrolled documents. Submission documents for regulators DMFs, as Common Technical	**12**	CO2 CO3 CO5

	Document and Electronic Common Technical Documentation (CTD, eCTD). Concept of regulated and non regulated markets.		
[5]	Manufacturing operations and controls: Sanitation of manufacturing premises, mix-ups and cross contamination, processing of intermediates and bulk products, packaging operations, IPQC, release of finished product, process deviations, charge-in of components, time limitations on production, drug product inspection, expiry date calculation, calculation of yields, production record review, change control, sterile products, aseptic process control, packaging, reprocessing, salvaging, handling of waste and scrap disposal. Introduction, scope and importance of intellectual property rights. Concept of trade mark, copyright and patents.	**12**	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Quality Assurance of Pharmaceuticals- A compedium of Guide lines and Related materials Vol I & II, 2 nd edition, WHO Publications, 1999.

D. REFERENCE BOOKS

1. Weinberg, S. Good Laboratory Practice Regulations; M. Dekker: New York, 1995.
2. Sarker, D. K. *Quality Systems and Control for Pharmaceuticals*; John Wiley & Sons: Chichester, West Sussex ; Hoboken, Nj, 2008.
3. Willig, S. H.; Stoker, J. R. Good Manufacturing Practices for Pharmaceuticals : A Plan for Total Quality Control; Marcel Dekker: New York, 1997.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To Understand the cGMP aspects in a pharmaceutical industry
CO2	Understand	To appreciate the importance of documentation
CO3	Understand and apply	To understand the scope of quality certifications applicable to pharmaceutical industries
CO4	Understand and evaluate	To Analyse of raw materials, finished products, packaging materials in process quality control (IPQC)
CO5	Understand and apply	To understand the responsibilities of QA & QC departments.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1	2	1	2	2	1	3	3	3	2	1
CO2	3	2	2	2	1	2	1	2	1	2	3	3	3	3	1
CO3	3	2	2	2	1	2	-	2	2	1	3	3	3	2	1
CO4	3	2	2	2	2	3	1	2	1	3	3	3	3	3	1
CO5	3	2	2	2	3	3	-	2	2	3	3	3	3	3	1
Avg	3	2	2	2	1.6	2.4	0.6	2	1.6	2	2.6	3	3	2.6	1

M. PHARM. SEMESTER – I (MPH)
SUBJECT: PRODUCT DEVELOPMENT AND TECHNOLOGY TRANSFER (MQA104T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	-	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: Scope This deal with technology transfer covers the activities associated with Drug Substance, Drug Product and analytical tests and methods, required following candidate drug selection to completion of technology transfer from R&D to the first receiving site and technology transfer related to post-marketing changes in manufacturing places.
Objectives: Upon completion of this course the student should be able to

- To understand the new product development process
- To understand the necessary information to transfer technology from R&D to actual manufacturing by sorting out various information obtained during R&D
- To elucidate necessary information to transfer technology of existing products between various manufacturing places

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Principles of Drug discovery and development:** Introduction, Clinical research process. Development and informational content for Investigational New Drugs Application (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA), Supplemental New Drug Application (SNDA), Scale Up Post Approval Changes (SUPAC) and Bulk active chemical Post approval changes (BACPAC), Post marketing surveillance, Product registration guidelines – CDSCO, USFDA.	**12**	CO1 CO2
[2]	**Pre-formulation studies:** Introduction/concept, organoleptic properties, purity, impurity profiles, particle size, shape and surface area. Solubility, Methods to improve solubility of Drugs: Surfactants & its importance, co-solvency. Techniques for the study of Crystal properties and polymorphism. Pre-formulation protocol, Stability testing during product development.	**12**	CO3 CO4
[3]	**Pilot plant scale up:** Concept, Significance, design, layout of pilot plant scales up study, operations, large scale manufacturing techniques (formula, equipment, process, stability and quality control) of solids, liquids, semisolid and parenteral dosage forms. New era of drug products: opportunities and challenges.	**12**	CO1 CO2
[4]	**Pharmaceutical packaging:** Pharmaceutical dosage form and their packaging requirements, Pharmaceutical packaging materials, Medical device packaging, Enteral Packaging, Aseptic packaging systems, Container closure systems, Issues facing modern drug packaging, Selection and evaluation of Pharmaceutical packaging materials. **Quality control test**: Containers, closures and secondary packing materials.	**12**	CO3 CO4

[5]	**Technology transfer:** Development of technology by R & D, Technology transfer from R & D to production, Optimization and Production, Qualitative and quantitative technology models. Documentation in technology transfer: Development report, technology transfer plan and Exhibit.	**12**	CO5

C. TEXT BOOKS

1. Lachman, L.; Liebermann, H. A. The Theory and Practice of Industrial Pharmacy; Cbs Publishers & Distributors Pvt. Ltd: New Delhi, 2013.

D. REFERENCE BOOKS

1. Smith, C. G.; O'donnell, J. The Process of New Drug Discovery and Development; Informa Healthcare: New York, 2006.
2. Willig, S. H.; Tuckerman, M. M.; Hitchings, W. S. Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control; M. Dekker: New York, 1982.
3. Lieberman, H. A. Pharmaceutical Dosage Forms. Tablets, Vol. 1-3; New York, Ny Dekker, 1989.
4. Gibaldi, M. Biopharmaceutics and Clinical Pharmacokinetics; Pharmamed Press: Hyderabad, India, 2013.
5. Vandana Patravale; Disouza, J. I.; Maharukh Rustomjee. Pharmaceutical Product Development: Insights into Pharmaceutical Processes, Management and Regulatory Affairs; CRC Press: Boca Raton, 2016.
6. Abdou, H. M. Dissolution, Bioavailability and Bioequivalence; Mack Publishing Company: Easton, 1989.
7. Remington, J. P.; Gennaro, A. R. Remington: The Science and Practice of Pharmacy; Lippincott Williams & Wilkins: Baltimore, Md., 2000.
8. Dr. D.A.Savant. The Pharmaceutical Sciences; the Pharma Path Way 'Pure and Applied Pharmacy; Pragathi Books Pvt. Ltd, 2018.
9. Dean, D. A.; Evans, E. R.; Hall, I. H. Pharmaceutical Packaging Technology.; Taylor And Francis: London, 2000.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To understand new drug approval process and product registration guideline
CO2	Understand and Apply	To understand and apply preformulation studies in drug product development.
CO3	Understand	To understand development of drug product from R&D to Large scale manufacturing.
CO4	Understand and Evaluate	To understand and evaluate packaging requirement for drug products.
CO5	Understand and Create	To understand regulation for technology transfer for drug product development

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	3	-	3	-	3	3	0	3	3	2	2	-
CO2	3	3	3	3	-	1	-	3	0	0	3	3	3	3	1
CO3	3	3	1	3	3	3	3	3	3	3	3	3	3	2	2
CO4	3	-	3	3	-	0	1	0	1	2	3	3	3	3	2
CO5	3	3	3	3	3	3	3	3	3	2	3	3	3	3	2
Avg	3	2.4	2	3	1.2	2	1.4	2.4	2	1.4	3	3	2.8	2.6	1.4

M. PHARM. SEMESTER – I (MQA)
SUBJECT: PHARMACEUTICAL QUALITY ASSURANCE – PRACTICAL-I (MQA105P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	12	12	6	100	30	20	--	150

A. COURSE OVERVIEW

Scope: This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs dosage forms, preformulation study, stability study etc. as well as Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives: After completion of course, student is able

- To understand and apply the fundamentals of spectroscopy and chromatography in single and combination drug analysis
- To understand the role of analytical techniques in preformulation, stability study, formulation analysis, QC testing and Modern statistical tools in analysis
- To understand working and handling of various analytical instruments.

B. COURSE CONTENT

NO	TOPIC	P (hrs)	COs
[1]	**1**.Analysis of Pharmacopoeial compounds in bulk and in their formulations (tablet/ capsules/ semisolids) by UV Vis spectrophotometer **2**. Simultaneous estimation of multi-drug component containing formulations by UV spectrophotometry **3.** Experiments based on HPLC **4**. Experiments based on Gas Chromatography **5**. Estimation of riboflavin/quinine sulphate by fluorimetry **6**. Estimation of sodium/potassium by flame photometry or AAS **7**. Assay of raw materials as per official monographs **8.**Testing of related and foreign substances in drugs and raw materials	**90**	CO1 CO2 CO3 CO5
[2]	**1.** Case studies on • Total Quality Management • Six Sigma • Change Management/ Change control. Deviations, • Out of Specifications (OOS) • Out of Trend (OOT) • Corrective & Preventive Actions (CAPA) • Deviations **2.** Development of Stability study protocol **3** Estimation of process capability **4.** In process and finished product quality control tests for tablets, capsules,parenterals and semisolid dosage forms. **5.**To carry out pre formulation study for tablets, parenterals (2 experiment). **6**. To study the effect of pH on the solubility of drugs, (1 experiment) **7**. Quality control tests for Primary and secondary packaging materials **8**. Accelerated stability studies (1 experiment) **9**. Improved solubility of drugs using surfactant systems (1 experiment) **10**. Improved solubility of drugs using co-solvency method (1 experiment) 19. Determination of Pka and Log p of drugs.	**90**	CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Beckett, A. H.; Stenlake, J. B. *Practical Pharmaceutical Chemistry*; Athlone Press: London, 1988.
2. Lachman, L.; Liebermann, H. A. *The Theory and Practice of Industrial Pharmacy*; Cbs Publishers & Distributors Pvt. Ltd: New Delhi, 2013.

D. REFERENCE BOOKS

1. *Indian Pharmacopoeia*; Indian Pharmacopoeial Commission, Ministry of health and family welfare, Government of India: Ghaziabad, 2014; Vol. 1-4.
2. JW Munson. *Pharmaceutical Analysis - Modern Methods Part-B*; Marcel. Dekker Series.; Vol. 11.
3. Skoog, D. A.; F James Holler; Crouch, S. R. *Principles of Instrumental Analysis*; Thomson, Brooks/Cole: Belmont, Ca, 2007.
4. Sethi, P. D. *Quantitative Analysis of Drugs in Pharmaceutical Formulations*; Cbs Publishers & Distritutors: New Delhi, 2005.
5. Sharma B K. *Instrumental Methods of Chemical Analysis*, 27th edition.; Goel Publishing House: Meerut, 2011.
6. Garratt, D. C. *The Quantitative Analysis of Drugs : Assisted by L. Brealey Etc.*; Chapman & Hall: London, 1964.
7. Mendham, A. *Vogel's Textbook of Quantitative Chemical Analysis.*; Pearson: New Delhi, 2009.
8. Connors, K. A. *A Textbook of Pharmaceutical Analysis*; Wiley: New York, 1982.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To understand and apply the fundamentals of spectroscopy in single and combination drug analysis
CO2	Understand Apply and Evaluate	To understand and apply the fundamentals of chromatography in single and combination drug analysis
CO3	Understand Apply and Evaluate	To understand the role of analytical techniques in preformulation, stability study and formulation analysis.
CO4	Understand Apply and Evaluate	To understand the role of analytical techniques in QC testing and applications of modern statistical tools in analysis
CO5	Understand Apply and Evaluate	To understand working and handling of various analytical instruments.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	1	2	1	1	1	-	3	3	1	1	-
CO2	3	3	3	2	1	2	1	1	1	-	3	3	1	1	-
CO3	3	3	3	2	1	2	1	1	1	-	3	3	1	1	-
CO4	3	3	3	2	1	2	1	1	1	-	3	3	1	3	-
CO5	3	2	-	-	1	2	1	1	-	-	3	2	1	-	-
Avg	3	2.8	2.4	1.6	1	2	1	1	0.8	-	3	2.8	1	1.2	-

M. PHARM. SEMESTER – II (MQA)
SUBJECT: HAZARDS AND SAFETY MANAGEMENT (MQA201T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	0	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to convey the knowledge necessary to understand issues related to different kinds of hazard and their management. Basic theoretical and practical discussions integrate the proficiency to handle the emergency situation in the pharmaceutical product development process and provides the principle-based approach to solve the complex tribulations.

Objectives: At completion of this course, it is expected that students will be able to

- Understand about environmental problems among learners.
- Impart basic knowledge about the environment and its allied problems.
- Develop an attitude of concern for the industry environment.
- Ensure safety standards in pharmaceutical industry
- Provide comprehensive knowledge on the safety management
- Empower an ideas to clear mechanism and management in different kinds of hazard management system
- Teach the method of Hazard assessment, procedure, methodology for provide safe industrial atmosphere.

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Multidisciplinary nature of environmental studies**: Natural Resources, Renewable and non-renewable resources, Natural resources and associated problems, a) Forest resources; b) Water resources; c) Mineral resources; d) Energy resources; e) Land resources Ecosystems: Concept of an ecosystem and Structure and function of an ecosystem. Environmental hazards: Hazards based on Air, Water, Soil and Radioisotopes.	**12**	CO1
[2]	**Air based hazards**: Sources, Types of Hazards, Air circulation maintenance industry for sterile area and non sterile area, Preliminary Hazard Analysis (PHA) Fire protection system: Fire prevention, types of fire extinguishers and critical Hazard management system.	**12**	CO2 CO3 CO4 CO5
[3]	**Chemical based hazards:** Sources of chemical hazards, Hazards of Organic synthesis, sulphonating hazard, Organic solvent hazard, Control measures for chemical hazards, Management of combustible gases, Toxic gases and Oxygen displacing gases management, Regulations for chemical hazard, Management of over-Exposure to chemicals and TLV concept.	**12**	CO2 CO3 CO4 CO5
[4]	**Fire and Explosion :** Introduction, Industrial processes and hazards potential, mechanical electrical, thermal and process hazards. Safety and hazards regulations, Fire protection system: Fire prevention, types of fire extinguishers and critical Hazard management system mechanical and chemical explosion, multiphase reactions, transport effects and global rates. Preventive and protective management from fires and explosion-	**12**	CO2 CO3 CO4 CO5

	electricity passivation, ventilation, and sprinkling, proofing, relief systems -relief valves, flares, scrubbers.		
[5]	**Hazard and risk management**: Self-protective measures against workplace hazards. Critical training for risk management, Process of hazard management, ICH guidelines on risk assessment and Risk management methods and Tools Factory act and rules, fundamentals of accident prevention, elements of safety programme and safety management, Physicochemical measurements of effluents, BOD, COD, Determination of some contaminants, Effluent treatment procedure, Role of emergency services.	**12**	CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Bharucha E, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India.
2. Gajjar D, Nagdev S, A TEXTBOOK OF HAZARDS AND SAFETY MANAGEMENT, PV books, 2020.

D. REFERENCE BOOKS

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. T S S Dikshith. Hazardous Chemicals Safety Management and Global Regulations; Crc Press: Boca Raton, Florida, 2017.
3. "Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and apply	To understand about environmental problems among learners and impart basic knowledge about the environment and its allied problems.
CO2	Understand and Analyse	Development of attitude of concern for the industry environment and ensure safety standards in pharmaceutical industry
CO3	Understand and Remember	To provide comprehensive knowledge on the safety management
CO4	Understand and Apply	To empower ideas to clear mechanism and management in different kinds of hazard management system
CO5	Understand and Remember	To understand the method of Hazard assessment, procedure, methodology for provide safe industrial atmosphere

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1	3	2	3	1	2	3	3	-	1	-	-
CO2	3	3	3	1	3	2	1	1	3	3	3	-	1	-	-
CO3	3	3	3	1	3	2	-	1	3	3	3	-	1	-	-
CO4	3	3	3	1	3	2	-	1	3	3	3	-	1	-	-
CO5	3	3	3	1	3	2	-	1	3	3	3	-	1	-	-
Avg	3	3	3	1	3	2	0.8	1	2.8	3	3	-	1	-	-

M. PHARM. SEMESTER – II (MPH)
SUBJECT: PHARMACEUTICAL VALIDATION (MQA202T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Prac.	Total		Ext	Sess.	CM	Prac.	Total
04	-	-	04	04	75	15	10	-	100

A. COURSE OVERVIEW

Scope:The main purpose of the subject is to understand about validation and how it can be applied to industry and thus improve the quality of the products. The subject covers the complete information about validation, types, methodology and application.

Objectives:

At completion of this course, it is expected that students will be able to understand:

- Understand and remember the concept of calibration, qualification and validation
- Learn the theoretical aspects about the qualification of various equipments and instruments
- Understand and learn process validation of different dosage forms
- Learn the validation of analytical methods developed for quantification of drugs
- Understand and learn the cleaning validation of equipments employed in the manufacture of pharmaceuticals
- Learn the importance of patent and intellectual property rights

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	Introduction to validation: Definition of Calibration, Qualification and Validation, Scope, frequency and importance. Difference between calibration and validation. Calibration of weights and measures. Advantages of Validation, scope of Validation, Organization for Validation, Validation Master plan, Types of Validation, Streamlining of qualification & Validation process and Validation Master Plan. Qualification: User requirement specification, Design qualification, Factory Acceptance Test (FAT)/Site Acceptance Test (SAT), Installation qualification, Operational qualification, Performance qualification, Re-Qualification (Maintaining status- Calibration Preventive Maintenance, Change management).	**10**	CO1
[2]	Qualification of manufacturing equipment: Dry Powder Mixers, Fluid Bed and Tray dryers, Tablet Compression (Machine), Dry heat sterilization/Tunnels, Autoclaves, Membrane filtration, Capsule filling machine. Qualification of analytical instruments: UV-Visible spectrophotometer, FTIR, DSC, GC, HPLC, HPTLC, LC-MS.	**10**	CO2
[3]	Qualification of laboratory equipments: Hardness tester, Friability test apparatus, tap density tester, Disintegration tester, Dissolution test apparatus Validation of Utility systems: Pharmaceutical water system & pure steam, HVAC system, Compressed air and nitrogen.	**10**	CO2
[4]	Process Validation: Concept, Process and documentation of Process Validation. Prospective, Concurrent & Retrospective Validation, Re validation criteria, Process Validation of various formulations (Coated tablets, Capsules, Ointment/Creams, Liquid Orals and aerosols.), Aseptic filling: Media fill validation, USFDA guidelines on Process Validation- A life cycle approach. Analytical method validation: General principles, Validation of analytical method as per ICH guidelines and USP.	**10**	CO3 CO4

[5]	Cleaning Validation: Cleaning Method development, Validation of analytical method used in cleaning, Cleaning of Equipment, Cleaning of Facilities. Cleaning in place (CIP). Validation of facilities in sterile and non-sterile plant. Computerized system validation: Electronic records and digital signature - 21 CFR Part 11 and GAMP	**10**	CO5
[6]	General Principles of Intellectual Property: Concepts of Intellectual Property (IP), Intellectual Property Protection (IPP), Intellectual Property Rights (IPR); Economic importance, mechanism for protection of Intellectual Property –patents, Copyright, Trademark; Factors affecting choice of IP protection; Penalties for violation; Role of IP in pharmaceutical industry; Global ramification and financial implications. Filing a patent applications; patent application forms and guidelines. Types patent applications-provisional and non provisional, PCT and convention patent applications; International patenting requirement procedures and costs; Rights and responsibilities of a patentee; Practical aspects regarding maintaining of a Patent file; Patent infringement meaning and scope. Significance of transfer technology (TOT), IP and ethics-positive and negative aspects of IPP; Societal responsibility, avoiding unethical practices.	**10**	CO6

C. TEXT BOOKS

1. Berry, I. R.; Nash, R. A. *Pharmaceutical Process Validation*; Marcel Dekker: New York, 1993.
2. Syed Imtiaz Haider. *Pharmaceutical Master Validation Plan : The Ultimate Guide to FDA, GMP, and GLP Compliance*; St. Lucie Press: Boca Raton, 2002.

D. REFERENCE BOOKS

1. Loftus, B. T.; Nash, R. A. *Pharmaceutical Process Validation*; M. Dekker: New York ; Basel, 1984.
2. Carleton, F. J.; Agalloco, J. P. *Validation of Pharmaceutical Processes : Sterile Products*; M. Dekker: New York, 1999.
3. Lachman, L.; Liebermann, H. A. *The Theory and Practice of Industrial Pharmacy*; Cbs Publishers & Distributors Pvt. Ltd: New Delhi, 2013.
4. Syed Imtiaz Haider. *Validation Standard Operating Procedures a Step by Step Guide for Achieving Compliance in the Pharmaceutical, Medical Device, and Biotech Industries*; Informa Healthcare, 2001.
5. Cloud, P. A. *Pharmaceutical Equipment Validation : The Ultimate Qualification Handbook*; Informa Healthcare: New York, 2007. Validation of Pharmaceutical Processes: Sterile Products, Frederick J. Carlton (Ed.) and James Agalloco (Ed.), Marcel Dekker
6. Chung Chow Chan. *Analytical Method Validation and Instrument Performance Verification*; John Wiley & Sons: Hoboken, N.J., 2004.
7. Ludwig Huber. *Validation and Qualification in Analytical Laboratories*; Informa Healthcare: New York, 2007.
8. Respect, I.; Al, E. *Principles of Qualification and Validation in Pharmaceutical Manufacture : Recommendations on : Validation Master Plan : Installation and Operational Qualification : Non-Sterile Process Validation : Cleaning Validation*; S.L.] [S.N, 1996.
9. Destin Leblanc. *Validated Cleaning Technologies for Pharmaceutical Manufacturing*; Crc Press, 2000

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	Understand and remember the concept of calibration, qualification and validation
CO2	Learn	Learn the theoretical aspects about the qualification of various equipments and instruments
CO3	Understand and learn	Understand and learn analytical method validation and Pharmaceutical process validation
CO4	Learn	Understand and learn the cleaning validation of equipments employed in the manufacture of pharmaceuticals
CO5	Understand and learn	Learn the importance of patent and intellectual property rights

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	-	-	-	-	1	-	3	2	2	1	2
CO2	3	3	2	1	1	1	1	1	1	-	3	3	3	3	3
CO3	3	3	2	1	1	1	1	1	1	-	3	3	3	3	3
CO4	3	3	2	1	1	1	1	1	1	-	3	3	3	3	3
CO5	3	-	-	-	-	2	3	2	2	-	3	1	1	-	-
Avg.	3	2	1.2	0.6	0.6	1	1.2	1	1.2	-	3	2.4	2.4	2	2.2

M. PHARM. SEMESTER – II (MQA)
SUBJECT: AUDITS AND REGULATORY COMPLIANCE (MQA203T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	-	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course deals with the understanding and process for auditing in pharmaceutical industries. This subject covers the different aspects like methodology involved in the auditing process of different in pharmaceutical industries, preparing audit report and audit checklist preparation etc.

Objectives: Upon completion of this course the student should be able to

- To understand the importance of auditing
- To understand the methodology of auditing
- To carry out the audit process
- To prepare the auditing report
- To prepare the check list for auditing

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**Introduction: Objectives,** Management of audit, Responsibilities, Planning process, information gathering, administration, Classifications of deficiencies	**12**	CO1 CO2
[2]	**Role of quality systems and audits in pharmaceutical manufacturing environment:** cGMP Regulations, Quality assurance functions, Quality systems approach, Management responsibilities, Resource, Manufacturing operations, Evaluation activities, Transitioning to quality system approach, Audit checklist for drug industries.	**12**	CO1 CO2 CO5
[3]	**Auditing of vendors and production department:** Bulk Pharmaceutical Chemicals and packaging material Vendor audit, Warehouse and weighing, Dry Production: Granulation, tableting, coating, capsules, sterile production and packaging.	**12**	CO3 CO4 CO5
[4]	**Auditing of Microbiological laboratory:** Auditing the manufacturing process, Product and process information, General areas of interest in the building raw materials, Water, Packaging materials.	**12**	CO3 CO4 CO5
[5]	**Auditing of Quality Assurance and engineering department:** Quality Assurance Maintenance, Critical systems: HVAC, Water, Water for Injection systems, ETP	**12**	CO3 CO4 CO5

C. TEXT BOOKS

1. Ginsbury, K., Bismuth, G. Compliance auditing for Pharmaceutical Manufacturers, Interpharm/CRC, London, 2018

D. REFERENCE BOOKS

1. Gad, C.S. Pharmaceutical Manufacturing Handbook, Wiley-Interscience,1st ed,; New Jersey, 2008
2. Baird, R.M., Hodges, N.A., Denyar, S.P. Handbook of microbiological Quality control, 1st ed,; CRC Press, London, 2017.
3. Singer, D.C., Stefan, R., Van Staden, J.F. Laboratory auditing for quality and regulatory compliance, 1st ed,; Taylor and Francis, Boca Raton, 2005

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and remember	To discuss the importance of auditing
CO2	Understand and remember	To explain the methodology of auditing
CO3	Apply and evaluate	To describe the audit process
CO4	Analysis, Apply and Create	To prepare the audit report
CO5	Apply and create	To prepare the check list for auditing

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	1	-	-	-	-	-	3	2	2	1	2
CO2	2	1	0	3	1	-	-	-	-	-	3	2	3	2	2
CO3	2	1	2	2	1	-	-	-	-	-	3	3	3	3	2
CO4	2	2	1	2	1	-	-	2	-	-	3	2	3	2	2
CO5	3	1	1	2	2	-	-	2	-	-	3	1	3	1	3
Avg	2.2	1.2	1	2.2	1.2	-	-	0.8	-	-	3	2	2.8	1.8	2.2

M. PHARM. SEMESTER – II (MQA)

SUBJECT: PHARMACEUTICAL MANUFACTURING TECHNOLOGY (MQA204T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	-	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: This course is designed to impart knowledge and skills necessary to train the students with the industrial activities during Pharmaceutical Manufacturing.

Objectives: Upon completion of the course the student shall be able to

- The common practice in the pharmaceutical industry developments, plant layout and production planning
- Will be familiar with the principles and practices of aseptic process technology, non-sterile manufacturing technology and packaging technology.
- Have a better understanding of principles and implementation of Quality by design (QbD) and process analytical technology (PAT) in pharmaceutical manufacturing

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	Pharmaceutical industry developments: Legal requirements and Licenses for API and formulation industry, Plant location- Factors influencing. Plant layout: Factors influencing, Special provisions, Storage space requirements, sterile and aseptic area layout. Production planning: General principles, production systems, calculation of standard cost, process planning, routing, loading, scheduling, dispatching of records, production control.	**12**	CO1 CO5
[2]	Aseptic process technology: Manufacturing, manufacturing flowcharts, in process-quality control tests for following sterile dosage forms: Ointment, Suspension and Emulsion, Dry powder, Solution (Small Volume & large Volume). Advanced sterile product manufacturing technology : Area planning & environmental control, wall and floor treatment, fixtures and machineries, change rooms, personnel flow, utilities & utilities equipment location, engineering and maintenance. Process Automation in Pharmaceutical Industry: With specific reference to manufacturing of sterile semisolids, Small Volume Parenterals & Large Volume Parenterals (SVP & LVP), Monitoring of Parenteral manufacturing facility, Cleaning in Place (CIP), Sterilization in Place (SIP), Prefilled Syringe, Powdered Jet, Needle Free Injections, and Form Fill Seal Technology (FFS). Lyophilization technology: Principles, process, equipment.	**12**	CO1 CO2 CO4
[3]	Non sterile manufacturing process technology: Manufacturing, manufacturing flowcharts, in process-quality control tests for following Non-Sterile solid dosage forms: Tablets (compressed & coated), Capsules (Hard & Soft). Advance non-sterile solid product manufacturing technology: Process Automation in Pharmaceutical Industry with specific reference to manufacturing of tablets and coated products, Improved Tablet Production: Tablet production process, granulation and pelletization equipments, continuous and batch mixing, rapid mixing granulators, rota granulators, spheronizers and marumerisers, and other specialized granulation and drying equipment. Problems encountered.	**12**	CO1 CO3 CO4

	Coating technology: Process, equipments, particle coating, fluidized bed coating, application techniques. Problems encountered.		
[4]	Containers and closures for pharmaceuticals: Types, performance, assuring quality of glass; types of plastics used, Drug plastic interactions, biological tests, modification of plastics by drugs; different types of closures and closure liners; film wrapper; blister packs; bubble packs; shrink packaging; foil / plastic pouches, bottle seals, tape seals, breakable seals and sealed tubes; quality control of packaging material and filling equipment, flexible packaging, product package compatibility, transit worthiness of package, Stability aspects of packaging. Evaluation of stability of packaging material.	**12**	CO4 CO5
[5]	Quality by design (QbD) and process analytical technology (PAT): Current approach and its limitations. Why QbD is required, Advantages, Elements of QbD, Terminology: QTPP. CMA, CQA, CPP, RLD, Design space, Design of Experiments, Risk Assessment and mitigation/minimization. Quality by Design, Formulations by Design, QbD for drug products, QbD for Drug Substances, QbD for Excipients, Analytical QbD. FDA initiative on process analytical technology. PAT as a driver for improving quality and reducing costs: quality by design (QbD), QA, QC and GAMP. PAT guidance, standards and regulatory requirements.	**12**	CO3

C. TEXT BOOKS

1. Lachman, L.; Liebermann, H. A. *The Theory and Practice of Industrial Pharmacy*; Cbs Publishers & Distributors Pvt. Ltd: New Delhi, 2013.

D. REFERENCE BOOKS

1. Martin, A.; Bustamante, P.; Chun, A. H. C. *Physical Pharmacy : Physical Chemical Principles in the Pharmaceutical Sciences*; Lea & Febiger: Philadelphia, 1993.
2. Lieberman, H. A. *Pharmaceutical Dosage Forms Tablets, Vol. 1-3*; New York, Ny [U.A.] Dekker, 1990.
4. Banker, G. S.; Rhodes, C. T. *Modern Pharmaceutics*; Marcel Dekker: New York, 2002.
5. Willig, S. H.; Stoker, J. R. *Good Manufacturing Practices for Pharmaceuticals : A Plan for Total Quality Control*; Marcel Dekker: New York, 1997.
6. Ministry, India. *Indian Pharmacopoeia, 1996. Veterinary Supplement 2000*; Controller Of Publications: Delhi, 2000.
7. Great Britain. Stationery Office. *British Pharmacopoeia 2016.*; The Stationary Office: London, 2015.
8. United States Pharmacopœial Convention. *The United States Pharmacopoeia : The National Formulary*; United States Pharmacopoeial Convention: Rockville, Md, 2019.
9. Jean, U. K.; Goupale, D. C.; S Nayak. *Pharmaceutical Packaging Technology*; Hyderabad Pharmamed Pres, 2008..
10. Bauer, E. J. *Pharmaceutical Packaging Handbook*; Informa Healthcare: New York, 2009.
11. Shayne Cox Gad. *Pharmaceutical Manufacturing Handbook.*; Wiley-Interscience, 2008.

E. COURSE OUTCOMES

(Minimum 5 Cos are required)

CO Number	Skill	Statement
CO1	Understand and Analyse	To learn the common practice in the pharmaceutical industry developments, plant layout and production planning
CO2	Understand and Analyse	To be familiar with the principles and practices of aseptic process technology technology
CO3	Understand Apply and Evaluate	To have a better understanding of principles and implementation of Quality by design (QbD) process analytical technology (PAT) in pharmaceutical manufacturing
CO4	Understand and apply	To understand non sterile manufacturing technology, Process Automation in Pharmaceutical Industry with specific reference to manufacturing of tablets and coated products
CO5	Understand and analyse	To learn the quality control of packaging material, container and closure and evaluation of stability of packaging material

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	3	3	3	3	2.8	2.8	3	3	3	3	3	3	3	3	3

M. PHARM. SEMESTER – II (MQA)

SUBJECT: PHARMACEUTICAL QUALITY ASSURANCE – PRACTICAL-II (MQA105P)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
-	-	12	12	6	100	30	20	--	150

A. COURSE OVERVIEW

Scope: The main purpose of the subject is to understand about method validation, process validation, equipment qualification and how it can be applied to industry and thus improve the quality of the products. The subject also covers drugs and environmental analysis as well as Qbd and PAT.

Objectives

At completion of this course, it is expected that students will be able

- To Understand the fundamentals of analytical method, instrument and Pharmaceutical process validation.
- To Understand the fundamentals of pharmaceutical equipment and analytical instrument qualification. And aspects of Pat, QbD

B. COURSE CONTENT

NO	TOPIC	P (Hrs)	COs
[1]	• Organic contaminants residue analysis by HPLC • Estimation of Metallic contaminants by Flame photometer • Identification of antibiotic residue by TLC • Estimation of Hydrogen Sulphide in Air. • Estimation of Chlorine in Work Environment. • Sampling and analysis of SO2 using Colorimetric method • Validation of an analytical method for a drug • Qualification of at least two analytical instruments	**90**	CO1 CO2 CO3
[2]	• Check list for Bulk Pharmaceutical Chemicals vendors • Check list for tableting production. • Check list for sterile production area • Check list for Water for injection. • Design of plant layout: Sterile and non-sterile • Case study on application of QbD • Case study on application of PAT • Validation of a processing area • Qualification of Pharma equipments like Autoclave, Hot air oven, Powder Mixer (Dry), Tablet Compression Machine • Cleaning validation of one equipment • Qualification of Pharmaceutical Testing Equipment (Dissolution testing apparatus, Friability Apparatus, Disintegration Tester)	**90**	CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Lachman, L.; Liebermann, H. A. *The Theory and Practice of Industrial Pharmacy*; Cbs Publishers & Distributors Pvt. Ltd: New Delhi, 2013.
2. Loftus, B. T.; Nash, R. A. *Pharmaceutical Process Validation*; M. Dekker: New York ; Basel, 1984.

D. REFERENCE BOOKS

1. Indian Pharmacopoeia, Indian Pharmacopoeial Commission, Ministry of health and family welfare, Government of India, Vol- I, II, III, 2014.
2. JW Munson. *Pharmaceutical Analysis - Modern Methods Part-B*; Marcel. Dekker Series.; Vol. 11.
3. Skoog, D. A.; F James Holler; Crouch, S. R. *Principles of Instrumental Analysis*; Thomson, Brooks/Cole: Belmont, Ca, 2007.
4. Sethi, P. D. *Quantitative Analysis of Drugs in Pharmaceutical Formulations*; Cbs Publishers & Distritutors: New Delhi, 2005.
5. Sharma B K. *Instrumental Methods of Chemical Analysis*, 27th edition.; Goel Publishing House: Meerut, 2011.
6. Chung Chow Chan; Netlibrary, I.; Al, E. *Analytical Method Validation and Instrument Performance Verification*; John Wiley & Sons: Hoboken, N.J., 2004.
7. *International conference on harmonisation of technical requirements for registration of pharmaceuticals for human use ich harmonised tripartite guideline validation of analytical procedures: text and methodology Q2(R1)*.
8. Cloud, P. A. *Pharmaceutical Equipment Validation : The Ultimate Qualification Handbook*; Informa Healthcare: New York, 2007.
9. Mendham, A. *Vogel's Textbook of Quantitative Chemical Analysis.*; Pearson: New Delhi, 2009.
10. Beckett, A. H.; Stenlake, J. B. *Practical Pharmaceutical Chemistry*; Athlone Press: London, 1988.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand Apply and Evaluate	To apply the fundamentals of spectroscopy and chromatography in drug and environmental analysis
CO2	Understand Apply and Evaluate	To Understand and apply the fundamentals of analytical method and Pharmaceutical process and utilities validation.
CO3	Understand Apply and Evaluate	To Understand and apply the fundamentals of pharmaceutical equipment and analytical instrument qualification.
CO4	Understand and Analyse	To understand the role of modern tools like QbD and PAT in Pharmaceutical processing.
CO5	Understand and Remember	To remember checklists for various dosage forms

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	1	2	1	1	1	3	3	2	1	1	-
CO2	3	3	3	2	1	2	1	1	1	-	3	2	2	2	3
CO3	3	3	3	2	1	2	1	1	1	-	3	2	2	2	3
CO4	3	-	-	2	-	1	-	1	-	-	3	3	2	3	-
CO5	3	-	-	-	-	1	-	1	-	-	3	1	1	1	-
Avg	3	1.8	1.8	1.6	0.6	1.6	0.6	1	0.6	0.6	3	2	1.6	1.8	1.2

M. PHARM. SEMESTER – III (MPH)

SUBJECT: RESEARCH METHODOLOGY AND BIOSTATISTICS -THEORY (MRM301T)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	CM	Prac	Total
4	-	-	4	4	75	15	10	-	100

A. COURSE OVERVIEW

Scope: To understand the applications of Biostatics in Pharmacy. This subject also deals to understand research methodology process, ethics in medical, clinical and pre-clinical research.

Objectives: Upon completion of the course the student shall be able to

- Know the various statistical techniques to solve statistical problems
- Appreciate statistical techniques in solving the problems.
- To know and understand medical research and ethical practise in clinical and non-clinical research

B. COURSE CONTENT

NO	TOPIC	L (Hrs)	COs
[1]	**General Research Methodology:** Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.	**12**	CO1
[2]	**Biostatistics:** Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests (students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.	**15**	CO2
[3]	**Medical Research:** History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.	**15**	CO3
[4]	**CPCSEA** guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anaesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.	**10**	CO4
[5]	**Declaration of Helsinki:** History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.	**08**	CO3 CO5

C. TEXT BOOKS

1. Kothari, C R. Research Methodology: Methods & Techniques. New Delhi, New Age International (P) Ltd., Publishers, Cop, 2004.

D. REFERENCE BOOKS

1. Prabhat Pandey, and Meenu Mishra Pandey. Research Methodology: Tools & Techniques. New Delhi, Bridge Center, 2015.
2. De, James E. Basic Statistics and Pharmaceutical Statistical Applications. New York, Marcel Dekker, 1999.
3. "GUIDELINES: Committee for the Purpose of Control and Supervision of Experiments on Animals." Cpcsea.nic.in, cpcsea.nic.in/Content/55_1_GUIDELINES.aspx.
4. Ulf Schmidt, et al. Ethical Research: The Declaration of Helsinki, and the Past, Present and Future of Human Experimentation. New York, Ny, Oxford University Press, 2020.
5. World Medical Association. "WMA - the World Medical Association-Declaration of Helsinki." Wma.net, WMA - The World Medical Association-Declaration of Helsinki, 2014, www.wma.net/what-we-do/medical-ethics/declaration-of-helsinki/.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand and Apply	To understand research methodology and application of study design in clinical research.
CO2	Remember, Understand and Apply	To learn and apply various biostatistical techniques in hypothesis testing of research.
CO3	Understand and Create	To know process of ethical medical research and protocol designing
CO4	Understand and Remember	To understand ethics and regulations use of animals in research.
CO5	Understand and Remember	To know ethics and regulation in clinical research.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	3	-	3	3	2	-	3	3	1	-	3
CO2	3	1	1	3	-	1	-	-	3	-	3	2	2	-	3
CO3	3	3	2	1	3	3	3	3	3	3	3	2	2	-	3
CO4	3	3	2	1	2	3	3	3	3	3	3	2	2	-	3
CO5	3	1	2	2	3	3	3	3	2	3	3	3	3	-	3
Avg	3	2	2	2	2.2	2	2.4	2.4	2.6	1.8	3	2.4	2	-	3

B. TECH. SEMESTER – VII (CE)
SUBJECT: BIG DATA AND ANALYTICS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

Reference Code CE720

A. COURSE OBJECTIVE

The objective of the course is to understand digital data, data preprocessing, data warehousing and various supervised and unsupervised algorithms. Students will learn big data, sources of big data and various platforms to handle big data. They will also learn HADOOP and its components.

B. DETAILED SYLLABUS

[1] Types of Digital Data (Structured, Semi-Structured, Unstructured)

[2] Introduction to Big Data.

[3] Te Big Data Technology Landscape
NoSQL – NewSQL
Hadoop- Introduction to Eco system

[4] Hadoop – Distributed File System and Processing using MapReduce

[5] Introduction to Map Reduce Programming

[6] Introduction to Big Data Analytics

[7] Data Storage and Handling (Apache Cassandra/mongoDB)

[8] Querying Data using Hive/Pig like components

[9] Data Reporting Tools (i.e. Community Edition : Jasper Soft

[10] The realm of Data Science

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Big Data and Analytics – Seema Acharya and Subhashini C – Wiley India
2) Hadoop: The Definitive Guide by Tom White
3) Big Data Analytics: Methods and Applications by B. L. S. Prakasa Rao (Editor), S. B. Rao (Editor)

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Learn various types of digital data and how to deal with them.
- Learn various data cleaning, data transformation, data reductions techniques.
- Students will learn various supervised and unsupervised algorithms
- Understand big data, sources of big data, characteristics of big data
- Students will learn HADOOP and its components.
- Learn concepts of mapreduce programming.

B. TECH. SEMESTER – VI (CE)
SUBJECT: MACHINE LEARNING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5.0	60	40	25	25	150

Reference Code CS622

A. COURSE OBJECTIVE

- Learn basic principles and techniques of machine learnings
- Develop ability to solve real world problems which requires computational intelligence

B. DETAILED SYLLABUS

[1] Introduction

Overview ,Supervised and unsupervised learning, Learning task, instances, features, labels, reward/loss, training, testing

[2] Classification

Overview of classification: setup, training, test, validation dataset, overfitting. Classification families: linear discriminative, non-linear discriminative, decision trees, probabilistic (conditional and generative), nearest neighbor

[3] Decision tree classification

Purity, Gini index, entropy, Algorithms for constructing a decision tree, Pruning methods to avoid over-fitting, Regression trees

[4] Probabilistic classifiers

Basics of Probability, Classifiers, LDA, QDA, Generative classifiers: Naive Bayes classification, Conditional classifier: Logistic

[5] Regression

Linear regression, Logistic regression

[6] Hyper Plane Classifier and convex optimization

Loss regularization framework for classification, loss functions: square, perceptron, logistic, hinge, regularizer. Review of convex optimization and unconstrained function

[7] Support Vector Machine

Max margin motivation: low density, high stability, Margin geometry to primal SVM formulation for separable training data, Dual formulation and role of alpha in a form of sparse local regression, Inseparable data, slack variables, hinge loss, upper bound on 0/1 training loss Handling non-linear regression by lifting data points to higher dimension,Polynomial, Gaussian, RBF kernels, Sequential minimal optimization (SMO) algorithm

[8] Clustering

Mixture model and Expectation maximization, K-Means Clustering, Distance based clustering, Density based clustering techniques

[9] Ensamble learning
Bagging and Boosting, Random forest, Adaboost

[10] Dimensionality reduction
Curse of dimensionality, Principal Component Analysis, Latent Semantic Analysis

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Machine Learning. T. Mitchell. McGraw-Hill, 1997.

2) Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017

3) Pattern recognition and machine learning by Christopher Bishop, Springer Verlag,2006.

D. COURSE OUTCOMES

- Understand various supervised and unsupervised learning algorithms.
- Ability to analyze performance of Machine Learning algorithms.
- Understand the mathematical foundation required for solving problems using machine learning techniques.
- Ability to apply various machine learning techniques to solve the real world problems.

B.TECH. SEMESTER – I (EC/CE/IT)

SUBJECT: PROGRAMMING FOR PROBLEM SOLVING - I

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
4	0	3	7	5.5	60	40	50*	-	150

Reference Code ESC201

*TW Marks includes Viva based on TW

DETAILED SYLLABUS

[1] OVERVIEW OF C

Basic structure of C program, compiling and running C program

[2] CONSTANTS, VARIABLES AND DATA TYPES

Types of constants, basic data types, identifier, variable, enum, symbolic constant, typedef, keywords, overflow and underflow

[3] OPERATORS AND EXPRESSIONS

Arithmetic, relational, logical, assignment, bitwise, and sizeof() operators, operator precedence and associativity, expression evaluation

[4] MANAGING INPUT OUTPUT OPERATIONS

getchar() and putchar() functions, formatted I/O using printf() and scanf()

[5] DECISION MAKING AND BRANCHING

if and if...else statement, nested and ladder if...else, conditional operator, switch statement, goto statement with warning

[6] DECISION MAKING AND LOOPING

while, do...while, and for loops, nested loops, break and continue statements

[7] ARRAYS AND STRINGS

Introduction to arrays, declaration, initialization and access of one-dimensional and two-dimensional arrays, Introduction to multi-dimensional and variable length arrays, declaration and initialization of strings, printing and scanning strings to/from standard I/O, string handling functions, list of strings

[8] USER-DEFINED FUNCTIONS

Function prototype and function declaration, function definition, function call, actual and formal parameters/arguments, return type and return statement, Nested function call, recursion, scope, visibility, and lifetime of variables.

B. TECH. SEMESTER – II (EC/CE/IT)

SUBJECT: PROGRAMMING FOR PROBLEM SOLVING - II

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
4	0	3	7	5.5	60	40	50*	-	150

Reference Code ESC201

*TW Marks includes Viva based on TW

DETAILED SYLLABUS

[1] BASICS OF C++

Overview, Program structure, keywords, identifiers, constants, data types, symbolic constants, declaration of variables, operators, namespaces, control structures, dynamic memory – C style – malloc(), calloc(), realloc() and free() Vs C++ style - new and delete keywords, reference and pointer

[2] FUNCTIONS IN C++

main function (variations in signature), function prototype, inline functions, call and return by reference, default parameters, function overloading

[3] INTRODUCTION TO OBJECT ORIENTED PROGRAMMING

Procedural Vs Object Oriented Programming, Principles of OOP, Benefits and applications of OOP

[4] CLASSES AND OBJECTS – ENCAPSULATION AND ABSTRACTION

Introduction, private and public members, Defining member functions, static members, Objects as function arguments and return type, friend functions, const member functions, Constructors and their types, Destructor, Operator overloading, type conversion

[5] INTRODUCTION TO C++ STRING CLASS

[6] INHERITANCE

Introduction, types of inheritance – single, multiple, multilevel, hierarchical, and hybrid inheritance, Protected members, overriding, virtual base class

[7] POLYMORPHISM

Introduction, Pointers and Objects, this pointer, pointer to derived classes, virtual and pure virtual functions, dynamic binding

[8] INPUT/OUTPUT

Introduction to streams, standard I/O stream objects, stream classes, unformatted and formatted I/O, manipulators

[9] EXCEPTION HANDLING

Basics of exception handling, try-catch-throw, rethrowing exceptions, user defined exceptions

B. TECH. SEMESTER – VII (CE)
SUBJECT: CLOUD COMPUTING AND IOT

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

A. COURSE OBJECTIVE

- To explain the components of the cloud infrastructure and their functions.
- To describe service models such as Software-as-a-Service, Platform-as-a-Service, Infrastructure-as-a-Service; and various deployment models of the cloud;
- To introduce the concepts how virtual machines, hypervisors, virtual networks and virtual storage work together.
- To understand about the fundamentals of Internet of Things and its building blocks along with their characteristics and protocols

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B. DETAILED SYLLABUS

[1] Introduction to Cloud Computing
- Overview of Computing
- Cloud Computing (NIST Model)
- Properties, Characteristics & Disadvantages
- Role of Open Standards

[2] Cloud Computing Architecture
- Service Models (Iaas, Paas, Saas, XaaS)
- Deployment Models

[3] Service Management in Cloud Computing
- Service Level Agreements(SLAs) and related examples
- Cloud Economics and related examples

[4] Virtualization
- Benefits of virtualization
- Types of virtualization
- Load balancing
- Hypervisors.

[5] The management of virtual machines for cloud infrastructures
- Distributed management of virtual machines
- Scheduling techniques for advance reservation of capacity
- Capacity management to meet SLA commitments

[6] Data Management in Cloud Computing
- Looking at Data, Scalability & Cloud Services
- Database & Data Stores in Cloud
- Large Scale Data Processing

[7] Cloud Security
- Infrastructure Security
- Data security and Storage

• Identity and Access Management
• Access Control, Trust, Reputation, Risk

[8] Introduction to IoT, IoT architecture, IoT challenges.

[9] Networking protocols- MQTT and COAP

[10] Communication Protocols
• Zigbee
• 6LoWPAN
• RFID

[11] Software Defined Network (SDN), SDN for IoT

[12] Smart Use cases of IoT

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
2) Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
3) "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
4) Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
5) Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010
6) "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- explain the core concepts of the cloud computing paradigm
- understand virtualization and outline its role in enabling the cloud computing system model
- Understand the concept of Cloud Security.
- understand building blocks of Internet of Things and characteristics.
- design and develop scalable, reliable and cost effective solutions of real world problems using compute, networking, storage and database services of cloud.

B. TECH. SEMESTER – V (CE)
SUBJECT: SMART DEVICE PROGRAMMING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
0	1	2	3	2.0	-	-	25	25	50

Reference Code CS

A. COURSE OBJECTIVE

The Objective of this course is to expose students to programming of various smart devices. This will help students to use the computational power of ubiquitous smart devices to solve real world problems. This will help students to create applications which can easily reach masses.Students will be able to write code once and use the same code to create applications for different platforms.

B. DETAILED SYLLABUS

[1] Programming Framework
Introduction to Dart programming language and Flutter framework. Installation of Flutter

[2] DART - Programming
Data types, variables, operators and decision making (branching and looping)

[3] DART - Programming
Functions and classes, Nullability and Collections

[4] Dart – Programming
Asynchronous programming, concurrency and unit testing

[5] FLUTTER
Introduction to Widgets, Layouts and gestures, State management

[6] FLUTTER
Connectivity with the database and automated testing, Packages and access to REST APIs

[7] FLUTTER
Controlling smart devices (like lamp or fan) using applications developed with the Flutter framework. Deployment of the Flutter application.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Dart Apprentice, first edition, by Jonathan Sande & Matt Galloway
2) Quick Start Guide to Dart Programming, by Sanjib Sinha, Apress
3) Beginning App Development with Flutter, by Rap Payne, Apress
4) Flutter Apprentice, by Kevin D Moore, Michael Katz and Vincent Ngo

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- write programs using Dart programming language
- develop applications using Flutter framework for android, ios, macos, windows and linux

platforms

- connect to database and access REST APIs from application developed using Flutter
- write automated test cases for testing their Flutter code and be able to deploy their application on various platforms
- control smart hardware devices like lamps and fans from Flutter application

B. TECH. SEMESTER – V (CE)
SUBJECT: WEB APPLICATION DEVELOPMENT

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	0	2	4	3.0	40	-	25	25	90

A. COURSE OBJECTIVE

The objective of this course is to make the students familiar Web Application Development. The subject provides knowledge of .NET framework and .NET core architecture along with the knowledge of core C# language. The emphasis is given on building real world data driven applications. The ORM entity framework should be used while building web applications. The students will understand the complete application life cycle of a web application starting from designing to deployment on a local server.

B. DETAILED SYLLABUS

[1] .NET Framework

Architecture, Assembly development, Page life cycle of ASP.NET web application, Introduction to Visual Studio Editor, Web application development using server controls, State management for ASP.NET web application, Data driven ASP.NET web application using ORM (EF)

[2] Programming in C#

Environment, Literals, Variables and Data Types, Operators and Expressions, Handling arrays, Manipulating strings, Classes and objects, Inheritance, Interfaces, Delegates, Lambda Expression, LINQ, Events, Exception handling, Asynchronous programming

[3] .NET Core

Middleware And Request Pipeline in ASP.NET Core, .NET Core MVC, MVC Pattern, Routing, Razor, Model Validation, Test Driven Development, Tag helpers, Debugging, Tracing and Logging.

[4] Deployment

Deployment of .NET application to IIS, Deployment of .NET application to Cloud server

C. RECOMMENDED TEXT / REFERENCE BOOKS

(1) Beginning ASP.NET 4.5 in C#. Author : Matthew Macdonald, Publisher : Apress

(2) Pro. ASP.NET Core MVC Sixth Edition, Author : Adam Freeman, Publisher : Apress

(3) Professional C# 7.0 and .NET Core 2.0, Author : Christian Nagel, Publisher : Wrox

(4) ASP.NET Core in Action, Author : Andrew Lock, Publisher : MANNING

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- Develop assembly(dll/exe) applications

- Design and develop database driven web applications using .NET Framework
- Construct amplifiers with active loads along with the Study of frequency response of all amplifiers
- Design and develop dynamic, cross-platform web applications using .NET Core and MVC design patterns.
- Utilize EF Core ORM for powering .NET Core driven web applications.
- Host web application into IIS and cloud environments.

B. TECH. SEMESTER – VI (CE)
SUBJECT: WEB SERVICE DEVELOPMENT

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	0	2	4	3.0	40	-	25	25	90

A. COURSE OBJECTIVE

The objective of this course is to familiarize the students with the concepts and principles of service orientation. We aim to cover SOAP-based and RESTful web services and to guide the students to implement them. The course will give detailed knowledge of concepts of micro-services architecture and make students aware about the concepts of application containers.

B. DETAILED SYLLABUS

[1] Principles of Service Orientation

Common principles, interrelation between principles, comparing service orientation with object orientation.

[2] Web services

Web Services roles, Service Descriptions with WSDL and Messaging with SOAP, UDDI basics. Web service coordination, orchestration, and choreography. Windows Communication Foundation: Introduction, Operations, Service, data and message contracts.

[3] Web API

Introduction, controller, configuration, routing, parameter binding, action return type, media type formatters. message handlers, action filters, CRUD operation, Http client to consume Web API, dependency injection.

[4] Micro services

Introduction, architecture, features, monolithic vs. micro-services, principles, advantages.

[5] **Containers:**

Introduction, creation, configuration, commands. e.g. Docker, Podman, Coordinating containerized applications: Introduction, architecture, components, commands, configuring cluster. e.g. Docker Swarm, Kubernetes

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Thomas Erl, “Service-Oriented Architecture: Concepts, Technology, and Design”, Pearson Education.

2) Tugberk Ugurlu, Alexander Zeitler and Ali Kheyrollahi, “Pro. ASP .NET Web API”, Apress.

3) Sam Newman, “Building Microservices”, O’Reilly.

4) Sean P. Kane and Karl Matthias, “Docker: Up & Running”, O’Reilly.

5) Brendan Burns and Kelsey Hightower, “Kubernetes: Up and Running” , O’Reilly.

6) Kurtz, Jamie, Wortman, Brian, “ASP.NET Web API 2: Building a REST Service from Start to Finish”, Apress.

7) Ronnie Mitra and Irakli Nadareishvili, “Microservices: Up and Running”, O’Reilly.

D. COURSE OUTCOMES

At the end of the course, students should be able to:

- understand service orientation concepts and principles.
- design and develop service oriented applications in standard manner
- develop SOAP based and RESTful web services.
- design and development of micro-services and containers.

M. TECH. SEMESTER – II (CH)
SUBJECT: ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS [MC]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	0	0	100

A. COURSE OVERVIEW

To understand any specific phenomena occurring in the chemical process industries, it is essential to know the cause of that phenomena. The study of behaviour of chemical properties with independent parameters is essential to accurately predict the separation phenomena or chemical reactions. Classical thermodynamics gave reasons for such behaviour and Statistical thermodynamics provides better insight in to such phenomena from molecular level. Most of separations in chemical industries are equilibrium based which includes vapor-liquid, liquid-liquid, vapor-liquid-liquid, solid-liquid at equilibrium. This course encompasses the study of both macroscopic level and molecular level understanding of key thermodynamic properties to handle such equilibrium cases and explore possible ways of solving problems associated with non-ideality in VLE, LLE, VLLE, SLE & reaction equilibria for multicomponent mixtures. These concepts will be applied in understanding several important industrial and academic applications. Apart from this, the behaviour of gases at molecular level, its interaction with other gases will be studied at molecular level. The study of behaviour of solids whether as a reactant or as a catalyst will be done at molecular level.

B. COURSE CONTENT [Total 48 hrs]

NO	TOPIC	L+T (hrs)	COs
[1]	**Introduction to Phase Equilibria** General principles of Classical Thermodynamics, basic postulates, estimation of Thermodynamic Properties, fundamental equations-equations of state, Gibbs-Duhem equation, Gaseous Mixtures and Fugacity, Liquid Mixtures and Fugacity.	6	CO1 CO2
[2]	**Models for Activity Coefficients using Excess Gibbs Energy** Introduction to excess Gibbs energy, Activity models such as Redlich-kister equation, Wohl's equation, Van Laar equation, Margule's equation, Wilson equation, NRTL, UNIQUAC & UNIFAC, Thermodynamic consistency test for VLE data, Liquid-Liquid Equilibria; Vapor-Liquid-Liquid Equilibria; Solid-Liquid Equilibria; Solid-Gas Equilibria, Ethics concern with VLE data.	8	CO1 CO2
[3]	**Introduction to Chemical Reaction Equilibria** Equilibrium criterion for a chemical reaction, concept of Equilibrium conversion (x), equilibrium constant (k), evaluation of equilibrium constants at different	6	CO1 CO2

	temperatures, equilibrium conversion of single reactions and multi reaction equilibria, Phase rule for chemically reacting systems.		
[4]	**Introduction to Statistical Thermodynamics** Probability theory, Different thermodynamic distributions- Boltzmann, Bose – Einstein & Fermi-Dirac, Laws of thermodynamics & their applications, Properties of elementary particles.	10	CO3 CO4 CO5
[5]	**Partition Function, Ensembles** Behavior of Monatomic gases and solids, Behavior of Diatomic and polyatomic gases, Models to predict properties of such gases and solids	12	CO3 CO4 CO5
[6]	**Chemical Equilibrium** Equilibrium constant, Equilibrium Composition, Simultaneous reactions, Ionization	6	CO4 CO5

C. TEXT BOOKS

1. Smith, J. M.; Van Ness, H. C. Introduction to Chemical Engineering Thermodynamics; Fourth Edition, McGraw Hill Book Company: Singapore, 1987.
2. Sonntag, R. E. & Van Wylen, Gordon J. Fundamentals of Statistical Thermodynamics; First Edition, John Wiley & Sons: United States of America, 1968.

D. REFERENCE BOOKS

1. Narayan, K. V. A Textbook of Chemical Engineering Thermodynamics; Second Edition, PHI Learning Private Limited: Delhi, 2013.
2. Rao, Y.V.C. Chemical Engineering Thermodynamics; First Edition, Universities Press India Private Limited: Hyderabad, 1997.
3. S. Sandler, “Chemical, Biochemical and Engineering Thermodynamics”,4th edition, Wiley, India.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	**Remembering Understanding Applying Analysing Evaluating Critiquing**	Understand and Apply the relationship between the fundamental thermodynamic properties.
CO2		Selection of thermodynamic models to estimate the properties for mixtures involving equilibria of different phases such as VLE, LLE, VLLE, SLE, SVE as well as reactions.
CO3		Introducing concept of quantum mechanics and analyze the effect of various energy levels for estimating behavior of components.
CO4		Applying Statistical Thermodynamics at molecular level for addressing change in properties of key thermodynamic quantities.

CO5		establishing the appropriate connection of the macroscopic evaluation and behavior of the properties of the system with its molecular description critiquing behavior of solids and gases during separation or reactions at molecular level.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3	3	2	3	2	2	2	3	3	2	2	2	3
CO2	3	3	3	2	2	3	3	3	3	3	2	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	2.8	3	2.8	2.8	2.8	2.8	3	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	3

M. TECH. SEMESTER – II (CH)

SUBJECT : NEW SEPARATION TECHNIQUES

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	0	0	3	3	60	40	50	0	150

A. COURSE OVERVIEW

The course deals with the understanding of conventional separation techniques and new separation techniques used in chemical process industries. The subject focusing on the basics of multi component distillation and all types of membrane based separation operations. The emphasis is given on the synthesis of membrane, characterization of membrane and selection of suitable type of membrane separation processes with industrial examples and other types of separation operations.

B. COURSE CONTENT [Total 40 hrs]

Sr. No.	Topics	L+T	COs
1	**Introduction to Separation technology** Fundamentals of Separation Processes and its classification, advantage and limitation of various conventional separation processes and need of new separation methods, basic terms associated with the membrane technology	2	CO1
2	**Multicomponent Distillation** Concept of MCD, Bubble point dew point calculation, key component concept, short cut methods, number of stage calculation, Fensky and Underwood equation	10	CO2
3	**Membrane types, materials, synthesis and characterization**: Definition of Membrane, Advantages and limitations of membrane technology compared to other separation processes, Membrane materials and properties, Synthesis methods of membrane, types of membrane and membrane modules, Flux equation, transport mechanism, factors affecting on membrane operation	10	CO3
4	**Membrane processes** Types of pressure driven membrane processes like microfiltration, ultra filtration, reverse osmosis, nano filtration using membrane and their industrial applications,	10	CO4
5	**Other typs of Separation processes –**	8	CO5

	Gas separation, pervaporation, Ion exchange membrane and electrodialysis, introduction to liquid membrane, membrane distillation , membrane reactor, super critical fluid extraction		

C. TEXT BOOKS

1. Membrane separation processes – Kaushik Nath, Second edition, PHI learning private limited

2. Fundamentals of Multicomponent Distillation – Charles D Holland, McGraw Hill Chemical Engineering series,

D. REFERENCE BOOKS

1. Basic Principles of Membrane Technology, Mulder M, Kluwer Academic Publishers, London, 1996.
2. Membrane Technology and Research, Baker R. W., Inc.(MTR), Newark, California, USA, 2004.

3. Separation Process Principles – J.D. Seader , E.J. Henley , Second edition, Wiley

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering Understanding Applying Analysing Evaluating Creating	Understand about various types of conventional and new separation methods used in industry with their advantages and limitations
CO2		Concept of multi component distillation
CO3		Types of Membrane, synthesis method, characterization of membrane, membrane modules, factors affecting on membrane operations
CO4		Various types of pressured driven membrane operations
CO5		Basics of other types of separation operation including gas separation, electro dialysis, ion exchange membrane, supercritical fluid extraction, LEM

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	.

CO1	2	2	1	2	2	2	3	3	2	1	1	2	2	2	2	2	
CO2	3	3	2	2	2	2	2	2	2	2	2	2	2	3	3	2	
CO3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	3	3	
CO4	3	2	3	2	2	2	2	2	2	2	2	2	3	3	3	3	
CO5	2	1	2	2	2	3	2	3	2	2	2	2	2	2	2	2	
Avg	2.6	2.2	2	2	2	2.2	2.2	2.4	2	1.8	2.8	2	2.2	2.4	2.6	2.4	

(M.Tech. Semester VII (CH)

Subject: Computational and Numerical Methods

Reference Subject Code: xxxx

Teaching Scheme (hr/week)				Credits	Exam Scheme (Marks)				
Lect	Tut	Prac	Total		Ext	Sess	TW	Prac	TOTAL
4	0	0	4	4	60	40	50	00	150

A. COURSE OVERVIEW

Numerical solutions of various mathematical models such as lumped parameter models and distributed parameter models describing steady state and dynamic behaviours of Chemical Process Systems and parameter estimation using numerical methods in Chemical Engineering.

Objectives:

To apply numerical methods for solving various problems in chemical engineering systems and to develop computer programs using languages like C/C++ and commercial software like Matlab in order to educate the students for solving research-oriented problems. Fundamentals of numerical methods/algorithms to solve systems of different mathematical equations (e.g. linear/nonlinear algebraic equations, ordinary / partial differential equations) will be introduced. Practical are designed for solving actual chemical engineering problems through computer programming and coding.

COURSE CONTENT [Total 45 hrs]

Sr No	TOPIC	L Hrs	COs
1	**Basics of Vectors, Scalars and matrix algebra** Addition/subtraction, multiplication/division of vectors, matrix multiplication, inverse of matrix, determinant and rank of matrix, eigen values, sparse matrices, Use of MATLAB for matrix algebra, approximation and concept of error and error analysis	04	1,3
2	**Numerical methods for linear algebraic equations** Gauss elimination method, Gauss-Jordan method, Jacobi method, Successive – over relaxation method, tri-diagonal matrix, MATLAB programming	08	1,2,3
3	**Numerical methods for nonlinear algebraic equations** Successive substitution method, Newton-Raphson method, Secant method, False position method, single variable and	08	1, 2,3,4, 5

	multivariable case studies, MATLAB functions for nonlinear algebraic equations		
4	**Eigen Value Problems** Eigen value analysis of linear and nonlinear systems and solution of homogeneous equations using eigen values	**04**	**1,2,3**
5	**Regression, interpolation, curve fitting, numerical integration** Simple interpolation, Lagrange's interpolation, Newton's interpolation, Simpson's rule, trapezoid method, linear regression, polynomial regression, exponential and power regression, MATLAB routines and commands	**04**	**1,2,3**
6	**Numerical methods for IVP and BVP ordinary differential equations** Explicit and implicit ODEs, Euler's explicit and implicit methods, explicit Adams-Bashforth methods, implicit Adams-Mouton methods, Predictor – corrector methods, Runge-Kutta methods, MATLAB solvers for ODEs, Finite difference, Orthogonal collocation and Orthogonal collocation on finite-element methods for ODE-BVP, Shooting Methods for solving BVP	**10**	**1,2,3, 4,5,6**
7	**Numerical methods for Partial differential equations** Steady state and dynamic PDES, method of lines, Crank-Nicholson method, finite-difference, Orthogonal collocation and orthogonal collocation on finite element methods	**07**	**1,2, 3,4,5, 6**

Practical and Term work **(50 marks)**

Simulation experiments are designed to use MATLAB software for solving linear/nonlinear algebraic equations for steady state problems in Chemical Engineering and for solving dynamic problems in Chemical Engineering. Simulation experiments for parameter estimation problems in chemical engineering systems are also designed.

Text Books:

1. Gupta, S. K. *Numerical Methods for Engineers*, 3rd ed.; New Age International Publishers: New Delhi, 2015.
2. Chapra, S. C. *Applied Numerical Methods with MATLAB for Engineers and Scientist*, 3rd ed.*;* McGraw-Hill: New York, 2012.

Reference Books:

1. Beers, K J. *Numerical Methods for Chemical Engineering Applications in MATLAB*, Cambridge University Press: UK, 2006.

2. Constantinides, A.; Mostoufi, N. *Numerical Methods for Chemical Engineers with MATLAB Applications*, Prentice Hall International Series: New Jercy, 1999.

COURSE OUTCOMES

CO Number	Skill	Statement
CO1	UNDERSTANDING	**Remember** and **understand** the various numerical methods to solve various linear and nonlinear steady state and dynamic problems in chemical engineering systems described by ODE, PDE, AE and NAE
CO2	ANALYSING	Carry out the **error analysis** in the numerical solutions of chemical engineering problems
CO3	APPLYING	**Apply** linear algebraic equation solution techniques and nonlinear algebraic equation techniques for solving steady states of chemical engineering systems. Use **Matlab** to i**mplement** numerical methods in simulations.
CO4	EVALUATING	**Do** critical evaluation of the performance of various numerical methods using simulations for solving chemical engineering problems.
CO5	CREATING	Develop Matlab codes for various numerical methods
CO6	REMEBERING & EVALUATING	**Generate** a matlab program for industrial application to carry out steady state and dynamics analysis.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	0	2	2	1	2	1	2	3	2	3	2	3
CO2	2	1	2	1	0	2	3	1	2	2	3	3	3	3	3	3
CO3	2	3	3	2	2	3	3	2	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	2	2	2	2	2	3	2	2	3
CO5	2	3	3	2	3	3	3	2	3	2	2	3	2	3	2	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
Avg	2.3	2.3	2.5	2	1.8	2.7	2.8	1.8	2.5	2.2	2.5	2.8	2.67	2.67	2.17	3

M. TECH. SEMESTER –II (CH)
SUBJECT: OPTIMIZATION TECHNIQUE

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	0	0	3	3	60	0	0	0	60

A. COURSE OVERVIEW

Motivation: Study, understand, utilize the appropriate mathematical models and tools to solve the process problems associated with any field or industry in the most optimistic manner.

B. COURSE CONTENT

NO	TOPIC	L (hrs)	Cos
[1]	**Introduction to Operational Research** ● Introduction, ● Engineering Application, ● Methods of Operation Research, ● Formulation, ● Graphical method of Solution	3	CO1 & CO3 & CO4
[2]	**Linear Programming** ● Simplex method ● Degeneracy ● Big-M method ● Revised Simplex method	5	CO2 & CO3 & CO4
[3]	**Transportation Model** ● North-West Corner rule, ● Row and Column Minima method, ● Least-cost method, ● Vogel's approximation method, ● Degeneracy in transportation problem, ● stepping stone method, ● modified distribution method, ● unbalanced supply and demand, ● profit maximization problem, ● trans-shipment problems	5	CO3 & CO4 & CO5
[4]	**Assignment Model** ● Hungarian method for solution ● Variation of the assignment problem - non-square matrix, restriction on assignments. ● Maximization problem ● Travelling salesman problem ● Travelling salesman problem (shortest cyclic route models)	5	CO2 & CO3 & CO4
[5]	**Scheduling Optimization and Related Models on Sequencing** ● Batch Scheduling ● Formulation of sequencing models and its applications. ● Introduction to Gantt Chart and its Application to Different types of Transfer policies.	5	CO5 & CO6

[6]	**Advanced topics in Linear Programming** ● Duality in Linear Programming ● Primal to Dual conversion ● Duality Theorem and Dual Simplex method	**5**	CO2 & CO3 & CO4
[7]	**Dynamic programming** ● Bellman's principle of optimality, ● Examples on the application of routing problem, inventory problem, marketing problem	**4**	CO4 & CO5 & CO6
[8]	**Non-Linear Programming** ● Elimination Methods — Unrestricted Search, Exhaustive Search, Dichotomous search, Fibonacci method, Golden Section Method, ● Kuhn tucker condition	**4**	CO1 & CO2 & CO3 & CO4

C. TEXT BOOKS

1. Gupta P., Hira D.S., "Operation Research", S. Chand & Company Ltd
2. Rao S.S., "Engineering Optimization: Theory and Practice", Willey Publication.
3. Vohra N D, Quantitative Techniques in Management, Tata McGraw Hill, New Delhi

D. REFERENCE BOOKS

1. Sharma S D & Sharma H, Operations Research: Theory, methods & applications,
2. K. Nath R. Nath Arora J.S., "Introduction to Optimum Design", Elsevier Academic Press.
3. Hiller & Libermann, Introduction to Operations Research, Tata McGraw Hill
4. Hamdy A. Taha, "Operation Research", Pearson Education.
5. Operation Research – V. K. Kapoor, S. Chand Publication

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Define	**Define** the type of the problem in terms of Linear programming problem or Non-linear programming problem
CO2	Describe	**Describe** the formulation of the problem into mathematical approach/model
CO3	Application	**Apply** the types of numerical/mathematical methods to be used in industry to have optimal solution
CO4	Solution	**Solve** the type of the problem using the appropriate method
CO5	Development	**Develop** a skill to deal with type of problem to get best possible result

CO6	Use	**Use** the mathematical tool to solve the trickiest problem

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	2	2	2	2	2	2	2	2	3	3	3	3	3
CO2	3	3	3	2	2	2	2	2	2	2	2	1	3	3	3	3	3
CO3	3	3	2	2	2	2	1	1	1	1	1	1	3	3	3	3	2
CO4	3	3	2	2	2	2	1	1	1	1	1	1	2	2	2	3	2
CO5	2	2	2	1	3	1	1	1	1	1	1	1	3	3	2	3	2
CO6	2	2	2	2	3	1	1	1	1	1	1	1	3	3	2	2	3
Avg	2.7	2.7	2.3	1.8	2.3	1.7	1.3	1.3	1.3	1.3	1.3	1.2	2.8	2.8	2.5	2.8	2.5

Process synthesis

Teaching scheme (Hr/week)			Examination scheme				
Lecture	Tutorial	Term work	Theory	Sessional	Term work	Viva-voce	Total
3	1	2	60 Marks 3 Hr	40 Marks 1 Hr	50 Marks	-	150

Objective:

	Topic	Contact hours	CO
1	**Introduction:** Introduction to design and process synthesis. Preliminary process design. Basic steps in process flow sheet synthesis. Decomposition strategies for process synthesis. A Case study: Synthesis of Ethyl Alcohol process.	6+2	1
2	**Scheduling:** Introduction to design and scheduling of batch processes.Concepts of single and multi product batch plants, transfer policies, parallel units and intermediate storage.Synthesis of flow shop plants.	6+2	2
3	**Simulation in process design:** Process simulation modes, Methods of solving nonlinear equations, Recycle partitioning and tearing.	6+2	3
4	**Heat and power integration:** The basic concepts of Heat Ex-changer Network Synthesis (HENS) and Mass Exchange Networks (MEN). Synthesis of ideal multi-component distillation systems. Heat integrated distillation systems.	6+2	4
5	**Synthesis of reactors and reactor networks:** Mathematical approach and Heuristic approach.	3+1	5
6	**Process flexibility:** Introduction to the concept of flexibility, Mathematical formulas for flexibility analysis and some solution methods.	3+1	5
7	**Optimization for Process Synthesis:** Introduction to optimization techniques.MINLP problems. MINLP models to solve HENS, distillation sequences, reactor network synthesis.	6+2	6

Text books:

1. Biegler, Grossmann, and Western berg., Systematic methods of chemical process design.
2. Rudd Dole,F,Powers Gray J, Siirola , Jeffrey J, Process , Process synthesis , Engle wood cliffs, Printice hall, 1973.

Course Outcomes

CO Number	Skill Levels	Statement
CO1	Remember Understand Application Analysis Evaluate Create	Concept of design, synthesis along with basic steps for process flow sheet synthesis.
CO2		Scheduling of multi product and multipurpose batch plants and design of flow shop plant.
CO3		Process plant simulation including partitioning and tearing algorithms.
CO4		Concepts of HENS and MENS.
CO5		Synthesis of reactors and reactor networks using various methods. Introduction to process flexibility.
CO6		Optimization techniques and their use in process synthesis.

CO PO MAPPING MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	2	2	2	2	3	2	3	2	3	3	3	3	3	3
CO2	3	3	2	2	2	2	2	2	2	3	2	3	3	3	3	3	3
CO3	3	3	3	2	2	2	2	3	2	3	2	3	3	3	3	3	2
CO4	3	3	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
CO5	3	2	2	2	2	2	2	3	2	2	2	2	3	3	3	3	3
CO6	2	2	2	2	2	2	2	3	2	2	2	2	3	3	3	2	3
Avg	2.8	2.5	2.3	2.0	2.0	2.0	2.0	2.7	2.0	2.5	2.0	2.5	2.8	3.0	3.0	2.8	2.8

Skill Development and Employability

As an outcome of this course students can identify suitable equipment, reaction and separations. They will also be familiar with synthesis of heat exchanger and mass exchange networks.Students are trained to design and analyze flow sheets with a focus on improving efficiency and sustainability. Employability of students in R&D and design organizations improves substantially after clearing this course.

(M. Tech. Semester I (CH)

Subject: ADVANCED CHEMICAL REACTION ENGINEERING

Reference Subject Code: MC XXX

Teaching Scheme (hr/week)				Credits	Exam Scheme (Marks)				
Lect	Tut	Prac	Total		Ext	Sess	TW : Seminar	Prac	TOTAL
3	1	--	4	4	60	40	50	--	150

A. COURSE OVERVIEW

Non-isothermal reactor design under steady state and unsteady state conditions, non-ideal flow modelling in real reactors, catalytic and non-catalytic heterogeneous reactions and reactor design, application of Matlab for solving reaction engineering problems.

Objectives:

To introduce students to advanced topics of chemical reaction engineering, such as non-isothermal reactor design, multi-phase reactions and reactor design, catalytic reactions and reactor design and application of software for solving the associated problems of advanced topics of chemical reaction engineering.

COURSE CONTENT [Total 45 hrs]

Sr No	TOPIC	L Hrs	COs
1	**Non-isothermal reactor design** Energy balance for CSTR/PFR/Batch reactor under adiabatic and non-adiabatic conditions, multiple steady states in CSTR/PFR, use of MATLAB for design/analysis of non-isothermal reactors.	09	1,2,3, 4,5,6
2	**Non-ideal flow and mathematical modeling** Zero parameter, one parameter and two parameter modeling of non-ideal flow in reactors	09	1,2,3, 4,5,6
3	**Fluid-fluid heterogeneous reactor design** Gas-liquid and liquid-liquid heterogeneous reactions, mathematical models, reactor design for fluid-fluid heterogeneous reactions	09	1, 2,3,4, 5,6
4	**Fluid-solid heterogeneous reactor design**	09	1,2,3, 4,5,6

	Gas-solid and liquid-solid heterogeneous reactions, mathematical models, reactor design for fluid-solid heterogeneous reactions		
5	**Catalytic reactors** Solid catalysed reactions and reactor design, mathematical models and reactor design	**09**	**1,2,3, 4,5,6**

Seminar Term work **(50 marks)**

A seminar topic of relevance to advanced reaction engineering is assigned to the student that may involve simulation and students are supposed to present the seminar work and submit the seminar project at the end the semester.

Text Books:

1. Levenspiel, O., Chemical Reaction Engineering, 3rd edition, Wiley Eastern Pvt. Ltd.
2. Fogler, H. S., Elements of Chemical Reaction Engineering, Prentice-Hall.

Reference Books:

1. Smith, J. M., Chemical Engineering Kinetics, 3rd Edition, Mc-Graw Hill Publication

COURSE OUTCOMES

CO Number	Skill	Statement
CO1	UNDERSTANDING	**Remember** and **understand** the non-isothermal reactor design, non-ideal flow modeling, heterogeneous catalytic and non-catalytic reactions and reactor design
CO2	ANALYSING	Carry out the **analysis** of non-isothermal reactors and heterogeneous reactors
CO3	APPLYING	**Apply** software such as Matlab, for design and analysis of non-isothermal reactors and heterogeneous reactors.
CO4	EVALUATING	**Do critical** evaluation of the non-isothermal reactors and heterogeneous reactors performances using simulations.
CO5	CREATING	**Design** reactors for non-isothermal conditions and for heterogeneous reactions
CO6	REMEBERING & EVALUATING	**Generate** a matlab program for industrial application to carry out steady state and dynamics analysis of non-isothermal reactors and heterogeneous reactors

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	0	2	2	1	2	1	2	3	3	2	3	3
CO2	2	1	2	1	0	2	3	1	2	2	3	3	3	2	3	3

CO3	2	3	3	2	2	3	3	2	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	2	2	2	2	2	3	2	3	3
CO5	2	3	3	2	3	3	3	2	3	2	2	3	2	2	2	2
CO6	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2
Avg	**2.3**	**2.3**	**2.5**	**2**	**1.8**	**2.7**	**2.8**	**1.8**	**2.5**	**2.2**	**2.5**	**2.8**	**2.67**	**2.0**	**2.67**	**2.67**

M. Tech. Semester I (Chemical Engineering)
Subject: Advanced Transport Phenomena
Reference Subject Code: MC 201

Teaching Scheme (hr/week)				Credits	Exam Scheme (Marks)				
Lect	Tut	Prac	Total		Ext	Sess	TW	Prac	TOTAL
3	1	0	4		60	40			100

Motivation: Transport phenomena is the subject which deals with the different transport processes such as momentum, energy and mass,ubiquitous in industry as well as in nature.

Objectives:

- To acquireknowledge on momentum, heat and mass transfer in Chemical engineering systems and their analogous behaviour.
- Momentum, heat and mass transfer are taught together due to the underlying similarities of the mathematics tools and molecular mechanisms describing such processes.
- The students will be made aware of the core scientific connections and will be encouraged to solve problems based on relevant analogie

Learning Outcomes: On successful completion of course students will be able,

- To Identify transport properties and analyze the mechanism of momentum, energy and mass transport.
- To Apply conservation laws to formulate differential form of equations of change for mass, momentum and heat transfer problems.
- To solve linear partial differential equations along with appropriate boundary conditions to get the velocity, temperature and concentration profiles of different engineering problems.
- Recognize non Newtonian fluids and apply appropriate models to solve them

Detailed Syllabus: [36 hrs]

1. **Transport By Molecular motion [4 hrs]**
   Momentum, energy and mass transport by molecular level

2. **Transport in turnbulemt flow and eddy tranport properties [7 hrs]**
   Turbulent momentum, energy and masss trasnport

3. **Transport across the phase boundaries [7 hrs]**
   Friction factor, Heat trasnfer co-efficient and mass transfer co-efficient with use of empirical correlation
4. **Transport in large system [10 hrs]**
   Macroscopic balance in pieces of equipment or parts thereof for isothermal , non-isothermal and mixtures
5. **Transport by other mechanism [8 hrs]**
   Momentum transport in polymeric liquid, Energy transport by radiation and mass transport in multi component system.

Text Books:

1.Bird R B, Stewart W E and Light fort R N, “Transport Phenomena”, John Wiley and Sons (2002)

Reference Book:

1. Welty J R , Wilson R E and WicksC E , “Fundamentals of Momentum , Heat and Mass Transfer”, 4thed, John Wiley and Sons (2001).

2. John C Slattery, “Momentum, Energy and Mass transfer in continua”, McGraw Hill, Co. (1972
3.BennetC U and Myers J E, “ Momentum, Heat and Mass Transfer” Tata McGraw Hill Publishing Co. (1975)
4.Robert S Brodkey and Harry C Hersing, “Transport Phenomena a Unified approach” McGraw Hill Book Co. (1988)

Advanced Transport Phenomena

CO of MC201	MC201.1	MC201.2	MC201.3	MC201.4	MC201.5	MC201.6	**Average**
Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems	2	3	3	3	3	2	**2.7**
Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.	2	3	3	3	2	2	**2.5**
Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	1	2	3	2	3	2	**2.2**
Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems	2	2	2	3	2	2	**2.2**
Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	2	2	2	2	3	2	**2.2**
The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2	2	2	2	2	2	**2**
Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	3	2	2	2	2	2	**2.2**
Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	1	2	2	2	2	2	**1.8**
Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	2	2	2	2	2	**2**

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	2	2	2	2	2	**1.8**
Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	1	2	2	2	2	2	**1.8**
Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	2	2	2	2	2	2	**2**

M. TECH. SEMESTER – I (CH)

SUBJECT : INTRODUCTION TO ENVIRONEMTAL ENGINEERING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	50	0	150

A. COURSE OVERVIEW

The course deals with the understanding of environmental issues generated by chemical process industries due to various types of pollutants. The subject focusing on the sampling, measurement and control strategy for air and waste water treatment. The emphasis is given on the implementation of solid waste management system in chemical process industries. Apart from these, Cleaner and greener route of synthesis is discussed to motivate students for source correction methods rather than end of the pipe solution and do research in the same area.

B. COURSE CONTENT [Total 44 hrs]

Sr. No.	Topics	L+T	COs
1	**Introduction to Environmental Engineering** Ecology and various cycles, Acid rain, ozone depletion, green house gases, photochemical smog , various types of pollutants , Environmental laws , introduction to environmental chemistry	4	CO1
2	**Air Pollution and Control** Air pollution sources and its classification, Effects of air pollutants, meteorological aspects of air pollution, Dry/wet adiabatic lapse rate and environmental lapse rate, atmospheric stability and plume behavior, Gaussian plume behavior model for area, line and point source. Air pollutant sampling and measurement, various types of air pollution control methods, equipment and its design , selection criteria of air pollution control equipment	16	CO1 CO2
3	**Industrial Waste Water Treatment** Sources of industrial waste water and its characteristics, need of waste water treatment methods, use of various types of physical, chemical and biological methods for waste water treatment under primary, secondary and tertiary methods , advanced oxidation processes, membrane technology for waste water treatment	16	CO3 CO4
4	**Solid Waste Management** Types and classification of solid waste, collection and transportation of solid waste, Solid waste disposal methods and 5R concept	3	CO5

5	**Cleaner Production** – objectives, methods, Planning and strategy , case studies , Circular economy, Green Chemistry concept	3	CO3 CO4
6.	Noise Pollution sources of noise pollution & their control methods	2	CO5

C. TEXT BOOKS

1. Environmental Pollution Control Engineering by C. S. Rao, Wiley Eastern Ltd

2. Waste Water Engineering – Treatment, Disposal & Reuse by Metcalf & Eddy Inc. Tata McGraw Hill Publications

D. REFERENCE BOOKS

1. Introduction to Environmental Engineering by Mackenzie L. Davis & David A. Cornwell,McGraw Hill International Publications

2. Environmental Engineering by Raw, Peavy&Tchobanoglous

3. Chemistry for Environmental Engineering 3rd Ed. by Sawyer &McCarty McGrawHil

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering Understanding Applying Analysing Evaluating Creating	Understand the sources and effect of different types of pollution on the environment(Air, Water, Land etc.) , Environmental Laws
CO2		meteorological aspects of air pollution, Atmospheric stability and plume behavior, sampling and measurement of air pollutants, Air pollution control equipment and its design
CO3		Types of water pollutants and waste water characteristics, Collection and testing of waste water samples, Waste water treatment schemes
CO4		Evaluate the significance of advanced oxidation processes for waste water treatment, Cleaner and greener route of production,Circular economy
CO5		Understand about solid waste and its classification , Collection and Transportation of solid waste, Various disposal methods for hazardous solid waste, noise pollution and its control

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	.

CO1	2	2	1	2	3	2	3	3	2	3	3	2	2	2	2	2	
CO2	3	3	2	2	2	2	2	2	2	2	3	2	2	3	3	2	
CO3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	3	3	
CO4	3	2	3	2	2	2	2	2	2	3	2	2	3	3	3	3	
CO5	2	1	2	3	3	2	2	3	2	2	2	2	2	2	2	2	
Avg	2.6	2.2	2	2.2	2.4	2	2.2	2.4	2	2.4	2.4	2	2.2	2.4	2.6	2.4	

M. TECH. SEMESTER – I (CH)

SUBJECT: PARTICULATE TECHNOLOGY [MC]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	0	0	100

A. COURSE OVERVIEW

This online course is intended as an introduction to particle technology. The topics included have been selected to give coverage of the broad areas of particle technology: particle size analysis packed and fluidized beds, storage and transport (hopper design, pneumatic conveying, standpipes, slurry flow), separation (filtration and gas cyclones), safety (fire and explosion hazards, health hazards). For each of the topics studied, the fundamental science involved is introduced and this is linked, where possible, to industrial practice.

B. COURSE CONTENT [Total 48 hrs]

NO	TOPIC	L+T (hrs)	COs
[1]	**Physical properties & characteristic of material**: bulk density, packed density, particulate density, angle of repose, angle of friction, angle of slide, adhesion etc. Particle size measurement techniques. Particulate matter sampling and analysis in ambient air as well as in stationary emission sources. Various air pollution control measures like ESP, bag filters, cyclone separators etc.	8	CO1 CO2
[2]	**Flow through bins:** Flow regimes, mass flow, tunnel flow design of storage vessel, Mohr circle, pressure in bins hoppers and silos, pressure in masses of particles	6	CO1 CO2
[3]	**Fluidization:** flow regimes in fluidized bed, Geldart particle characterization, concept of minimum fluidization velocity, determination of Minimum Fluidization Velocity. Industrial application of fluidized bed, Gross behaviour of fluidized beds, pressure drop, terminal velocity in fluidized beds, choice of distributor type, voidage in fluidized beds, transport disengaging height.	10	CO2 CO3
[4]	**Particle oscillation in fluidized bed:** Development of model to account for the phenomenon, analysis of forces acting on a vertical array of particle.	8	CO3 CO4
[5]	**Particle segregation in gas fluidized bed:** Mechanism of particle mixing and segregation for binary mixture, effect of particle size density, shape and gas velocity. Bubble dynamics, Onset fluidization and Jet penetration theory. Entrainment phenomena in Fluidization	8	CO3 CO4
[6]	**Pneumatic conveying**: Introduction, Positive and Negative systems, Combined and dual combined systems, pressure drop and rating in pneumatic conveying. Type of feeders and valves.	6	CO5

CO Number	Skill	Statement
CO1	Comprehension	Understand the types particle properties and characteristic for handling of various solids.
CO2	Comprehension	Understand standard methods for particulate matter sampling and analysis as well as various air pollution control measures for particulate matter.
CO3	Application	Fluidization techniques and determination of various operating parameters of fluidization operation.
CO4	Analysis	Development of fluidization models to account for various phenomenon.
CO5	Application	Pneumatic conveying for utilization in various industries for effective handling and conveying of solids.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3	3	2	3	2	2	2	3	3	2	2	2	3
CO2	3	3	3	2	2	3	3	3	3	3	2	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	2.8	3	2.8	2.8	2.8	2.8	3	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	3

MC 116 : PROCESS MODELING AND IDENTIFICATION

Teaching scheme (Hr/week)			Examination scheme				
Lecture	**Tutorial**	**Term work**	**Theory**	**Sessional**	**Term work**	**Viva -voce**	**Total**
3	**1**	**-**	**60 Marks 3 Hr**	**40 Marks 1 Hr**	**50**	**-**	**150**

1. Introduction to modeling: Classification of modeling schemes. Introduction to first principle models, gray box models, black box models.
2. Statistical Preliminaries: random process, random variables, time invariance, correlation, correlation coefficient etc.
3. Input signal design: Concept of persistency of excitation, concept of plant friendly ness, design and implementation of input signals like RGS, PRBS, Maximum length signals, Multi level signals, Relay feed back signals, Introduction to Signal design for closed loop systems.
4. Linear models: Introduction to the concept of local linearization. Detailed discussion on time series and state space model development. Introduction to linear regression, analysis of least squares estimate, best linear unbiased estimate, Recursive identification methods, Partial least squares, total least squares, introduction to prediction error methods and Instrumental variable methods. Introduction to commercial softwares on system identification.
5. Nonlinear models: Introduction to ANN based nonlinear model identification. Modeling of complex nonlinear systems using fuzzy decomposition and multi model approach. Modeling of nonlinear systems using Voltera series models. Concept of block oriented nonlinear model identification. Development of nonlinear models using Ortho normal basis functions.
6. Model order: Introduction to concept of structure selection and model order, conventional model order reduction techniques. Introduction to nonlinear model order reduction techniques.
7. Stochastic modeling: Development of stochastic time series models, Introduction to concept of kalman filtering, Introduction to nonlinear ARX and nonlinear ARMAX type models. Introduction to extended kalman filters.

REFERENCE BOOKS

System Identification by Torsten Soderstrom and Petre stoica, Prentice Hall International series in systems and control engineering.
System Identification Theory for the user, Lennert Ljung, Prentice hall PTR, Upper saddle River, NJ, 07458.
Lessons in estimation theory for signal Processing communications and control, by Jerry M.Mendal, Prentice hall signal processing series.
Perturbation signals for system identification, Editor Keith Godfrey, Prentice Hall International series
System identification special addition, Automatica, 1995 November.

Course Outcomes

CO Number	Skill Levels	Statement
CO1	Remember	Application of fundamental concepts and development of white box state space models.
CO2	Understand	Development of discrete time state space models and their applications
CO3	Application	Development of linear time series models and their applications
CO4	Analysis	Development of nonlinear models including Artificial Intelligence based models and their applications
CO5	Evaluate	Application of model order reduction techniques
CO6	Create	Development of stochastic models and their applications

CO PO MAPPING MATRIX

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	2	2	2	3	2	3	2	3	3	3	3	3	3
CO 2	3	3	2	2	2	2	2	2	2	3	2	3	3	3	3	3	3
CO 3	3	3	3	2	2	2	2	3	2	3	2	3	3	3	3	3	2
CO 4	3	3	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
CO 5	3	2	2	2	2	2	2	3	2	2	2	2	3	3	3	3	3
CO 6	2	2	2	2	2	2	2	3	2	2	2	2	3	3	3	2	3
Avg	2.8	2.5	2.3	2.0	2.0	2.0	2.0	2.7	2.0	2.5	2.0	2.5	2.8	3.0	3.0	2.8	2.8

M. TECH. SEMESTER – II (CH)
SUBJECT: ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS [MC]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	0	0	100

A. COURSE OVERVIEW

To understand any specific phenomena occurring in the chemical process industries, it is essential to know the cause of that phenomena. The study of behaviour of chemical properties with independent parameters is essential to accurately predict the separation phenomena or chemical reactions. Classical thermodynamics gave reasons for such behaviour and Statistical thermodynamics provides better insight in to such phenomena from molecular level. Most of separations in chemical industries are equilibrium based which includes vapor-liquid, liquid-liquid, vapor-liquid-liquid, solid-liquid at equilibrium. This course encompasses the study of both macroscopic level and molecular level understanding of key thermodynamic properties to handle such equilibrium cases and explore possible ways of solving problems associated with non-ideality in VLE, LLE, VLLE, SLE & reaction equilibria for multicomponent mixtures. These concepts will be applied in understanding several important industrial and academic applications. Apart from this, the behaviour of gases at molecular level, its interaction with other gases will be studied at molecular level. The study of behaviour of solids whether as a reactant or as a catalyst will be done at molecular level.

B. COURSE CONTENT [Total 48 hrs]

NO	TOPIC	L+T (hrs)	COs
[1]	**Introduction to Phase Equilibria** General principles of Classical Thermodynamics, basic postulates, estimation of Thermodynamic Properties, fundamental equations-equations of state, Gibbs-Duhem equation, Gaseous Mixtures and Fugacity, Liquid Mixtures and Fugacity.	6	CO1 CO2
[2]	**Models for Activity Coefficients using Excess Gibbs Energy** Introduction to excess Gibbs energy, Activity models such as Redlich-kister equation, Wohl's equation, Van Laar equation, Margule's equation, Wilson equation, NRTL, UNIQUAC & UNIFAC, Thermodynamic consistency test for VLE data, Liquid-Liquid Equilibria; Vapor-Liquid-Liquid Equilibria; Solid-Liquid Equilibria; Solid-Gas Equilibria, Ethics concern with VLE data.	8	CO1 CO2
[3]	**Introduction to Chemical Reaction Equilibria** Equilibrium criterion for a chemical reaction, concept of Equilibrium conversion (x), equilibrium constant (k), evaluation of equilibrium constants at different	6	CO1 CO2

	temperatures, equilibrium conversion of single reactions and multi reaction equilibria, Phase rule for chemically reacting systems.		
[4]	**Introduction to Statistical Thermodynamics** Probability theory, Different thermodynamic distributions- Boltzmann, Bose – Einstein & Fermi-Dirac, Laws of thermodynamics & their applications, Properties of elementary particles.	10	CO3 CO4 CO5
[5]	**Partition Function, Ensembles** Behavior of Monatomic gases and solids, Behavior of Diatomic and polyatomic gases, Models to predict properties of such gases and solids	12	CO3 CO4 CO5
[6]	**Chemical Equilibrium** Equilibrium constant, Equilibrium Composition, Simultaneous reactions, Ionization	6	CO4 CO5

C. TEXT BOOKS

1. Smith, J. M.; Van Ness, H. C. Introduction to Chemical Engineering Thermodynamics; Fourth Edition, McGraw Hill Book Company: Singapore, 1987.
2. Sonntag, R. E. & Van Wylen, Gordon J. Fundamentals of Statistical Thermodynamics; First Edition, John Wiley & Sons: United States of America, 1968.

D. REFERENCE BOOKS

1. Narayan, K. V. A Textbook of Chemical Engineering Thermodynamics; Second Edition, PHI Learning Private Limited: Delhi, 2013.
2. Rao, Y.V.C. Chemical Engineering Thermodynamics; First Edition, Universities Press India Private Limited: Hyderabad, 1997.
3. S. Sandler, “Chemical, Biochemical and Engineering Thermodynamics”,4th edition, Wiley, India.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	**Remembering Understanding Applying Analysing Evaluating Critiquing**	Understand and Apply the relationship between the fundamental thermodynamic properties.
CO2		Selection of thermodynamic models to estimate the properties for mixtures involving equilibria of different phases such as VLE, LLE, VLLE, SLE, SVE as well as reactions.
CO3		Introducing concept of quantum mechanics and analyze the effect of various energy levels for estimating behavior of components.
CO4		Applying Statistical Thermodynamics at molecular level for addressing change in properties of key thermodynamic quantities.

CO5		establishing the appropriate connection of the macroscopic evaluation and behavior of the properties of the system with its molecular description critiquing behavior of solids and gases during separation or reactions at molecular level.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3	3	2	3	2	2	2	3	3	2	2	2	3
CO2	3	3	3	2	2	3	3	3	3	3	2	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	2.8	3	2.8	2.8	2.8	2.8	3	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	3

M. TECH. SEMESTER – II (CH)

SUBJECT : NEW SEPARATION TECHNIQUES

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	0	0	3	3	60	40	50	0	150

A. COURSE OVERVIEW

The course deals with the understanding of conventional separation techniques and new separation techniques used in chemical process industries. The subject focusing on the basics of multi component distillation and all types of membrane based separation operations. The emphasis is given on the synthesis of membrane, characterization of membrane and selection of suitable type of membrane separation processes with industrial examples and other types of separation operations.

B. COURSE CONTENT [Total 40 hrs]

Sr. No.	Topics	L+T	COs
1	**Introduction to Separation technology** Fundamentals of Separation Processes and its classification, advantage and limitation of various conventional separation processes and need of new separation methods, basic terms associated with the membrane technology	2	CO1
2	**Multicomponent Distillation** Concept of MCD, Bubble point dew point calculation, key component concept, short cut methods, number of stage calculation, Fensky and Underwood equation	10	CO2
3	**Membrane types, materials, synthesis and characterization**: Definition of Membrane, Advantages and limitations of membrane technology compared to other separation processes, Membrane materials and properties, Synthesis methods of membrane, types of membrane and membrane modules, Flux equation, transport mechanism, factors affecting on membrane operation	10	CO3
4	**Membrane processes** Types of pressure driven membrane processes like microfiltration, ultra filtration, reverse osmosis, nano filtration using membrane and their industrial applications,	10	CO4
5	**Other typs of Separation processes –**	8	CO5

	Gas separation, pervaporation, Ion exchange membrane and electrodialysis, introduction to liquid membrane, membrane distillation , membrane reactor, super critical fluid extraction		

C. TEXT BOOKS

1. Membrane separation processes – Kaushik Nath, Second edition, PHI learning private limited

2. Fundamentals of Multicomponent Distillation – Charles D Holland, McGraw Hill Chemical Engineering series,

D. REFERENCE BOOKS

1. Basic Principles of Membrane Technology, Mulder M, Kluwer Academic Publishers, London, 1996.
2. Membrane Technology and Research, Baker R. W., Inc.(MTR), Newark, California, USA, 2004.

3. Separation Process Principles – J.D. Seader , E.J. Henley , Second edition, Wiley

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering Understanding Applying Analysing Evaluating Creating	Understand about various types of conventional and new separation methods used in industry with their advantages and limitations
CO2		Concept of multi component distillation
CO3		Types of Membrane, synthesis method, characterization of membrane, membrane modules, factors affecting on membrane operations
CO4		Various types of pressured driven membrane operations
CO5		Basics of other types of separation operation including gas separation, electro dialysis, ion exchange membrane, supercritical fluid extraction, LEM

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	.

CO1	2	2	1	2	2	2	3	3	2	1	1	2	2	2	2	2	
CO2	3	3	2	2	2	2	2	2	2	2	2	2	2	3	3	2	
CO3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	3	3	
CO4	3	2	3	2	2	2	2	2	2	2	2	2	3	3	3	3	
CO5	2	1	2	2	2	3	2	3	2	2	2	2	2	2	2	2	
Avg	2.6	2.2	2	2	2	2.2	2.2	2.4	2	1.8	2.8	2	2.2	2.4	2.6	2.4	

(M.Tech. Semester VII (CH)

Subject: Computational and Numerical Methods

Reference Subject Code: xxxx

Teaching Scheme (hr/week)				Credits	Exam Scheme (Marks)				
Lect	Tut	Prac	Total		Ext	Sess	TW	Prac	TOTAL
4	0	0	4	4	60	40	50	00	150

A. COURSE OVERVIEW

Numerical solutions of various mathematical models such as lumped parameter models and distributed parameter models describing steady state and dynamic behaviours of Chemical Process Systems and parameter estimation using numerical methods in Chemical Engineering.

Objectives:

To apply numerical methods for solving various problems in chemical engineering systems and to develop computer programs using languages like C/C++ and commercial software like Matlab in order to educate the students for solving research-oriented problems. Fundamentals of numerical methods/algorithms to solve systems of different mathematical equations (e.g. linear/nonlinear algebraic equations, ordinary / partial differential equations) will be introduced. Practical are designed for solving actual chemical engineering problems through computer programming and coding.

COURSE CONTENT [Total 45 hrs]

Sr No	TOPIC	L Hrs	COs
1	**Basics of Vectors, Scalars and matrix algebra** Addition/subtraction, multiplication/division of vectors, matrix multiplication, inverse of matrix, determinant and rank of matrix, eigen values, sparse matrices, Use of MATLAB for matrix algebra, approximation and concept of error and error analysis	04	1,3
2	**Numerical methods for linear algebraic equations** Gauss elimination method, Gauss-Jordan method, Jacobi method, Successive – over relaxation method, tri-diagonal matrix, MATLAB programming	08	1,2,3
3	**Numerical methods for nonlinear algebraic equations** Successive substitution method, Newton-Raphson method, Secant method, False position method, single variable and	08	1, 2,3,4, 5

	multivariable case studies, MATLAB functions for nonlinear algebraic equations		
4	**Eigen Value Problems** Eigen value analysis of linear and nonlinear systems and solution of homogeneous equations using eigen values	**04**	**1,2,3**
5	**Regression, interpolation, curve fitting, numerical integration** Simple interpolation, Lagrange's interpolation, Newton's interpolation, Simpson's rule, trapezoid method, linear regression, polynomial regression, exponential and power regression, MATLAB routines and commands	**04**	**1,2,3**
6	**Numerical methods for IVP and BVP ordinary differential equations** Explicit and implicit ODEs, Euler's explicit and implicit methods, explicit Adams-Bashforth methods, implicit Adams-Mouton methods, Predictor – corrector methods, Runge-Kutta methods, MATLAB solvers for ODEs, Finite difference, Orthogonal collocation and Orthogonal collocation on finite-element methods for ODE-BVP, Shooting Methods for solving BVP	**10**	**1,2,3, 4,5,6**
7	**Numerical methods for Partial differential equations** Steady state and dynamic PDES, method of lines, Crank-Nicholson method, finite-difference, Orthogonal collocation and orthogonal collocation on finite element methods	**07**	**1,2, 3,4,5, 6**

Practical and Term work **(50 marks)**

Simulation experiments are designed to use MATLAB software for solving linear/nonlinear algebraic equations for steady state problems in Chemical Engineering and for solving dynamic problems in Chemical Engineering. Simulation experiments for parameter estimation problems in chemical engineering systems are also designed.

Text Books:

1. Gupta, S. K. *Numerical Methods for Engineers*, 3rd ed.; New Age International Publishers: New Delhi, 2015.
2. Chapra, S. C. *Applied Numerical Methods with MATLAB for Engineers and Scientist*, 3rd ed.*;* McGraw-Hill: New York, 2012.

Reference Books:

1. Beers, K J. *Numerical Methods for Chemical Engineering Applications in MATLAB*, Cambridge University Press: UK, 2006.

2. Constantinides, A.; Mostoufi, N. *Numerical Methods for Chemical Engineers with MATLAB Applications*, Prentice Hall International Series: New Jercy, 1999.

COURSE OUTCOMES

CO Number	Skill	Statement
CO1	UNDERSTANDING	**Remember** and **understand** the various numerical methods to solve various linear and nonlinear steady state and dynamic problems in chemical engineering systems described by ODE, PDE, AE and NAE
CO2	ANALYSING	Carry out the **error analysis** in the numerical solutions of chemical engineering problems
CO3	APPLYING	**Apply** linear algebraic equation solution techniques and nonlinear algebraic equation techniques for solving steady states of chemical engineering systems. Use **Matlab** to i**mplement** numerical methods in simulations.
CO4	EVALUATING	**Do** critical evaluation of the performance of various numerical methods using simulations for solving chemical engineering problems.
CO5	CREATING	Develop Matlab codes for various numerical methods
CO6	REMEBERING & EVALUATING	**Generate** a matlab program for industrial application to carry out steady state and dynamics analysis.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	0	2	2	1	2	1	2	3	2	3	2	3
CO2	2	1	2	1	0	2	3	1	2	2	3	3	3	3	3	3
CO3	2	3	3	2	2	3	3	2	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	2	2	2	2	2	3	2	2	3
CO5	2	3	3	2	3	3	3	2	3	2	2	3	2	3	2	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
Avg	2.3	2.3	2.5	2	1.8	2.7	2.8	1.8	2.5	2.2	2.5	2.8	2.67	2.67	2.17	3

M. TECH. SEMESTER –II (CH)
SUBJECT: OPTIMIZATION TECHNIQUE

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	0	0	3	3	60	0	0	0	60

A. COURSE OVERVIEW

Motivation: Study, understand, utilize the appropriate mathematical models and tools to solve the process problems associated with any field or industry in the most optimistic manner.

B. COURSE CONTENT

NO	TOPIC	L (hrs)	Cos
[1]	**Introduction to Operational Research** ● Introduction, ● Engineering Application, ● Methods of Operation Research, ● Formulation, ● Graphical method of Solution	3	CO1 & CO3 & CO4
[2]	**Linear Programming** ● Simplex method ● Degeneracy ● Big-M method ● Revised Simplex method	5	CO2 & CO3 & CO4
[3]	**Transportation Model** ● North-West Corner rule, ● Row and Column Minima method, ● Least-cost method, ● Vogel's approximation method, ● Degeneracy in transportation problem, ● stepping stone method, ● modified distribution method, ● unbalanced supply and demand, ● profit maximization problem, ● trans-shipment problems	5	CO3 & CO4 & CO5
[4]	**Assignment Model** ● Hungarian method for solution ● Variation of the assignment problem - non-square matrix, restriction on assignments. ● Maximization problem ● Travelling salesman problem ● Travelling salesman problem (shortest cyclic route models)	5	CO2 & CO3 & CO4
[5]	**Scheduling Optimization and Related Models on Sequencing** ● Batch Scheduling ● Formulation of sequencing models and its applications. ● Introduction to Gantt Chart and its Application to Different types of Transfer policies.	5	CO5 & CO6

[6]	**Advanced topics in Linear Programming** ● Duality in Linear Programming ● Primal to Dual conversion ● Duality Theorem and Dual Simplex method	**5**	CO2 & CO3 & CO4
[7]	**Dynamic programming** ● Bellman's principle of optimality, ● Examples on the application of routing problem, inventory problem, marketing problem	**4**	CO4 & CO5 & CO6
[8]	**Non-Linear Programming** ● Elimination Methods — Unrestricted Search, Exhaustive Search, Dichotomous search, Fibonacci method, Golden Section Method, ● Kuhn tucker condition	**4**	CO1 & CO2 & CO3 & CO4

C. TEXT BOOKS

1. Gupta P., Hira D.S., "Operation Research", S. Chand & Company Ltd
2. Rao S.S., "Engineering Optimization: Theory and Practice", Willey Publication.
3. Vohra N D, Quantitative Techniques in Management, Tata McGraw Hill, New Delhi

D. REFERENCE BOOKS

1. Sharma S D & Sharma H, Operations Research: Theory, methods & applications,
2. K. Nath R. Nath Arora J.S., "Introduction to Optimum Design", Elsevier Academic Press.
3. Hiller & Libermann, Introduction to Operations Research, Tata McGraw Hill
4. Hamdy A. Taha, "Operation Research", Pearson Education.
5. Operation Research – V. K. Kapoor, S. Chand Publication

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Define	**Define** the type of the problem in terms of Linear programming problem or Non-linear programming problem
CO2	Describe	**Describe** the formulation of the problem into mathematical approach/model
CO3	Application	**Apply** the types of numerical/mathematical methods to be used in industry to have optimal solution
CO4	Solution	**Solve** the type of the problem using the appropriate method
CO5	Development	**Develop** a skill to deal with type of problem to get best possible result

CO6	Use	**Use** the mathematical tool to solve the trickiest problem

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	2	2	2	2	2	2	2	2	3	3	3	3	3
CO2	3	3	3	2	2	2	2	2	2	2	2	1	3	3	3	3	3
CO3	3	3	2	2	2	2	1	1	1	1	1	1	3	3	3	3	2
CO4	3	3	2	2	2	2	1	1	1	1	1	1	2	2	2	3	2
CO5	2	2	2	1	3	1	1	1	1	1	1	1	3	3	2	3	2
CO6	2	2	2	2	3	1	1	1	1	1	1	1	3	3	2	2	3
Avg	2.7	2.7	2.3	1.8	2.3	1.7	1.3	1.3	1.3	1.3	1.3	1.2	2.8	2.8	2.5	2.8	2.5

Process synthesis

Teaching scheme (Hr/week)			Examination scheme				
Lecture	Tutorial	Term work	Theory	Sessional	Term work	Viva-voce	Total
3	1	2	60 Marks 3 Hr	40 Marks 1 Hr	50 Marks	-	150

Objective:

	Topic	Contact hours	CO
1	**Introduction:** Introduction to design and process synthesis. Preliminary process design. Basic steps in process flow sheet synthesis. Decomposition strategies for process synthesis. A Case study: Synthesis of Ethyl Alcohol process.	6+2	1
2	**Scheduling:** Introduction to design and scheduling of batch processes.Concepts of single and multi product batch plants, transfer policies, parallel units and intermediate storage.Synthesis of flow shop plants.	6+2	2
3	**Simulation in process design:** Process simulation modes, Methods of solving nonlinear equations, Recycle partitioning and tearing.	6+2	3
4	**Heat and power integration:** The basic concepts of Heat Ex-changer Network Synthesis (HENS) and Mass Exchange Networks (MEN). Synthesis of ideal multi-component distillation systems. Heat integrated distillation systems.	6+2	4
5	**Synthesis of reactors and reactor networks:** Mathematical approach and Heuristic approach.	3+1	5
6	**Process flexibility:** Introduction to the concept of flexibility, Mathematical formulas for flexibility analysis and some solution methods.	3+1	5
7	**Optimization for Process Synthesis:** Introduction to optimization techniques.MINLP problems. MINLP models to solve HENS, distillation sequences, reactor network synthesis.	6+2	6

Text books:

1. Biegler, Grossmann, and Western berg., Systematic methods of chemical process design.
2. Rudd Dole,F,Powers Gray J, Siirola , Jeffrey J, Process , Process synthesis , Engle wood cliffs, Printice hall, 1973.

Course Outcomes

CO Number	Skill Levels	Statement
CO1	Remember Understand Application Analysis Evaluate Create	Concept of design, synthesis along with basic steps for process flow sheet synthesis.
CO2		Scheduling of multi product and multipurpose batch plants and design of flow shop plant.
CO3		Process plant simulation including partitioning and tearing algorithms.
CO4		Concepts of HENS and MENS.
CO5		Synthesis of reactors and reactor networks using various methods. Introduction to process flexibility.
CO6		Optimization techniques and their use in process synthesis.

CO PO MAPPING MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	2	2	2	2	3	2	3	2	3	3	3	3	3	3
CO2	3	3	2	2	2	2	2	2	2	3	2	3	3	3	3	3	3
CO3	3	3	3	2	2	2	2	3	2	3	2	3	3	3	3	3	2
CO4	3	3	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
CO5	3	2	2	2	2	2	2	3	2	2	2	2	3	3	3	3	3
CO6	2	2	2	2	2	2	2	3	2	2	2	2	3	3	3	2	3
Avg	2.8	2.5	2.3	2.0	2.0	2.0	2.0	2.7	2.0	2.5	2.0	2.5	2.8	3.0	3.0	2.8	2.8

Skill Development and Employability

As an outcome of this course students can identify suitable equipment, reaction and separations. They will also be familiar with synthesis of heat exchanger and mass exchange networks.Students are trained to design and analyze flow sheets with a focus on improving efficiency and sustainability. Employability of students in R&D and design organizations improves substantially after clearing this course.

(M. Tech. Semester I (CH)

Subject: ADVANCED CHEMICAL REACTION ENGINEERING

Reference Subject Code: MC XXX

Teaching Scheme (hr/week)				Credits	Exam Scheme (Marks)				
Lect	Tut	Prac	Total		Ext	Sess	TW : Seminar	Prac	TOTAL
3	1	--	4	4	60	40	50	--	150

A. COURSE OVERVIEW

Non-isothermal reactor design under steady state and unsteady state conditions, non-ideal flow modelling in real reactors, catalytic and non-catalytic heterogeneous reactions and reactor design, application of Matlab for solving reaction engineering problems.

Objectives:

To introduce students to advanced topics of chemical reaction engineering, such as non-isothermal reactor design, multi-phase reactions and reactor design, catalytic reactions and reactor design and application of software for solving the associated problems of advanced topics of chemical reaction engineering.

COURSE CONTENT [Total 45 hrs]

Sr No	TOPIC	L Hrs	COs
1	**Non-isothermal reactor design** Energy balance for CSTR/PFR/Batch reactor under adiabatic and non-adiabatic conditions, multiple steady states in CSTR/PFR, use of MATLAB for design/analysis of non-isothermal reactors.	09	1,2,3, 4,5,6
2	**Non-ideal flow and mathematical modeling** Zero parameter, one parameter and two parameter modeling of non-ideal flow in reactors	09	1,2,3, 4,5,6
3	**Fluid-fluid heterogeneous reactor design** Gas-liquid and liquid-liquid heterogeneous reactions, mathematical models, reactor design for fluid-fluid heterogeneous reactions	09	1, 2,3,4, 5,6
4	**Fluid-solid heterogeneous reactor design**	09	1,2,3, 4,5,6

	Gas-solid and liquid-solid heterogeneous reactions, mathematical models, reactor design for fluid-solid heterogeneous reactions		
5	**Catalytic reactors** Solid catalysed reactions and reactor design, mathematical models and reactor design	**09**	**1,2,3, 4,5,6**

Seminar Term work **(50 marks)**

A seminar topic of relevance to advanced reaction engineering is assigned to the student that may involve simulation and students are supposed to present the seminar work and submit the seminar project at the end the semester.

Text Books:

1. Levenspiel, O., Chemical Reaction Engineering, 3rd edition, Wiley Eastern Pvt. Ltd.
2. Fogler, H. S., Elements of Chemical Reaction Engineering, Prentice-Hall.

Reference Books:

1. Smith, J. M., Chemical Engineering Kinetics, 3rd Edition, Mc-Graw Hill Publication

COURSE OUTCOMES

CO Number	Skill	Statement
CO1	UNDERSTANDING	**Remember** and **understand** the non-isothermal reactor design, non-ideal flow modeling, heterogeneous catalytic and non-catalytic reactions and reactor design
CO2	ANALYSING	Carry out the **analysis** of non-isothermal reactors and heterogeneous reactors
CO3	APPLYING	**Apply** software such as Matlab, for design and analysis of non-isothermal reactors and heterogeneous reactors.
CO4	EVALUATING	**Do critical** evaluation of the non-isothermal reactors and heterogeneous reactors performances using simulations.
CO5	CREATING	**Design** reactors for non-isothermal conditions and for heterogeneous reactions
CO6	REMEBERING & EVALUATING	**Generate** a matlab program for industrial application to carry out steady state and dynamics analysis of non-isothermal reactors and heterogeneous reactors

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	0	2	2	1	2	1	2	3	3	2	3	3
CO2	2	1	2	1	0	2	3	1	2	2	3	3	3	2	3	3

CO3	2	3	3	2	2	3	3	2	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	2	2	2	2	2	3	2	3	3
CO5	2	3	3	2	3	3	3	2	3	2	2	3	2	2	2	2
CO6	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2
Avg	**2.3**	**2.3**	**2.5**	**2**	**1.8**	**2.7**	**2.8**	**1.8**	**2.5**	**2.2**	**2.5**	**2.8**	**2.67**	**2.0**	**2.67**	**2.67**

M. Tech. Semester I (Chemical Engineering)
Subject: Advanced Transport Phenomena
Reference Subject Code: MC 201

Teaching Scheme (hr/week)				Credits	Exam Scheme (Marks)				
Lect	Tut	Prac	Total		Ext	Sess	TW	Prac	TOTAL
3	1	0	4		60	40			100

Motivation: Transport phenomena is the subject which deals with the different transport processes such as momentum, energy and mass,ubiquitous in industry as well as in nature.

Objectives:

- To acquireknowledge on momentum, heat and mass transfer in Chemical engineering systems and their analogous behaviour.
- Momentum, heat and mass transfer are taught together due to the underlying similarities of the mathematics tools and molecular mechanisms describing such processes.
- The students will be made aware of the core scientific connections and will be encouraged to solve problems based on relevant analogie

Learning Outcomes: On successful completion of course students will be able,

- To Identify transport properties and analyze the mechanism of momentum, energy and mass transport.
- To Apply conservation laws to formulate differential form of equations of change for mass, momentum and heat transfer problems.
- To solve linear partial differential equations along with appropriate boundary conditions to get the velocity, temperature and concentration profiles of different engineering problems.
- Recognize non Newtonian fluids and apply appropriate models to solve them

Detailed Syllabus: [36 hrs]

1. **Transport By Molecular motion [4 hrs]**
   Momentum, energy and mass transport by molecular level

2. **Transport in turnbulemt flow and eddy tranport properties [7 hrs]**
   Turbulent momentum, energy and masss trasnport

3. **Transport across the phase boundaries [7 hrs]**
   Friction factor, Heat trasnfer co-efficient and mass transfer co-efficient with use of empirical correlation
4. **Transport in large system [10 hrs]**
   Macroscopic balance in pieces of equipment or parts thereof for isothermal , non-isothermal and mixtures
5. **Transport by other mechanism [8 hrs]**
   Momentum transport in polymeric liquid, Energy transport by radiation and mass transport in multi component system.

Text Books:

1.Bird R B, Stewart W E and Light fort R N, “Transport Phenomena”, John Wiley and Sons (2002)

Reference Book:

1. Welty J R , Wilson R E and WicksC E , “Fundamentals of Momentum , Heat and Mass Transfer”, 4thed, John Wiley and Sons (2001).

2. John C Slattery, “Momentum, Energy and Mass transfer in continua”, McGraw Hill, Co. (1972
3.BennetC U and Myers J E, “ Momentum, Heat and Mass Transfer” Tata McGraw Hill Publishing Co. (1975)
4.Robert S Brodkey and Harry C Hersing, “Transport Phenomena a Unified approach” McGraw Hill Book Co. (1988)

Advanced Transport Phenomena

CO of MC201	MC201.1	MC201.2	MC201.3	MC201.4	MC201.5	MC201.6	**Average**
Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems	2	3	3	3	3	2	**2.7**
Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.	2	3	3	3	2	2	**2.5**
Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	1	2	3	2	3	2	**2.2**
Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems	2	2	2	3	2	2	**2.2**
Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	2	2	2	2	3	2	**2.2**
The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2	2	2	2	2	2	**2**
Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	3	2	2	2	2	2	**2.2**
Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	1	2	2	2	2	2	**1.8**
Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	2	2	2	2	2	**2**

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	2	2	2	2	2	**1.8**
Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	1	2	2	2	2	2	**1.8**
Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	2	2	2	2	2	2	**2**

M. TECH. SEMESTER – I (CH)

SUBJECT : INTRODUCTION TO ENVIRONEMTAL ENGINEERING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	50	0	150

A. COURSE OVERVIEW

The course deals with the understanding of environmental issues generated by chemical process industries due to various types of pollutants. The subject focusing on the sampling, measurement and control strategy for air and waste water treatment. The emphasis is given on the implementation of solid waste management system in chemical process industries. Apart from these, Cleaner and greener route of synthesis is discussed to motivate students for source correction methods rather than end of the pipe solution and do research in the same area.

B. COURSE CONTENT [Total 44 hrs]

Sr. No.	Topics	L+T	COs
1	**Introduction to Environmental Engineering** Ecology and various cycles, Acid rain, ozone depletion, green house gases, photochemical smog , various types of pollutants , Environmental laws , introduction to environmental chemistry	4	CO1
2	**Air Pollution and Control** Air pollution sources and its classification, Effects of air pollutants, meteorological aspects of air pollution, Dry/wet adiabatic lapse rate and environmental lapse rate, atmospheric stability and plume behavior, Gaussian plume behavior model for area, line and point source. Air pollutant sampling and measurement, various types of air pollution control methods, equipment and its design , selection criteria of air pollution control equipment	16	CO1 CO2
3	**Industrial Waste Water Treatment** Sources of industrial waste water and its characteristics, need of waste water treatment methods, use of various types of physical, chemical and biological methods for waste water treatment under primary, secondary and tertiary methods , advanced oxidation processes, membrane technology for waste water treatment	16	CO3 CO4
4	**Solid Waste Management** Types and classification of solid waste, collection and transportation of solid waste, Solid waste disposal methods and 5R concept	3	CO5

5	**Cleaner Production** – objectives, methods, Planning and strategy , case studies , Circular economy, Green Chemistry concept	3	CO3 CO4
6.	Noise Pollution sources of noise pollution & their control methods	2	CO5

C. TEXT BOOKS

1. Environmental Pollution Control Engineering by C. S. Rao, Wiley Eastern Ltd

2. Waste Water Engineering – Treatment, Disposal & Reuse by Metcalf & Eddy Inc. Tata McGraw Hill Publications

D. REFERENCE BOOKS

1. Introduction to Environmental Engineering by Mackenzie L. Davis & David A. Cornwell,McGraw Hill International Publications

2. Environmental Engineering by Raw, Peavy&Tchobanoglous

3. Chemistry for Environmental Engineering 3rd Ed. by Sawyer &McCarty McGrawHil

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering Understanding Applying Analysing Evaluating Creating	Understand the sources and effect of different types of pollution on the environment(Air, Water, Land etc.) , Environmental Laws
CO2		meteorological aspects of air pollution, Atmospheric stability and plume behavior, sampling and measurement of air pollutants, Air pollution control equipment and its design
CO3		Types of water pollutants and waste water characteristics, Collection and testing of waste water samples, Waste water treatment schemes
CO4		Evaluate the significance of advanced oxidation processes for waste water treatment, Cleaner and greener route of production,Circular economy
CO5		Understand about solid waste and its classification , Collection and Transportation of solid waste, Various disposal methods for hazardous solid waste, noise pollution and its control

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	.

CO1	2	2	1	2	3	2	3	3	2	3	3	2	2	2	2	2	
CO2	3	3	2	2	2	2	2	2	2	2	3	2	2	3	3	2	
CO3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	3	3	
CO4	3	2	3	2	2	2	2	2	2	3	2	2	3	3	3	3	
CO5	2	1	2	3	3	2	2	3	2	2	2	2	2	2	2	2	
Avg	2.6	2.2	2	2.2	2.4	2	2.2	2.4	2	2.4	2.4	2	2.2	2.4	2.6	2.4	

M. TECH. SEMESTER – I (CH)

SUBJECT: PARTICULATE TECHNOLOGY [MC]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	0	0	100

A. COURSE OVERVIEW

This online course is intended as an introduction to particle technology. The topics included have been selected to give coverage of the broad areas of particle technology: particle size analysis packed and fluidized beds, storage and transport (hopper design, pneumatic conveying, standpipes, slurry flow), separation (filtration and gas cyclones), safety (fire and explosion hazards, health hazards). For each of the topics studied, the fundamental science involved is introduced and this is linked, where possible, to industrial practice.

B. COURSE CONTENT [Total 48 hrs]

NO	TOPIC	L+T (hrs)	COs
[1]	**Physical properties & characteristic of material**: bulk density, packed density, particulate density, angle of repose, angle of friction, angle of slide, adhesion etc. Particle size measurement techniques. Particulate matter sampling and analysis in ambient air as well as in stationary emission sources. Various air pollution control measures like ESP, bag filters, cyclone separators etc.	8	CO1 CO2
[2]	**Flow through bins:** Flow regimes, mass flow, tunnel flow design of storage vessel, Mohr circle, pressure in bins hoppers and silos, pressure in masses of particles	6	CO1 CO2
[3]	**Fluidization:** flow regimes in fluidized bed, Geldart particle characterization, concept of minimum fluidization velocity, determination of Minimum Fluidization Velocity. Industrial application of fluidized bed, Gross behaviour of fluidized beds, pressure drop, terminal velocity in fluidized beds, choice of distributor type, voidage in fluidized beds, transport disengaging height.	10	CO2 CO3
[4]	**Particle oscillation in fluidized bed:** Development of model to account for the phenomenon, analysis of forces acting on a vertical array of particle.	8	CO3 CO4
[5]	**Particle segregation in gas fluidized bed:** Mechanism of particle mixing and segregation for binary mixture, effect of particle size density, shape and gas velocity. Bubble dynamics, Onset fluidization and Jet penetration theory. Entrainment phenomena in Fluidization	8	CO3 CO4
[6]	**Pneumatic conveying**: Introduction, Positive and Negative systems, Combined and dual combined systems, pressure drop and rating in pneumatic conveying. Type of feeders and valves.	6	CO5

CO Number	Skill	Statement
CO1	Comprehension	Understand the types particle properties and characteristic for handling of various solids.
CO2	Comprehension	Understand standard methods for particulate matter sampling and analysis as well as various air pollution control measures for particulate matter.
CO3	Application	Fluidization techniques and determination of various operating parameters of fluidization operation.
CO4	Analysis	Development of fluidization models to account for various phenomenon.
CO5	Application	Pneumatic conveying for utilization in various industries for effective handling and conveying of solids.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3	3	2	3	2	2	2	3	3	2	2	2	3
CO2	3	3	3	2	2	3	3	3	3	3	2	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	2.8	3	2.8	2.8	2.8	2.8	3	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	3

MC 116 : PROCESS MODELING AND IDENTIFICATION

Teaching scheme (Hr/week)			Examination scheme				
Lecture	**Tutorial**	**Term work**	**Theory**	**Sessional**	**Term work**	**Viva -voce**	**Total**
3	**1**	**-**	**60 Marks 3 Hr**	**40 Marks 1 Hr**	**50**	**-**	**150**

1. Introduction to modeling: Classification of modeling schemes. Introduction to first principle models, gray box models, black box models.
2. Statistical Preliminaries: random process, random variables, time invariance, correlation, correlation coefficient etc.
3. Input signal design: Concept of persistency of excitation, concept of plant friendly ness, design and implementation of input signals like RGS, PRBS, Maximum length signals, Multi level signals, Relay feed back signals, Introduction to Signal design for closed loop systems.
4. Linear models: Introduction to the concept of local linearization. Detailed discussion on time series and state space model development. Introduction to linear regression, analysis of least squares estimate, best linear unbiased estimate, Recursive identification methods, Partial least squares, total least squares, introduction to prediction error methods and Instrumental variable methods. Introduction to commercial softwares on system identification.
5. Nonlinear models: Introduction to ANN based nonlinear model identification. Modeling of complex nonlinear systems using fuzzy decomposition and multi model approach. Modeling of nonlinear systems using Voltera series models. Concept of block oriented nonlinear model identification. Development of nonlinear models using Ortho normal basis functions.
6. Model order: Introduction to concept of structure selection and model order, conventional model order reduction techniques. Introduction to nonlinear model order reduction techniques.
7. Stochastic modeling: Development of stochastic time series models, Introduction to concept of kalman filtering, Introduction to nonlinear ARX and nonlinear ARMAX type models. Introduction to extended kalman filters.

REFERENCE BOOKS

System Identification by Torsten Soderstrom and Petre stoica, Prentice Hall International series in systems and control engineering.
System Identification Theory for the user, Lennert Ljung, Prentice hall PTR, Upper saddle River, NJ, 07458.
Lessons in estimation theory for signal Processing communications and control, by Jerry M.Mendal, Prentice hall signal processing series.
Perturbation signals for system identification, Editor Keith Godfrey, Prentice Hall International series
System identification special addition, Automatica, 1995 November.

Course Outcomes

CO Number	Skill Levels	Statement
CO1	Remember	Application of fundamental concepts and development of white box state space models.
CO2	Understand	Development of discrete time state space models and their applications
CO3	Application	Development of linear time series models and their applications
CO4	Analysis	Development of nonlinear models including Artificial Intelligence based models and their applications
CO5	Evaluate	Application of model order reduction techniques
CO6	Create	Development of stochastic models and their applications

CO PO MAPPING MATRIX

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	2	2	2	3	2	3	2	3	3	3	3	3	3
CO 2	3	3	2	2	2	2	2	2	2	3	2	3	3	3	3	3	3
CO 3	3	3	3	2	2	2	2	3	2	3	2	3	3	3	3	3	2
CO 4	3	3	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
CO 5	3	2	2	2	2	2	2	3	2	2	2	2	3	3	3	3	3
CO 6	2	2	2	2	2	2	2	3	2	2	2	2	3	3	3	2	3
Avg	2.8	2.5	2.3	2.0	2.0	2.0	2.0	2.7	2.0	2.5	2.0	2.5	2.8	3.0	3.0	2.8	2.8

D. CH. SEMESTER – I (CH)
SUBJECT: APPLIED CHEMISTRY
(DK103)

Teaching Scheme (Hr/W)			Exam Scheme (Marks)				
L	P	T	Theory	Sessional	Practical.	Term Work	Total
3	3	1	60	40	50	25	175

1. Basic Concept **(6 Hour)**

Matter, elements, compounds, atoms, molecules, molecular formula, mole concept, vogadro's number, gram-atomic weight, gram-molecular weight, equivalent weight, STP, Avogadro's hypothesis and its application, derivation of general gas equation PV=nRT, Dalton's law of partial pressure,

2. Atomic structure **(7 Hour)**

Thomson's model its limitation, Rutherford's model and its limitation,Brief introduction to Bohr's model and its limitation, Concept of shells and subshells , Dual nature of matter and light,,De-broglie relationship, Heisenberg uncertainity principle,Modern concept of atomic structure, atomic number, mass number, orbital concept, quantum numbers, shape of orbital, electron configuration of elements using Auf-bau principle, Hund's rule and Pauli's exclusion principle, isotopes, isobars.

3. Modern periodic table **(5 Hour)**

Brief introduction to Mandeleev's periodic table and its drawback, Classification of element on the basis of their electronic configuration, periodic trend of ionization energy, electron affinity and electron negativity of elements in periodic table

4. Chemical Bonding **(6 Hour)**

Ionic bonds, co-valent bonds, co-ordinate co-valent bonds, H-bonds, valence, electronic theory of valence, Dot & Lewis formula of elements, Valence bond theory(VBT) and geometry of some simple molecules having hybridization of sp^3, sp^2, sp, Valence shell electron repulsion pair theory(VSEPR) with shape of some simple molecules like BeF_2,,BF_3, CH_4, PCl_5, Molecular Orbital Theory(MOT) of homo nuclear diatomic molecules like H_2,He_2,O_2, N_2.

5. Chemical equilibrium **(6 Hour)**

Reversible & irreversible reaction, rate of reaction, law of mass action, equilibrium state, equilibrium constant Ke for homogeneous and heterogeneous systems, relationship between Ke and K_P, Le-Chatelier principle and its application

6. Ionic equilibrium **(6 Hour)**

Ionization of strong and weak electrolytes in water, ionic equilibrium, acid and base theories, dissociation constant of weak acid, Ka, weak base K_b and Ksp Self-ionization of water K_W, pH scale, determination of pH of solution from its strength, buffer solutions, Common ion effect with illustrative example

7. Solutions **(4 Hour)**

Types of solutions, different methods of expressing strength of solutions, viz. molarity. molality, normality, formality, weight percent, preparation of standard solutions, Vapour pressure and Rault's law, ideal and non-ideal solution, positive and negative deviation of non-ideal solution from Rault's law

8. Water and its treatment **(6 Hour)**

Sources of water, hard and soft water, kinds of hardness, effect of hardness, removal of hardness of water by soda-lime, permutite and ion-exchange process.

Text Book:

Essential of Physical chemistry –Arun Bahl,B.S.Bahl,G.D.Tuli

Reference :

General Chemistry- V P Mehta
General Chemistry -T.T.T.I Bhopal
Chemistry Foundations - David E Goldberg
Applied Chemistry - Dr. A S Patel, Dr. K M Shah,
Chemistry the central science - Theodore L Brown, H. Eugene Leney

Sr. No.	Topic	No. of Lectures	CO
1	**Basic Concepts** Matter, elements, compounds, atoms, molecules, molecular formula, mole concept, Avogadro's number, gram-atomic weight, gram-molecular weight, equivalent weight, STP, Avogadro's hypothesis and its application, derivation of general gas equation PV=nRT, Dalton's law of partial pressure.	**4Hr**	CO-1
2	**Atomic structure** Thomson's model its limitation, Rutherford's model and its limitation, Brief introduction to Bohr's model and its limitation, Concept of shells and subshells, Dual nature of matter and light,, De-Broglie relationship, Heisenberg uncertainty principle, Modern concept of atomic structure, atomic number, mass number, orbital concept, quantum numbers, shape of orbital, electron configuration of elements using Auf-bau principle, Hund's rule and Pauli's exclusion principle, isotopes, isobars.	**7Hr.**	CO-2
3	**Modern periodic table** Brief introduction to Mendeleev's periodic table and its drawback, Classification of element on the basis of their electronic configuration, periodic trend of ionization energy, electron affinity and electron negativity of elements in periodic table.	**5Hr.**	CO-3
4	**Chemical Bonding** Ionic bonds, co-valent bonds, co-ordinate co-valent bonds, H-bonds, valence, electronic theory of valence, Dot & Lewis formula of elements, Valence bond theory (VBT) and geometry of some simple molecules having hybridization of sp^3, sp^2, sp, Valence shell electron repulsion pair theory (VSEPR) with shape of some simple molecules like BeF_2,,BF_3, CH_4, PCl_5, Molecular Orbital Theory(MOT) of homo nuclear diatomic molecules like H_2,He_2,O_2, N_2.	**7Hr.**	CO-2
5	**Chemical equilibrium** Reversible & irreversible reaction, rate of reaction, law of mass action, equilibrium state, equilibrium constant Ke for homogeneous and heterogeneous systems, relationship between Ke and K_P, Le-Chatelier's principle and its application.	**5Hr.**	CO-4
6	**Ionic equilibrium** Ionization of strong and weak electrolytes in water, ionic equilibrium, acid and base theories, dissociation constant of weak acid, Ka, weak base K_b and Ksp Self-ionization of water K_W, pH scale, determination of pH of solution from its strength, buffer solutions, Common ion effect with illustrative example.	**5Hr**	CO-4
7	**Solutions** Types of solutions, different methods of expressing strength of solutions, viz. Molarity. molality, normality, formality, weight percent, preparation of standard solutions, Vapour pressure and Rault's law, ideal and non-ideal solution, positive and negative deviation of non-ideal solution from Rault's law.	**4Hr.**	CO-1
8	**Water and its treatment** Sources of water, hard and soft water, kinds of hardness, effect of hardness, removal of hardness of water by soda-lime, permutite and ion-exchange process.	**6 Hr.**	CO-5

Sr. No.	Course Outcome	Statement After studying this course student will be able to :
1	CO-1	Relate the formula of mass, moles, atoms, molecules & different way of expressing concentration of the solution & their preparation.
2	CO-2	Acquire the knowledge of various models of atomic structure, principles of electronic configuration and hybridization & its theories.
3	CO-3	Identify a period & group on the periodic table as well as compare the periodic properties of elements.
4	CO-4	Understand & explain the essential aspects of chemical as well as ionic equilibrium & get knowledge of basic acid base concepts.
5	CO-5	Get the idea about type of water sample & its treatments.

DIPLOMA SEMESTER – II (CH)
SUBJECT: CHEMICAL ENGINEERING MATERIAL (DK208)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	--	4	4	60	40	--	--	100

A. COURSE OVERVIEW

The course imparts study of various process technologies and fundamental types of various engineering materials. Chemical Engineering Materials involves transforming raw materials into valuable end-products, the development of high-performance materials for our modern society, and understanding its various properties & applications.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	General principles of selection of materials. Definition & explanation of melting point, boiling point, specific heat, thermal conductivity, thermal expansion, thermal insulation, stresses, strain.	3	CO1
[2]	Definition, mechanism of corrosion, types of corrosion, dry & wet corrosion, direct corrosion, electro-chemical corrosion galvanic corrosion, high-temperature corrosion, atmospheric corrosion. Factors affecting/influencing corrosion rate, brief description, different methods for corrosion control and prevention.	11	CO1 CO3
[3]	General comparison of ferrous, non-ferrous & alloys. Properties of metals Cast iron, wrought iron, steel, Aluminium, zinc, chromium, nickel, tin, titanium, tungsten, platinum, silver, lead. Properties of alloy duralumin, Y-alloy, brass, bronze, Inconel, invar, Hastelloy, alloy steel. Types of furnaces for metal purification, blast furnace, arc furnace.	11	CO1 CO2 CO3
[4]	Definition of ceramic materials. Clay-chemical composition China clay, fire clay, bentonite. Refractories- definition, properties & classification of refractories. Bricks- manufacture, properties, uses & types of bricks. Glasses-definition, raw materials used & their effect on glass product, manufacture of glass in brief, types of glass, their properties & uses, soda lime, borosilicate, high silica, fibre, wool & foam glass. Porcelain- properties, composition & uses.	11	CO1 CO2 CO4
[5]	Polymers & their structure, addition & condensation polymerization. Plastic-definition, properties & classification. Rubber/Elastomers- definition, classification, sources, properties & uses of natural and synthetic rubber, vulcanization. Wood- properties, seasoning types, its advantages & limitations	11	CO1 CO2 CO5
[6]	Protective coatings, Metallic coating, chemical conversion coating, organic coating, ceramic coating, Paints-classification, ingredients of paints, their properties and importance, special types of paints & their application. Varnishes- definition, ingredients & classification.	07	CO1 CO5
[7]	Lubricants- definition, importance, types, properties & application, method of applying lubricants. Insulation- definition, types of insulating materials, electrical, thermal & sound insulation. Adhesive- definition, classification, advantages & limitations, mechanism of their effect on surface.	06	CO1 CO4

C. TEXTBOOKS

1. S.K. Hajra Choudhury., *Materials Science and Processes*, Indian Book Distributing Co., 1978.
2. S.C. Rangwala., *Engineering Materials.*, 3rd Edition, Charotar Book Stall, Anand, India., 1976.

D. REFERENCE BOOKS

1. Frank Rumford., *Chemical Engineering Materials.*, Nabu Press., 2011.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering	General Introduction, knowledge, and definition of various materials and their basic properties.
CO2	Understanding, Remembering	Methods, processes, and working of equipment's for obtaining various material.
CO3	Understanding, Remembering	To understand types of corrosion, its classification, mechanism, and factors affecting as well needed precaution methods. Also, to know types, properties, and application of Metals.
CO4	Remembering	To know types, properties, effect, and application of Ceramic Materials, Lubricants, Insulators and Adhesions.
CO5	Remembering	To know types, properties, effect, and application of Polymers, Plastics, Rubber, Wood, Coatings, Paint and Varnish.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	2	3	2	3	3	3
CO2	3	3	2	2	3	3	3	3	2	3	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	3	3	2.8	2.8	3	3	3	3	2.6	3	2.6	3	3	3

G. PSO (PROGRAM SPECIFIC OUTCOME)

PSO Number	Statement
PSO1	Graduates will exhibit competency in process industries across various sectors.
PSO2	Developed Proficient graduates for higher education and research

H. PEOS (PROGRAM EDUCATIONAL OBJECTIVE AND OUTCOME)

PEOS Number	Statement
PEOS 1	Fundamental knowledge of chemical engineering.
PEOS 2	Creating Eligibility to higher education
PEOS 3	Skill development

D. CH. SEMESTER – II (CH)

SUBJECT: ENGINEERING GRAPHICS

(DK205)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Practical	Total		Ext	Sess.	TW	Practical	Total
3	1	3	7	7	60	40	50	-	150

A. COURSE OVERVIEW

Objective: The objective for this course is to learn about various aspects of Technical Drawing.
To learn and make use of the use of drawing equipments.
The aspects of Orthographic Projection and Isometric projection are very useful in industries to have understanding of size, shape and geometry of any object.
To understand various machine parts, Graphs and Charts used in day to day life and industries.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	**Introduction** Drawing equipments, material & their uses, Planning & Layouts of the Drawing Lines, Letters and dimensioning Plane geometrical drawing: Simple geometrical construction such as construction of plain figure, drawing of arcs and other construction.	3	CO1 CO3
[2]	**Plane Geometry :-** Construction of curves used in engineering such as Conics(Ellipse, Parabola, Hyperbola) Cycloidal curves (Cycloid, Epi-cycloid, Hypocycloid) Involutes, Archemedian spirals.	9	CO1 CO4
[3]	**Solid Geometry :-** Projection of points, Projection of lines (without H.P & V.P) Projection of planes, Projection of right and regular solids (Prism, Pyramids, Cylinder and Cones)	12	CO1 CO4 CO6
[4]	**Orthographic Projection :-** Conversion of pictorial views into orthographic views,	5	CO2 CO3 CO4
[5]	**Isometric projection:-** Various Projection methods, First angle method of projection, Third angle method of projection, Rules for dimensioning, Conversion of pictorial view into orthographic views.	5	CO1 CO5
[6]	**Sectional Orthographic Projection :-** Conversion of pictorial views into orthographic projection with section type of sections-Full section, Half section, interpretation of orthographic views.	4	CO1 CO5 CO6

[7]	**Machine parts:-** Types of threads, Bolts & Nuts, Locking devices for Nuts Rod connections (cotter joints & knuckle joint, shaft couplings, bearings, welded joints.	3	CO1 CO3
[8]	**Graphs and Charts** Concept of representation of data on graphs & Charts	2	CO2 CO3

C. TEXT BOOKS

(It is necessary that at least 85% of course content is covered in prescribed textbooks. The format should be as per ACS referencing format)

Elementery Engineering Drawing by N.D.Bhatt,

Engineering Graphics by P.J.Shah

D. REFERENCE BOOKS

Machine Drawing by P.S.Gill (The format should be as per ACS referencing format)

E. COURSE OUTCOMES

(Minimum 5 Cos are required)

CO Number	Skill	Statement
CO1	Remembering	The general introductions and concept of Engineering Drawing.
CO2	Analysing	To choose appropriate devices for any given conditions.
CO3	Applying	To apply basic concepts of drawing in industrial devices.
CO4	Understanding	To understand the importance of technical drawing
CO5	Remembering	Types of drawings used in industries.
CO6	Understanding	To Understand basic methods of drawing.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	2	2	2	3	3	3	2	3	3	3	3	3
CO6	3	3	3	3	2	3	3	3	2	3	3	3	3	3
Avg	3	2.6	2.5	2.6	2.5	3	3	3	2.5	3	3	3	3	3

G. PSO (PROGRAM SPECIFIC OUTCOME)

PSO Number	Statement
PSO1	Graduates will exhibit competency in process industries across various sectors.
PSO2	Developed Proficient graduates for higher education and research

H. PEOS (PROGRAM EDUCATIONAL OBJECTIVE AND OUTCOME)

PEOS Number	Statement
PEOS 1	Fundamental knowledge of Technical drawing.
PEOS 2	Creating Eligibility to higher education
PEOS 3	Skill development

D. CH. SEMESTER – I (CH)

SUBJECT: ELEMENTS OF MECHANICAL & ELECTRICAL ENGG. (DK115)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	-	4	7	60	40	-	-	100

A. COURSE OVERVIEW

- The course is introducing general concept and their controls of basic concepts of Mechanical Engineering and Electrical Engineering.
- Students will learn about Steam boilers, Prime movers, IC Engines, Material Handling Equipments, Welding Processes, Power Transmission Systems. Also the concepts about Basic electrical engg, AC Circuits, Electrical Machines etc.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	**Boilers** Definition, Function, Classification, working principles of Babcock & Wilcox boiler & Cochran Boiler, Introduction to Boiler mountings & accessories, Different types of mountings & accessories-their application & working principle.	7	CO1 CO4
[2]	**Prime movers** Introduction, Function, Classification of prime mover, Working principle of Internal combustion engines, Four stroke (Petrol & Diesel) Two stroke(Petrol & Diesel), Introduction to Recent trends eg. MPFI(Multi Point Fuel Injection), DTS-I (Digital Twin System. Ignition)	6	CO1 CO3 CO4
[3]	**Power transmission & Safety** Introduction to power transmission, Modes of power transmission, Belt drives and its Numericals, Rope drives, Gear drives, Chain drive system, Causes of accidents & their remedies.	9	CO1 CO4
[4]	**Material Handling Equipments** Introduction, Classification of material handling equipments, Factors affecting the selection of Material Handling Equipments Hoisting equipments, conveying equipments, Selection of suitable material handling equipments for the given situation.	5	CO2
[5]	**Fundamentals of Electrical engineering** Modern electron theory, Basic electrical quantities (Current, Voltage, Resistance etc), Ohm's law, Farade's law of Electromagnetic Induction.	6	CO1 CO5 CO6
[6]	**Welding** Introduction to metal joining processes, Classification, Definition of Welding, Classification of welding, Arc welding: definition, working principle, types, equipments, electrode codification; Gas welding : definition, working principle, types, equipments, Types of welding flames, Flux, Brazing, Soldering, Safety precaution	9	CO1 CO3 CO6

	during welding process.		
[7]	**A.C. and D.C. Circuits** Introduction to electrical circuits, Fundamentals of A.C./ D.C. Circuits, Parallel and Series Connections, Examples, Star and Delta connection, Examples.	9	CO1 CO3 CO6
[8]	**Electrical Machines** Motor, Generator, Transformer- Introduction, Working principles, construction, Application, Specifications, Introduction, External connections of Electrical appliances (Single phase energy meter, A' meter, Voltmeter, Fan, Fluorescent tube)	6	CO1 CO5 CO6

C. TEXT BOOKS

(It is necessary that at least 85% of course content is covered in prescribed textbooks. The format should be as per ACS referencing format)

Elements of Mechanical Engineering by N.M.Bhatt,

Elements of Electrical Engineering by R.P.Ajwalia

D. REFERENCE BOOKS

Basic Mechanical Technology by P.S.Desai, S.B.Soni (The format should be as per ACS referencing format)

E. COURSE OUTCOMES

(Minimum 5 Cos are required)

CO Number	Skill	Statement
CO1	Remembering	The general introductions and concept of Mechanical & Electrical Engineering.
CO2	Analysing	To choose appropriate devices for any given conditions.
CO3	Applying	To apply basic concepts in industrial devices.
CO4	Understanding	To understand and importance of Mechanical & Electrical Engineering.
CO5	Remembering	Types of Mechanical & Electrical Devices used in industries.
CO6	Understanding	To Understand working principles, operations of various machines.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	2	2	2	3	3	3	2	3	3	3	3	3
CO6	3	3	3	3	2	3	3	3	2	3	3	3	3	3
Avg	3	2.6	2.5	2.6	2.5	3	3	3	2.5	3	3	3	3	3

G. PSO (PROGRAM SPECIFIC OUTCOME)

PSO Number	Statement
PSO1	Graduates will exhibit competency in process industries across various sectors.
PSO2	Developed Proficient graduates for higher education and research

H. PEOS (PROGRAM EDUCATIONAL OBJECTIVE AND OUTCOME)

PEOS Number	Statement
PEOS 1	Fundamental knowledge of mechanical engineering and electrical engineering.
PEOS 2	Creating Eligibility to higher education
PEOS 3	Skill development

SUBJECT: ENGINEERING ORGANIC CHEMISTRY (DK202)

Teaching Scheme (Hours/Week)				Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Ext**	**Sess.**	**TW**	**Pract.**	**Total**
3	**1**	**3**	**7**	**60**	**40**	**25**	**50**	**175**

1. Purification of organic compounds **(4 hours)**

Purification of organic compounds by crystallization, distillation, sublimation

2. Detection and estimation **(5 hours)**

Detection and estimation of C, H, N, O, S and halogens

3. IUPAC Nomenclature **(5 hours)**

IUPAC Nomenclature of aliphatic, aromatic and hetero-cyclic compounds

4. Stereo-chemistry **(4 hours)**

Stereo isomerism, optical isomerism, geometrical isomerism, Walden-Inversion

5. Study of Aliphatic compounds **(6 hours)**

Study of chemical reaction involving & IUPAC Nomenclature involving in important methods of preparation and chemical properties of following compounds with their uses.

Ethane, ethylene, acetylene, ethyl chloride, ethanol, acetaldehyde, acetone, chloroform, acetic acid, ethyl acetate, diethyl ether. Ethylamine, Granger reagent

6. Coal-tar **(3 hours)**

Fractional distillation and production of coal tar, isolation of its components

7. Study of Aromatic compound. **(6 hours)**

Study of Aromatic compound & chemical reaction involving in important methodsof preparation and their chemical properties of following aromatic compounds. Benzene, toluene, benzene halides, styrene, nitro-benzene, sulphonic acids, aniline, phenol, benzaldehyde, benzoic acid, salicylic acid

8. Orientation **(3 hours)**

Electronic theory of orientation of benzene substitution reactions

9. Carbohydrates **(4 hours)**

Classification of carbohydrates, brief information with their structural formula

10. Polymers **(5 hours)**

Types of polymers, Illustration with their monomers and polymers

Text books

Fundamental Organic Chemistry - P L Soni
Text book of Organic Chemistry - B S Bal & Arun Bhal
Basic concept of Organic Chemistry - Kice & Mar wel

Sr. No.	Topic	No. of Lectures	CO
1	**Purification of organic compounds** Purification of organic compounds by crystallization, distillation, sublimation	**4 hours**	CO-1
2	**Detection and estimation** Detection and estimation of C, H, N, O, S and halogens	**5 hours**	CO-2
3	**IUPAC Nomenclature** IUPAC Nomenclature of aliphatic, aromatic and hetero-cyclic compounds	**5 hours**	CO-3
4	**Stereo-chemistry** Stereo isomerism, optical isomerism, geometrical isomerism, Walden-Inversion	**4 hours**	CO-4
5	**Study of Aliphatic compounds** Study of chemical reaction involving & IUPAC Nomenclature involving in important methods of preparation and chemical properties of following compounds with their uses. Ethane, ethylene, acetylene, ethyl chloride, ethanol, acetaldehyde, acetone, chloroform, acetic acid, ethyl acetate, diethyl ether. Ethylamine, Granger reagent	**6 hours**	CO-5
6	**Coal-tar** Fractional distillation and production of coal tar, isolation of its components	**3 hours**	CO-6
7	**Study of Aromatic compound.** Study of Aromatic compound & chemical reaction involving in important methodsof preparation and their chemical properties of following aromatic compounds. Benzene, toluene, benzene halides, styrene, nitro-benzene, sulphonic acids, aniline, phenol, benzaldehyde, benzoic acid, salicylic acid	**6 hours**	CO-5
8	**Orientation** Electronic theory of orientation of benzene substitution reactions	**3 hours**	CO-5
9	**Carbohydrates** Classification of carbohydrates, brief information with their structural formula	**4 hours**	CO-7
10	**Polymers** Types of polymers, Illustration with their monomers and polymers	**5 hours**	CO-7

Sr. No.	Course Outcome	Statement After studying this course student will be able to :
1	CO-1	Understand the Various methods of purification of organic compounds.
2	CO-2	Analyze systematic knowledge of qualitative analysis and quantitative analysis of organic compounds.
3	CO-3	Evaluate the IUPAC nomenclature and structure of simple and complex organic compounds.
4	CO-4	Understand three dimensional structures of organic compounds and their importance in organic chemistry.
5	CO-5	Can illustrate the different chemical reaction and mechanism of organic compounds.
6	CO-6	Understand the isolation of various compounds from coal and coal tar.
7	CO-7	Can explain the different biomolecule, polymers and their properties.

DK 203 PHYSICAL CHEMISTRY

Teaching Scheme (hr/week)			Exam Scheme (Marks)				
L	T	PR	TH (3 hrs.)	SES	PR	TW	TOTAL
3	1	6	60	40	50	25	175

1. Chemical Kinetics.

Rate of Reaction, Rate law, Order of reaction, Molecularity of reaction, Derivation of rate constant for first and second order reaction, Zero order and Pseudo order reaction, half-life period, methods for determination of order of reaction, Theories of rate of reaction, effect of various parameters of rate of reaction, Catalyst and Catalysis, types of catalyst.

2. Colloids.

Basic term with definition, Classification of colloids, types of colloids, methods of preparation & purification of colloids, properties of colloids, Emulsion and Gel with its types, application of colloids.

3. Electrochemistry.

Basic term involved in electrochemistry, Electrodes and its types, Buffer solution & its types, Buffer capacity, Buffer range, Indicators and indicator range, Detail of instrumental methods of titration i.e. Potentiometric, Conducto- metric, pH-metric methods.

4. Surface Chemistry.

Adsorption and Absorption, Adsorption of Gases, Types of adsorption, Adsorption isotherms, Freundlich's and Langmuir adsorption isotherms, Gibb's equation, Chromatographic and Ion exchange adsorption. Effect of different parameters on adsorption.

5. Phase Rule.

Definition and statement of Phase Rule and term involved in it, one component system i.e. Water system and Sulphur System in detail with its Phase diagrams.

6. Distribution Law.

Nernst's Distribution law, Solution and solubility, solubility and absorption coefficients (α and β), effect of various parameters on absorption, type of binary solutions, application of distribution law and ratio.

Text Books.

1. Essential of Physical Chemistry
   By: B. S. Bahl & G. D. Tuli
   S. Chand & Co. New Delhi
2. Elements of physical Chemistry.
   By: S. Glasstone, Macmalin & co. Ltd. London.

Reference Books:

1. Engineering Chemistry
   By: Jain & Jain, Dhanpat Rai Publication.

Sr. No.	Topic	No. of Lectures	CO
1	Chemical Kinetics. Rate of Reaction, Rate law, Order of reaction, Molecularity of reaction, Derivation of rate constant for first and second order reaction, Zero order and Pseudo order reaction, half-life period, methods for determination of order of reaction, Theories of rate of reaction, effect of various parameters of rate of reaction, Catalyst and Catalysis, types of catalyst.	9Hr	CO-1
2	Colloids. Basic term with definition, Classification of colloids, types of colloids, methods of preparation & purification of colloids, properties of colloids, Emulsion and Gel with its types, application of colloids.	9Hr.	CO-2
3	Electrochemistry. Basic term involved in electrochemistry, Electrodes and its types, Buffer solution & its types, Buffer capacity, Buffer range, Indicators and indicator range, Detail of instrumental methods of titration i.e. Potentiometric, Conducto-metric, pH-metric methods.	8Hr.	CO-3
4	Surface Chemistry. Adsorption and Absorption, Adsorption of Gases, Types of adsorption, Adsorption isotherms, Freundlich's and Langmuir adsorption isotherms, Gibb's equation, Chromatographic and Ion exchange adsorption. Effect of different parameters on adsorption.	6Hr.	CO-4
5	Phase Rule. Definition and statement of Phase Rule and term involved in it, one component system i.e. Water system and Sulphur System in detail with its Phase diagrams.	6Hr.	CO-5
6	Distribution Law. Nernst's Distribution law, Solution and solubility, solubility and absorption coefficients (α and β), effect of various parameters on absorption, type of binary solutions, application of distribution law and ratio.	6Hr	CO-6

Sr. No.	Course Outcome	Statement After studying this course student will be able to :
1	CO-1	Acquire knowledge of different basic terms, way of determine order of different reaction, affecting parameter and some of important theories. Also become capable of calculating rate as well as order of reactions.
2	CO-2	Student learn about the properties, nature & characteristics of colloids & way of preparation with purification techniques. Different applications of it.
3	CO-3	Learn about basic terms of electrochemistry, types of cell and their potential calculation & formulation. Also get basic knowledge of classical electro-analytical methods
4	CO-4	Get the basic idea about surface as well as bulk phenomena and be able to apply them in routine use.
5	CO-5	To know the basics of phase rule. Recognize single component system, tow-component system, and different affecting parameters on phase equilibrium.
6	CO-6	Get idea about distribution concept & its application in day to day process as well as effect of different condition on it.

DIPLOMA CHEMICAL SEMESTER – IV
SUBJECT: HEAT TRANSFER (DK-403)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	3	7		60	40	25	50	175

A. COURSE OVERVIEW

- The course cover the fundamental aspects of Heat Transfer through convection, conduction and radiation. Understanding of Heat Exchanger, cooling tower and Evaporation by their industrial application.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction, Engineering heat transfer and analogies between various transport processes, modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzmann law, Thermal conductance and resistance, Convective and radiative conduction, Combined heat transfer process.	6	CO1
[2]	Concept of heat conduction, Linear one-dimensional Heat conduction through wall, through cylinder and through sphere, Conduction through composite plane wall, conduction through composite cylinder, conduction through composite sphere, critical insulation thickness for pipes. The nature of heat convection, The Nusselt Number, Determination of Nusselt Number, Forced convection (No derivation), Free convection (No derivation)	10	CO1 CO2
[3]	Heat transfer accompanied by phase change, Phenomenon of boiling, Regimes of pool boiling, Nucleate boiling & film boiling, Phenomenon of condensation.	5	CO5
[4]	Nature of thermal radiation, Absorption, Transmission, Reflection and Emission of Radiation, Emissive power of black body, Plank's distribution, Total emissive power, stefan-Boltzman law, Emissivity, Kirchoff's law, Black body, Wien's displacement law, radiation shields.	8	CO1 CO2
[5]	Introduction, types of heat exchangers, overall heat transfer coefficient, Effect of scale formation, logarithmic mean temperature difference, L.M.T.D. correction factors, Extended surfaces.	11	CO3
[6]	Introduction, Liquid characteristics, types of evaporator, Duhring rule & boiling point elevation, economy & capacity, method of feeding, examples based on single effect evaporator.	8	CO4

C. TEXT BOOKS

1. K A Gavhane, *Unit Operation II;* 3rd ed.; Nirali Prakashan, Pune, July 2017
2. McCabe and Smith, *Unit Operations of Chemical Engineering;* 4th ed.; McGraw Hill Book Company; New York, 1986

D. REFERENCE BOOKS

1. D.Q. Kern *Process Heat Transfer;* 3rd ed; Wiley Global Headquarters: USA 2019.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering	How conduction, convection and radiation is proceed in daily life and in chemical industries.
CO2	Understanding	Compare and understand Fourier's law, Newton's law, and Stefan Boltzmann law for mode of heat transfer.
CO3	Understanding	Demonstrate terminology of heat exchanger.
CO4	Understanding	Understand the role of evaporator in industries.
CO5	Understanding	Demonstrate condensation and boiling phenomena.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
CO4	3	3	3	2	3	2	3	2	2	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3	3	3	3
Avg	3	3	3	2.8	3	2.6	3	2.8	2.6	3	3	3	3	3

DIPLOMA CHEMICAL SEMESTER – IV (CH)
SUBJECT: FLUID FLOW OPERATION (DK-407)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	3	7		60	40	25	50	175

A. COURSE OVERVIEW

- The course is devised to introduce fundamental aspects of fluid flow behaviour. Students will learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Definition of fluid, fluid mechanics, static pressure, head, gauge pressure, absolute pressure, dynamic pressure, vacuum. Pressure measuring devices, Simple U tube manometer, differential U tube manometer, inclined tube manometer, measurement of absolute and gauge pressure by manometer, manometric liquids, purpose of pressure measurement. Mechanical pressure gauges, Bourdon tube, diaphragm & bellow gauges. Derivation & Calculation of pressure drop.	10	CO1 CO2
[2]	Purpose of flow measurement, definition of average mass & volumetric flow rates, Classification of flow meters, orifice meter, venturimeter, pitot tube, flow nozzle, rotameter, open weirs. Comparison & merits-demerits of flow meters. Calculation of flow rates by direct use of formulas	10	CO2
[3]	Definitions of ideal & real fluids, Newtonian & non-Newtonian fluids, behaviour of non-Newtonian fluids, definitions of different viscosities, viscosity measurement by Hagan Poiseuille's method, steady state & unsteady state flow. Reynold experiment, conclusions, definition of laminar flow, turbulent flow, and Reynold number, critical velocity, transition flow, assumptions of simple & modified Bernoulli's equation and its applications. Friction factor chart, significance, roughness parameter, relative roughness, skin friction, form friction comparison. Derivation of Fanning's friction equation. Head loss & pressure drop through pipe calculation. net head developed by pump, fluid HP, BHP calculation.	15	CO1 CO3
[4]	Pipes, tubes, pipe size, pipe fittings, their uses & sketches, joints-flange, expansion, Different types of valves, their construction, function & uses. Classification of pumps. Centrifugal pumps-volute & turbine type. Positive displacement pumps & gear, sliding vane, lobe, piston, plunger & diaphragm types fans – centrifugal forward & backward curved blades type. Blowers & compressors – reciprocating & rotary types (all fluid moving machineries are in brief) characteristic curves of centrifugal pump. Derivation of NPSH & calculation. Cavitation – causes & remedies.	15	CO4

[5]	Pneumatic type – vertical & horizontal types, Hydraulic type – vertical & horizontal types homogeneous flow & Industrial applications	3	**CO5**
[6]	Aggregative & particulate types. Mechanism, applications, calculation of pressure drops through fluidized bed. Comparison of packed & fluidized beds, their merits, demerits & applications.	4	**CO1**
[7]	Direct level measurement – tape, sight glass & float methods. Indirect level measurement – Air trap box, diaphragm box, bulbar system, differential U tube manometer methods.	3	**CO5**

C. TEXT BOOKS

1. Gavhane K.A., *Unit Operation-I*; 21st ed.; Nirali Prakashan; Pune, 2011.
2. McCabe, W., Smith, J. *Unit Operations of Chemical Engineering;* 5th ed.; McGraw Hill Incorporation: New York, 2004.

D. REFERENCE BOOKS

1. Badger, W. L., Banchero, J.T., *Introduction to Chemical Engineering;* McGraw Hill Incorporation: New York, 1955.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering	Understand the Various Fluid properties and their behaviour.
CO2	Understanding	Demonstrate the Knowledge of fluid static and dynamics to understand the fluid flow problems.
CO3	Understanding	Comprehension of fluid flow problems with the application of mass, momentum and energy equations.
CO4	Understanding	Summarise the performance of the fluid flow operations in industries.
CO5	Understanding	Classify various instruments relevant to fluid flow operation.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	3	2	2	2	2	2	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	2	2	2	2	2	2	2	3	3	3	3	3
Avg	3	2.6	2.8	2.6	2.8	2.8	2.6	2.6	2.6	2.8	2.6	3	3	3

DIPLOMA CHEMICAL SEMESTER – IV
SUBJECT: PROCESS CALCULATION (DK-405)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4		60	40	--	--	100

A. COURSE OVERVIEW

- The course is devised to introduce fundamental aspects of Process calculation. Students will learn to develop steady state material and energy balance equations for difference unit operations.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Dimensions & Units, Different systems of units, Conversion of units & simple problems on such topics. Composition of solids, Liquid mixtures, Ideal gas law, Gas constant, Composition of gaseous mixtures, Dalton's & Amaget's law and simple problems on above topics.	11	CO1
[2]	Concepts and importance of material balance, Classification of material balance Problems, Problems based on tie material, Inert material balance & simultaneous equation involving various unit operations, Concepts of recycle, purge and bypass. Simple steady state material balance problems with chemical reaction.	23	CO2 CO3 CO4 CO5
[3]	Forms of energy, Concepts of Cp, Cv, Calculation of enthalpy change, Thermo chemistry involving concepts & simple calculations of H_c, H_R & H_f, Simple energy balance problems.	8	CO2 CO4 CO5
[4]	Types of fuels, calorific value, Simple problems to find out the air requirement & composition of exit gases etc.	4	CO2

C. TEXT BOOKS

1. KA Gavhane, *Unit Operation II;* 3rd ed.; Nirali Prakashan, Pune, July 2017

D. REFERENCE BOOKS

1. Himmelbau. *Basic principles of calculation in chemical engineering;* 5th ed.; New Jersey 1989.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understanding	Understanding different systems units and dimensions.
CO2	Understanding	Classify of material balance problems, Fuels and Energy.
CO3	Understanding	Comprehension of material balance equations for difference unit operations.
CO4	Understanding	Understanding chemical reactions and calculate energy balance and material balance (with chemical reaction).
CO5	Understanding	Discuss material and energy balance with industrial examples.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	3	2	2	2	2	3	3	3	3
CO2	3	3	3	2	2	2	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	2	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	3	2.6	2.8	2.6	2.8	2.8	2.8	2.8	2.6	2.8	3	3	3	3

DIPLOMA CHEMICAL SEMESTER – IV (CH)
SUBJECT: MASS TRANSFER - I (DK-406)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	3	7		60	40	25	50	175

A. COURSE OVERVIEW

The course imparts understanding of fundamental concepts of mass transfer, various mass transfer operations and their equipment's.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Importance of mass transfer operations, classification of mass-transfer operations, methods of conducting mass transfer operations, fundamental design principles.	4	CO1
[2]	Concept of molecular and eddy diffusion, Fick's law for diffusion, Steady state molecular diffusion in fluids in laminar flow, simple problems on diffusion by direct use of formula.	6	CO1 CO2
[3]	Concept of equilibrium, diffusion between phases, mass transfer coefficients, local and average overall mass transfer coefficient, film theory, penetration theory, surface renewal theory, analogy between mass, heat and momentum transfer, concept of stage, stage efficiency, cascade etc.	7	CO1 CO2 CO3
[4]	Definition and application of absorption, equilibrium solubility of gases in liquids, effect of temperature and pressure on solubility, characteristics of ideal liquid solutions of raoult's law, nonideal liquid solutions of henry's law, choice of solvent, material balance for the component transfer in counter current and concurrent flow, concept of HETP and simple problems on absorption.	8	CO3 CO5
[5]	Definition and application of liquid extraction, liquid equilibrium for three component system, equilibrium triangular coordinates, system of three liquids one pair partially soluble and system of three liquids two pairs partially soluble, effect of temperature and pressure on the solubility curve, choice of solvents for the operation, simple problems using direct formula.	8	CO3 CO5
[6]	Definition and industrial application of leaching, preparation of solid, temperature of leaching, methods of operations and equipment for inplace leaching, heap leaching and percolation tanks, countercurrent multiple contact shanks system, filter-press leaching, agitated vessel, leaching during grinding, equipment like Dorr agitator, Rotocel, Kennedy extractor and Balloman extractor.	8	CO4 CO5
[7]	Construction and working of gas dispersed equipment's like bubble column (Sparged vessel), agitated vessel, tray tower, mechanically agitated vessels, tray efficiencies, liquid dispersed equipment's like venturi scrubbers, wetted wall column, spray tower, packed tower and comparison between tray and packed tower.	8	CO4

C. TEXTBOOKS

1. Treybal, Robert Ewald. *Mass-Transfer Operations*. New York: McGraw-Hill, 1980.
2. Dr. Kiran D Patil. *Principles and Fundamentals of Mass Transfer Operations-I.* Pune: Nirali Prakashan, 2002.
3. K A Gavhane. *Unit Operations-II (29th Edition)*, Pune: Nirali Prakashan, 2014.

D. REFERENCE BOOKS

1. McCabe, Warren L., and Julian C. Smith. *Unit Operations of Chemical Engineering*. New York: McGraw-Hill, 1967.
2. Walter L. Badger and Julius T. Banchero. *Introduction to Chemical Engineering.* New York: McGraw-Hill, 1955.
3. Richardson, J. F., J. H. Harker, J. R. Backhurst, and J. M. Coulson. *Coulson and Richardson's Chemical Engineering. Vol. 2, Vol. 2*. Oxford: Butterworth-Heinemann, 2002.
4. Perry, Robert H., and Don W. Green. *Perry's Chemical Engineers' Handbook.* New York: McGraw-Hill, 2008.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understanding	Understand mass transfer for same phase as well as different phases and basic principles for design in process industries
CO2	Understanding	Understand Fick's law and mass transfer coefficient for diffusion in fluids
CO3	Understanding	Understand theory & analogy for mass transfer and solubility of desired components in solvents
CO4	Understanding	Demonstrate Equipment's for mass transfer in gas-liquid and solid-liquid phases.
CO5	Understanding	Demonstrate mass transfer phenomena in gas-liquid, liquid-liquid and solid-liquid phases.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	2	2	2	2	3	3	3	3	3
CO5	3	3	3	3	3	2	3	2	2	3	3	3	3	3
Avg	3	3	3	2.8	3	2.6	2.8	2.6	2.6	3	3	3	3	3

DIPLOMA CHEMICAL SEMESTER – IV (CH)
SUBJECT: INSTUMENTATION (DK-402)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	-	4		60	40	--	--	100

A. COURSE OVERVIEW

This course covers the fundamentals of instrumentation used in industry and apply the key concepts of automatic control and instrumentation to process plants.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Concept and importance of instrumentation, classification of instruments, basic elements of instruments, characteristics of instruments in detail, brief explanation of first order system and second order system	4	CO1
[2]	Definition of thermometer, temperature scale, mercury in glass thermometer, Bimetallic & pressure spring thermometers, Principle of thermo electricity, Seebeck effect, Peltier effect & Thomson effect, Industrial thermocouple, lead wire thermowells, Resistance thermometer, Single wheatstone bridge circuit & Null bridge resistance thermometer, Deflection resistance thermometer circuit, Radiation & Optical pyrometers.	12	CO1 CO2
[3]	Pressure, Vacuum & Head measuring elements for gauge pressure & Vacuum, indicating elements for pressure gauges, Brief explanation about measurement of absolute pressure, Measuring pressures in corrosive fluids, Static accuracy of pressure gauges, Response of Mechanical Pressure gauges.	12	CO1 CO3
[4]	Head, density & Sp. Gravity, Direct measurement of liquid level, Pressure (Level) measurements in open vessel, level measurement in pressure vessels, Measurement of Interface level, Density measurement, level measurement by weighing, level of dry materials.	12	CO1 CO3
[5]	Recording Instruments, Indicating & Signalling Instruments, and Transmission of instrument readings, Control centre, and Instrumentation diagram.	4	CO4
[6]	Principle of working, important control modes with simple diagram, Comparison of PLC & DCS system, Principle of modem	4	CO5

C. TEXT BOOKS

1. Ekman D.P., *Industrial Instrumentation;* New Delhi: Wiley Eastern, 1985.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand the importance of Instruments in process industry.
CO2	Comprehension	Demonstrate the mechanical and electrical aspects of instruments used to measure temperature of process.
CO3	Understand	Recognize the mechanical and electrical aspects of pressure and level measurement devices and their suitability for process dependent application.
CO4	Understand	Understand Recording Instruments and Prepare Instrumentation diagrams.
CO5	Understand	Understand the principle, working of PLC and DCS.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	2	3	3	3	3	3	2	2	3	3	3	3
CO5	3	3	2	3	3	3	3	2	2	2	3	3	3	3
Avg	3	3	2.6	3	3	3	3	2.8	2.6	2.8	2.8	3	3	3

DIPLOMA CHEMICAL SEMESTER – IV (CH)
SUBJECT: CHEMICAL ENGINEERING EQUIPMENT DRAWING (DK-412)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
--	--	3	3		--	--	25	50	75

A. COURSE OVERVIEW

The course imparts drawing and understanding fundamental symbols, equipment's & their parts and flow diagrams in process industries.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Symbols of Chemical Engineering Equipment's Refer and draw the standard code/decodes and symbols for Chemical Engineering equipment's.	12	CO1
[2]	Diagrams of mounting and fitting parts Prepare sketches of various types of Valves, Pipe fittings, Joints etc.	6	CO2
[3]	Diagrams for Chemical Engineering Unit Operations Free hand sketch drawing of various Chemical Engineering Unit Operation equipment's like Heat Transfer equipment's, Mechanical Operation equipment's, Mass Transfer equipment's etc.	9	CO3
[4]	Flow diagrams Drawing preparation of block flow diagram and process flow diagrams using different equipment symbols for a process.	3	CO1 CO4
[5]	Piping & Instrumentation Diagrams Piping & Instrumentation symbols and P & ID diagram for a process.	6	CO1 CO5

C. TEXTBOOKS

1. Treybal, Robert Ewald. *Mass-Transfer Operations*. New York: McGraw-Hill, 1980.

D. REFERENCE BOOKS

1. M. Gopala Rao, Marshall Sittig. *Dryden's Outline of Chemical Technology for 21st Century (3rd Edition).* East-West Press.
2. McCabe, Warren L., and Julian C. Smith. *Unit Operations of Chemical Engineering*. New York: McGraw-Hill, 1967.
3. Walter L. Badger and Julius T. Banchero. *Introduction to Chemical Engineering.* New York: McGraw-Hill, 1955.
4. *Recommendations on Graphical Symbols for Process Flow Diagram, IS: 3232 – 1965.*

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understanding	To draw and understand symbols of chemical engineering equipment's.
CO2	Understanding	To draw diagrams of various mounting and fitting parts
CO3	Understanding	To draw diagrams and understand various unit operation equipment's for chemical engineering.
CO4	Understanding	To draw flow diagrams for a process.
CO5	Understanding	To draw symbols and flow diagram for pipping & instrumentation.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	2	2	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3	3	3	3	3	3
Avg	3	3	2.8	2.6	3	3	3	3	2.6	2.6	2.6	3	3	3

DIPLOMA CHEMICAL SEMESTER – V
SUBJECT: MASS TRSSNFER II (DK-405)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	3	7		60	40	25	50	175

A. COURSE OVERVIEW

- The course is devised to introduce fundamental aspects of Mass Transfer units operations. Students will learn distillation, humidification, drying, crystallization and adsorption unit operation with its industrial application, problem solving knowledge and different equipment that are used in industries.

B. COURSE CONTENT

NO	TOPIC	L+T (Hrs)	COs
[1]	Importance of distillation as separation method, vapor-liquid equilibrium, relative volatility, ideal solutions with Raoult's law, Henry's law, maximum & minimum liquid azeotropes, flash vaporization with material balance calculation, calculations of vapor-liquid equilibrium, Differential distillation with Rayleigh's equation of simple calculation, steam distillation, continuous rectification – binary system based on McCabe & Thiele methods with calculation, Extractive & Azeotropic distillation.	20	CO1 CO2 CO3 CO4
[2]	Concept of partial pressure & vapor pressure, definitions & simple calculations for absolute humidity, relative saturation & percentage saturation, concept of wet bulb temperature, dry bulb temperature, dew point, humid volume, humid heat, psychrometric chart, construction & working of different types of cooling tower, spray pond.	08	CO1 CO2 CO5
[3]	Applications, understanding of various definitions, types and classification of drying operations, equipments, freeze drying, drying test and derivation of equations for drying time and simple calculations.	12	CO1 CO2 CO3 CO5
[4]	Concept and application, types of adsorption, hystersis, characteristics and nature of adsorbents, effect of temperature, Freundlich equation and it's applications for single stage operation, heatless adsorber, major applications and factors affecting ion-exchange.	09	CO1 CO2 CO3 CO6
[5]	Concept and application, methods for supersaturation, classification of crystallizer, Meir's theory, concept of nucleation and crystal growth, effect of seeding and simple calculations for percentage yield, construction and working of Swenson Walker, tank, DTB, Krystal and Vacuum crystallizes.	11	CO1 CO2 CO3 CO6

C. TEXT BOOKS

1. Treybal, Robert Ewald. *Mass-Transfer Operations*. New York: McGraw-Hill, 1980.
2. Dr. Kiran D Patil. *Principles and Fundamentals of Mass Transfer Operations-I.* Pune: Nirali Prakashan, 2002.
3. K A Gavhane. *Unit Operations-II (29th Edition),* Pune: Nirali Prakashan, 2014.

D. REFERENCE BOOKS

1. McCabe, Warren L., and Julian C. Smith. *Unit Operations of Chemical Engineering*. New York: McGraw-Hill, 1967.
2. Walter L. Badger and Julius T. Banchero. *Introduction to Chemical Engineering.* New York: McGraw-Hill, 1955.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understanding	To understanding of mass transfer with suitable operations.
CO2	Understanding	To study the different equipment's used in mass transfer operations with its advantages, Limitations & applications.
CO3	Understanding	Able to compare and select different mass transfer operations with respective to applications.
CO4	Applying	To understanding of VLE data and also calculate theoretical number of trays required in distillation column.
CO5	Understanding	To understanding of humidification and drying operation with its different terminology.
CO6	Understanding	Able to understand adsorption, crystallization and ion-exchange operations.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	3	2	2	2	3	3	3	3	3
CO2	3	3	3	3	2	2	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	3	2.8	3	2.8	2.8	2.8	3	2.8	2.6	3	3	3	3	3

DIPLOMA CHEMICAL SEMESTER – V (CH)
SUBJECT: ELEMENT OF THERMODYNAMICS AND REACTION ENGINEERING (DK-512)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	--	4		60	40	--	--	100

A. COURSE OVERVIEW

The course imparts fundamentals of thermodynamics and reaction engineering. It introduces chemical engineering thermodynamics theory, thermodynamic properties with their evaluation, it's various applications, reaction kinetics for homogeneous reactions, types of reactors with their performance and their derivations.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Scope of thermodynamics, Internal energy, the first law of thermodynamics, Thermodynamics State and static function, Enthalpy, The steady state flow process Equilibrium, The phase rule, the reversible process, Constant volume and constant pressure process, Heat capacity.	10	CO1 CO2 CO4
[2]	Statement of the second law of thermodynamics, thermodynamics temperature scale, Entropy, Entropy changes of an ideal gas, Mathematical statement of the second law, the third law of the thermodynamics	10	CO1 CO2 CO4
[3]	The Carnot refrigeration, the vapor compression cycle, Compression of refrigeration cycle, the choice of refrigerant, Adsorption refrigeration, heat pump Liquefaction process	10	CO1 CO2 CO5
[4]	Thermodynamics, Chemical kinetics, Classification of reactions, Variable affecting the rate of reaction, Definition of rate.	06	CO1 CO3
[5]	(1) Concentration dependent term of a rate equation Single and multiple reaction, Elementary and nonelementary reaction, Kinetic view of equilibrium for elementary reaction, Molecularity and order of reaction, Representation of reaction rate, Testing of kinetic model (2) Temperature dependent term of a rate equation Arrhenius law, Collision theory, Transition state theory, Comparison of theory, Comparison of theory with Arrhenius law, Activation energy and temperature dependency, Rate of reaction prediction by the theories (No derivation for all topics)	08	CO1 CO3
[6]	Constant volume batch reactors, Temperature and rate of reaction, the search of rate equation.	06	CO2 CO3 CO6
[7]	Batch reactor; plug flow reactor, continuous stirred tank reactor.	10	CO2 CO3 CO7

C. TEXTBOOKS

1. K.A. Gavhane., *Chemical Engineering Thermodynamics-I*, Nirali Prakashan.
2. K.A. Gavhane., *Chemical Reaction Engineering-I*, Nirali Prakashan.
3. J.M. Smith, Hendrick Van Ness, Michael Abbott, Mark Swihart., *Introduction to Chemical Engineering Thermodynamics*, McGraw-Hill Education.

D. REFERENCE BOOKS

1. K.V. Narayanan., *A textbook of Chemical Engineering Thermodynamics*. PHI.
2. Octave Levenspiel., *Chemical Reaction Engineering*, John Wiley & Sons, Singapore, 3rd edition, 1998.
3. H.S. Fogler., *Elements of Chemical Reaction Engineering*, Prentice-Hall, NJ, 4th edition, 2006.
4. J. M. Smith., *Chemical Engineering Kinetics*, McGraw Hill, 3rd edition, 1981.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understanding	To understand the basic concepts of thermodynamics, thermodynamic properties and its role, reaction engineering.
CO2	Applying	To apply theoretical concepts and equations to solve problems based on laws of thermodynamics, refrigeration and liquefaction cycles, kinetics, reactions, and rate of equations
CO3	Understanding	To understand type of reactions, reaction kinetics, the kinetics of homogeneous reactions, and its related theory.
CO4	Understanding	To develop the understanding about the fundamental knowledge about laws of thermodynamics and their developed mathematical equations.
CO5	Understanding	To develop the understanding working of refrigeration and liquefaction cycles/processes.
CO6	Understanding	To understand interpretation of batch reactor, develop rate expression and role of temperature.
CO7	Understanding	Enhance the knowledge on types of reactors, working of reactors and developing rate equations.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	2	2	2	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO6	3	3	3	3	2	3	3	3	2	3	3	3	3	3
CO7	3	3	3	3	2	3	3	2	2	3	3	3	3	3
Avg	3	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.7	3	3	3	3	3

DIPLOMA CHEMICAL SEMESTER – V
SUBJECT: PETROLEUM REFINING AND PETROCHEMICAL TECHNOLOGY
(DK-513)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	3	7		60	40	25	50	175

A. COURSE OVERVIEW

- To familiarize the students with characteristics of Crude, it's refining to get commercially important fractions and products. To help the students in understanding the unit operations and unit processes in manufacture of various petrochemicals and their downstream products.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Origin & formation of petroleum, Reserves & deposit of world, Indian petroleum refineries with their location & capacity, composition of petroleum.	5	CO1
[2]	Classification of crude oil, Crude Assay Analysis, ASTM Distillation, Thermal properties of petroleum	10	CO1 CO2
[3]	Dehydration & Desalting of crude, pipe still heaters, Distillation of crude oil, Important products, properties & test methods, additives for various petroleum products.	10	CO1 CO3
[4]	Physical & Chemical Impurities, Treatment of gasoline, Kerosene & lubes by various methods. Removal of sulfur and sulfur compound.	10	CO4
[5]	Objective of cracking & Reforming operations, effect of temperature & pressure on cracking, advantages of cracking, Reforming & Platforming.	10	CO6
[6]	Definition, History, Major Petrochemical products and their producers in India, Raw materials for Petrochemicals, Characteristics of Petrochemical Industry.	5	CO1
[7]	Manufacture of Methanol, Formaldehyde, Ethylene & Polyethylene, Vinyl chloride, Ethanol, Ethylene di-chloride, Ethylene oxide, Propylene & Polypropylene, Cumene, Acylonitrile, Butadiene, Iso butylene, Butanol, Styrene LAB, Phenol, Terphthalic Acid & DMT, Phthalic anhydride and Malaik anhydride	10	CO5

C. TEXT BOOKS

1. Bhaskara Rao, B.K., *Modern Petroleum Refining Processes*, 6th Ed. Oxford & Ibh, New Delhi, 2017.
2. Bhaskara Rao, B.K., *A Text on Petro Chemicals*, 5th Ed, Khanna Publisher, New Delhi, 2010.

D. REFERENCE BOOKS

1. G.N. Sarkar, *Advanced Petroleum Refining;* Khanna Publishers: New York, 1955.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remember	Understand the basics of Petroleum Crude and Petrochemical products and its composition.
CO2	Understand	Explain the knowledge of different refining processes.
CO3	Apply	Understand the Properties and Implement the Test methods of Petroleum Products.
CO4	Analyse	Examine the different Treatment Process for Petroleum Products.
CO5	Create	Develop the production processes of various Petrochemical products.
CO6	Understand	Understand Cracking and Reforming operation and explain different processes for cracking and reforming operation.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	2	2	3	2	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	2	3	3	3	3	3
CO6	3	3	3	3	3	3	3	2	2	3	3	3	3	3
Avg	3	3	3	3	3	3	3	2.5	2.5	3	2.8	3	3	3

DIPLOMA CHEMICAL SEMESTER – V
SUBJECT: FERTILIZER TECHNOLOGY (DK-514)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	3	7		60	40	25	50	175

A. COURSE OVERVIEW

To inculcate the knowledge of various processes and operations of the chemical industries, among the diploma students of chemical engineering.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Need of fertilizer, type of fertilizer, mends and dements of fertilizer, fertilizer industries at glance.	5	CO1
[2]	Roll of Nitrogenous fertilizer, sources and properties of hydrogen, nitrogen and ammonia, manufacture of synthesis gas by steam hydrocarbon, reforming and partial oxidation methods, synthesis of ammonia, types of converters, storage and handling of ammonia. A. Urea: properties and uses, manufacture of urea by total recycle process with Montecatini and Toyokotsu process. B. Ammonium nitrate: properties, manufacturing process and uses. C. Ammonium sulfate: properties, manufacturing processes and uses. D Ammonium chloride properties, manufacturing processes and uses	10	CO2
[3]	Roll of potassium as fertilizer, properties, and sources of potash and production of KCl.	10	CO3
[4]	Roll of Phosphorus as fertilizer, types of rock phosphate, production of elemental phosphorus (yellow or red) manufacture. of phosphoric acid by wet method, electric arc furnace method, production of normal and super triple phosphate, ammonium phosphate, major engineering problem of such industries.	10	CO4
[5]	Manufacture and granulation of mixed fertilizer and bulk blending.	10	CO6
[6]	Brief idea about air pollution, methods of controlling the air pollution and effluent treatment for fertilizer industries.	5	CO5

C. TEXT BOOKS

1. Dryden's Outlines of Chemical Technology, 2nd Ed. By M. Gopala Rao & Marshall Sitting, East West Press Pvt. Ltd., New Delhi.

D. REFERENCE BOOKS

1. Shreve's Chemical Process Industries, 5th Ed. By, George F. Austin McGraw Hill International Edition.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To use relevant fertilizer on the basis of different properties to improve fertility of soil.
CO2	Analyse	Analyse the roll of nitrogen and flow of raw materials to finished products in process flow diagrams of nitrogenous fertilizer industries and to understand the various associated engineering problems.
CO3	Explain	Identify process flow diagrams of potassium fertilizer industries and to understand the various associated engineering problems.
CO4	Explain	Explaining the production processes of Phosphorus Fertilizer products.
CO5	Create	Create awareness among students for the research and innovation in the field of Fertilizer industries for environmental issues and sustainability.
CO6	Understand	To understand manufacturing of mixed fertilizer and calculate different grade of fertilizer.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	2	2	2	2	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	2	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	2	3	3	3	3	3
CO6	3	3	3	2	3	3	3	3	3	2	2	3	3	3
Avg	3	3	3	2.8	2.6	3	3	2.6	2.6	2.6	2.5	3	3	3

DIPLOMA CHEMICAL SEMESTER – V

SUBJECT: POLYMER TECHNOLOGIES [DK-517]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	-	4		60	40	-	-	100

A. COURSE OVERVIEW

- The course is introducing general concept of polymer & polymerization techniques Students will learn to what is polymerizations and their productions methods, classifications of polymerization techniques. And and also to gain the knowledge of chemistry of polymerization, plastics, fibers, rubbers, Resins for Adhesives and Protective Coating, Fiber and Film, Polymer processing.etc….

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction to polymers: Brief history, About polymers, Classification of polymers according to chemical and geometrical structure of polymer molecules, General remarks on polymer microstructure, Microstructure based on the chemical structure – Organic and inorganic polymers, Homochain and heterochain polymers, Homopolymers and copolymers, Microstructure based on the geometrical structure – Linear, branched and cross-linked polymers, Random, alternating, block and graft co-polymers, Stereo-regular polymers – Optical isomerism, Geometrical isomerism, glass transition temperature.	5	CO1 CO2
[2]	Chemistry of Polymerisation: Introduction, Chain polymerisation – Free radical polymerisation, Ionic polymerisation, Introduction to catalytic polymerisation, Step polymerization.	7	CO1 CO2
[3]	Polymerization Techniques: Bulk polymerisation, Solution polymerisation, Suspension polymerisation, Emulsion polymerisation, Melt polycondensation, Solution Polycondensation, Interfacial polymerization	6	CO2 CO3
[4]	Plastics: Introduction, Classification of Plastics, Raw Materials, Preparation, properties, and applications for the Addition Polymerization Products like Poly Ethylene, LDPE, HDPE, PVC, Poly Styrene, Alloys, blends, and composites, Engineering Plastics like Nylon, ABS, Poly Carbonates, TEFLON etc, Recent trends in plastics like bio degradable plastics etc.	5	CO1 CO4 CO5
[5]	Rubbers: Introduction and classification of rubber, vulcanization, reinforcement with carbon black, Natural rubber, Prepartion, properties, and applications of synthetic rubbers like SBR, Poly Butadiene, Poly Ethylene- Propylene & Butyl Rubber, Brief of some important rubber like Nitrile rubber , Neoprene, Reclaim Rubber.	10	CO1 CO4 CO5
[6]	Resins for Adhesives and Protective Coating: Introduction, Condensation polymerization products like Phenol Formaldehyde (Phenolic Resins), Amino Resins, Polyester Resins, Alkyl Resins and Epoxy Resins, Polyurethane Resins, Poly Amide Resins	10	CO1 CO4 CO5

[7]	Fiber and Film: Introduction to fiber, Properties of fiber, Cellulosic fiber: Viscose Rayon and Cellulose Acetate, Polyamide fibers, Polyester fiber, Acrylic fibers, carbon fibers, Films: Viscose & Cellulose Acetate, Poly olefins, Poly Vinyl Chloride	10	CO1 CO5 CO4
[8]	Polymer processing: Extrusion, injection molding, compression molding, blow molding, film extrusion, spinning, extrusion film blowing, etc.	7	CO1 CO3

C. TEXT BOOKS

1. V R Gowarikar, Polymer Science, 6th edition, New Delhi 1986.
2. R Sinha, Outlines of polymer Technology, Esten Economy Edition, New Delhi, 2000.

D. REFERENCE BOOKS

1. Fred W Billmeyer Jr, Text Book of Polymer Science, 3rd edition, New York, 1984.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering	To Remembering of general introduction of polymers, polymerizations, polymerizations techniques, Rubbers, Plastics, Resins, Fibers and film, polymers processing.
CO2	Remembering	To Remembering of types of polymers, polymerizations, polymerisation techniques, Rubbers, plastics.
CO3	Understanding	To Understanding of polymerization techniques & polymer processing.
CO4	Analyse	To Analyse different applications of polymerizations products like Rubbers, Plastics, Resins, Fibers & Films.
CO5	Remembering	To Remembering of properties of Plastics, Fibers & Films.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	2	2	2	3	2	3	2	3	3	3
CO2	3	3	3	2	2	3	3	3	2	3	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	2	2	2	2	2.5	2	3	3	2.5	3	2.5	3	3	3
Avg	2.8	2.6	2.6	2.6	2.5	2.6	2.8	3	2.5	3	2.5	3	3	3

DIPLOMA CEHMICAL SEMESTER – III
SUBJECT: MECHANICAL OPERATION (DK-301)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	3	7		60	40	25	50	175

A. COURSE OVERVIEW

- The course cover the fundamental aspects size reduction, different equipment that use for size reduction. Also cover different mechanical operation like mixing, agitation, sedimentation and filtration.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Definition of Unit Operation and Unit Process, Difference between Unit operation and Unit Process, Examples of Unit Operation & Unit Process.	01	CO1
[2]	Specific properties of solids, Density & Bulk density. Definition and calculation of particle diameter, Sphericity, equivalent diameter, specific surface area, volume surface mean diameter, mass mean diameter, shape factor, Calculation of no. of particles.	07	CO1 CO2
[3]	Need of screen analysis, Types of screen analysis, Application of screen analysis, Types of screens, trommel, grizzlies, Vibrating screen etc. Ideal & actual screen, Capacity & effectiveness of screen (With derivation). Calculation of capacity and effectiveness of screen, faults in screening.	12	CO1 CO3
[4]	Definition and need of size reduction, Principles of size reduction, characteristics of comminuted products, Energy & power requirements in communition, laws of size reduction, work index, Types of size reduction equipment with their principle, construction & working, derivation of equation of angle of nip and critical speed. Calculation of angle of nip, capacity & Ribbon factors. Open & close circuit grinding.	10	CO1 CO2 CO3
[5]	Definition of sedimentation, theory of bath sedimentation, Interphase height and time curve, Flocculation principle, Gravity thickener. Explanation of free and hindered settling, cyclone separator, efficiency of cyclone separator. Definition of Stoke's law and Newton's law for terminal settling velocity.	10	CO1 CO4
[6]	Definition and applications of filtration, Equipments for liquid – solid separation., Filter press, Rotary vacuum filter, filter media and its required characteristics, filter aids and method of application, calculation of special cake resistance, filter media resistance, porosity for constant rate, constant pressure system and vacuum drum, constant rate filtration and constant pressure filtration, classification of centrifugal equipment, batch centrifuge, Advantages and disadvantages of centrifuge over filter press.	12	CO1 CO4 CO5
[7]	Classification of Impellers, vortex formation and swirling, methods of vortex prevention, factors affecting agitation, Purpose of mixing solids and paste, Principle construction & working of Ribbon blender, Muller mixer, Banbury mixer & Kneaders.	08	CO1 CO6

C. TEXT BOOKS

1. MaCabe & Smith, *Unit Operation in Chemical Engineering;* 5th ed.; McGraw Hill Book Company; New York, 1993
2. K A Gavhane, *Unit Operation I;* 3rd ed.; Nirali Prakashan, Pune, July 2015

D. REFERENCE BOOKS

1. Coulson and Richardson *Chemical Engineering Vol. I;* 7th ed; Landon: 1999.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understanding	To impart the basic concepts of mechanical operations in chemical process industries.
CO2	Remembering	To develop understanding about size analysis, size reduction and solid handling.
CO3	Understanding	Understanding and defining the of screen analysis with difference equipment.
CO4	Understanding	Understand mechanical separation methods such as filtration, and sedimentation, and associated equipments used for achieving these methods
CO5	Understanding	Classify and explain solid-solid, solid-fluid related operations.
CO6	Understanding	To get knowledge for mixing and agitation operation

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
CO4	3	3	3	2	3	2	3	2	2	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3	3	3	3
Avg	3	3	3	2.8	3	2.6	3	2.8	2.6	3	3	3	3	3

DIPLOMA CEHMICAL SEMESTER – III
SUBJECT: CHEMICAL PROCESS INDUSTRIES (DK-308)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	3	7		60	40	25	50	175

A. COURSE OVERVIEW

The course imparts study of various process technologies and fundamentals of various organic and inorganic process industries. It helps in understanding manufacturing, various process parameters, basic functioning of equipment's and engineering problems for various industries.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	General Survey of Chemical Industries, Importance contribution to human life & classification of chemical industries. Classification of fuels, Fuel gases.	10	CO1 CO2
[2]	Manufacture of Soda ash, Caustic Soda, Chlorine & Hydrogen. Types of cement, classification of cement, manufacturing of cement & major engineering problems of cement industries.	10	CO1 CO2 CO3 CO4
[3]	Chemicals from seawater, manufacture of common salt and. bromine. Classification of drugs, manufacture of penicillin and aspirin.	07	CO1 CO2 CO3 CO5
[4]	Classification of oil & fats, Extraction of vegetable oil, Hydrogenation of oil, manufacture of soap and glycerine, major engineering problems of all such industries.	08	CO1 CO2 CO3 CO5
[5]	Types of electrochemical Indus., electroplating and refining of Aluminium.	05	CO1 CO3 CO5
[6]	Manufacture of sugar and starches. Ethanol from molasses by fermentation, major engineering problems. Methods of pulp production, manufacture of pulp by Kraft process, recovery of chemicals from black liquor & major engineering problems.	10	CO1 CO2 CO3 CO6
[7]	Classification of dyes, manufacture of H-acid and B-naphtha. Classification of pesticides, manufacture of parathion, 2-4-D, BHC.	10	CO1 CO2 CO3 CO6

C. TEXTBOOKS

1. M. Gopala Rao, Marshall Sittig., *Dryden's Outlines of Chemical Technology*, 3rd Edition, East West press private limited, New Delhi.

D. REFERENCE BOOKS

1. George T. Austin., *Shreve's Chemical Process Industries*, 3rd Edition, Tata McGraw Hill.
2. W. L. Faith, Donald B. Keyes, Ronald L. Clark., *Industrial chemicals*, John Wiley and Sons, New York, 1950.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering	To know the basics of various chemical industries and to know various unit operation and unit processes for manufacturing.
CO2	Evaluating	To identify and solve engineering problems during production.
CO3	Understanding	To develop the comprehensive understanding about the fundamental knowledge and manufacturing process for various chemical products.
CO4	Understanding	To understand the treatment, reaction, and separation steps in a flow diagram of chemical production processes for fuel gases, chlor-alkali, and cement industries.
CO5	Understanding	To understand the treatment, reaction, and separation steps in a flow diagram of chemical production processes for marine chemicals, pharmaceuticals, oil & fat, and electrochemical industries.
CO6	Understanding	To understand the treatment, reaction, and separation steps in a flow diagram of chemical production processes for carbohydrate, pulp & paper, pesticides, and dyes & intermediate industries.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	3	2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	2	3	2	2	3	3	3	3	3
CO5	3	3	3	2	3	2	3	2	2	3	3	3	3	3
CO6	3	3	3	2	3	2	3	2	2	3	3	3	3	3
Avg	3	2.8	3	2.3	3	2.5	3	2.5	2.5	3	3	3	3	3

DIPLOMA CEHMICAL SEMESTER – III
SUBJECT: INDUSTRIAL SAFETY & ENVIRONMENTAL ENGINEERING (DK - 319)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	3	7		60	40	25	50	175

A. COURSE OVERVIEW

- The course is introducing general concept and their controls of safety, environment, and pollution. Students will learn to safety objects, role of chemical engineers, chemical hazards, mechanical hazards, electrical hazards, fire hazardsnand their xontols and prevention methods. and some pollution like water pollution, noise pollution, miscellaneous pollution, and solid waste disposal methods,

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	General introduction & concepts of safety Safety of organization industrial plant lay out of safety, safety measures concept & importance of safety in chemical industries.	5	CO1 CO4
[2]	Chemical & fire Hazards & their control Defination, source, & classification of hazards like chemical, fire, different methods for controlling chemical & fire hazards, objective & importance of fire prevention, fire extinguishing agents & device with their working.	7	CO1 CO4
[3]	Other hazards & occupational diseases Concept of mechanical, electrical & noise hazards with their precaution. & notified dangerous occupational diseases with their cause and their prevention	6	CO1 CO4
[4]	Personal Protective Devices Protective devices for head, ears, eyes, face, respiratory system, hand ,feet etc.	5	CO2
[5]	Introduction to pollution : Introduction to environmental pollution, sources of pollutants, effects of pollution on human health, vegetation , animal life & effect on environment.& Miscellaneous Pollution : Sources types of effect of noise pollution, radiation etc.	10	CO1 CO5 CO6
[6]	Air Pollution: Sources & Types of air pollutant, classification, properties of air pollutant, effect of air pollution, Air pollution control methods like gravitational settling, Diffusion, Electrostatic precipitation, Centrifugal impaction, Direct interception etc. Air pollution controlling equipments like gravity settler, cyclone separator, fabric filter, electrostatic precipitator, wet scrubber etc..	10	CO1 CO5 CO6
[7]	Water pollution: Introduction, characterization of water, BOD, COD, VM, SM, classification of sources. Water pollution, sewage treatment processes like primary, secondary of final treatment, Brief idea about CETP of design criteria for Industrial effluent treatment plant.	10	CO1 CO5 CO6
[8]	Solid waste of disposal methods : Sources of classification, Methods of disposal like dumping, sanitary land filling, incineration, composting etc.	7	CO1 CO5 CO6

C. TEXT BOOKS

1. S. Rao, Environmental Pollution control engineering, 2nd edition, New age International (P) Ltd.,Hyderabad, January, 2006.

D. REFERENCE BOOKS

1. Danieal A. Crowel & Joseph. F, 2nd edition, Prentice hall PT, New Jersey, 2002.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remembering	The general introductions and concept of safety.
CO2	Analysing	To choose appropriate protective devise for any given conditions.
CO3	Applying	To apply hazard & pollution analysis techniques for risk assessment..
CO4	Understanding	To understand fire hazards, objective, source and importance of safety and their objects.
CO5	Remembering	Types of Pollutions And Sources...
CO6	Understanding	To Understand Control methods, and disposal management.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	2	2	2	3	3	3	2	3	3	3	3	3
CO6	3	3	3	3	2	3	3	3	2	3	3	3	3	3
Avg	3	2.6	2.5	2.6	2.5	3	3	3	2.5	3	3	3	3	3

DIPLOMA CEHMICAL SEMESTER – III
SUBJECT: PLANT UTILITIES & ENERGY ENGINEERING (DK-320)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	3	7		60	40	25	50	175

A. COURSE OVERVIEW

- The course is devised to introduce fundamental aspects of fluid flow behaviour. Students will learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Types of energy, energy crisis, Renewable sources of energy, conventional & non-Conventional sources of energy, energy conservation.	5	CO1 CO2
[2]	Classification, types, sources, properties, uses, storage, handling & selection factors of various conventional fuels in the form of a. Solid: Coal, Lignite, Coke b. Liquid: Gasoline, Kerosene, Naphtha, Fuel oil, Diesel c. Gaseous: N.G., Refinery gas, Water gas, Producer gas, Coke oven gas, LPG, Oil gas, Industrial Gases etc	10	CO2
[3]	Solar energy: Solar radiation, collectors, storage & applications Wind energy: Introduction, nature of wind & wind farm Biomass energy: Introduction, Biomass conversion technology by wet & Dry process Geothermal energy: Introduction & Sources of geothermal energy. Nuclear energy: Introduction, Nuclear Fuels & Nuclear reactions, types of Propellant & moderators	15	CO1 CO3
[4]	Importance, Consumption & source of water, water analysis, types of hardness, methods of softening of water like lime soda, zeolite, ion exchange methods etc., Purification of water by screening, sedimentation, coagulation, filtration & sterilization, treatment for boiler feed water, Reuse & Recycling of process water, definition of enthalpy, wet steam, superheated steam, specific volume, Types-classification & comparison of steam generators, Factors affecting the selection of steam generator	15	CO4
[5]	Introduction, use of air as chemical raw material & utility, concept of compressed air, blower air, fan air, instrument air etc., various methods of refrigeration in brief like ice, evaporate, vapor, steam jet refrigeration etc, types of refrigerating agent like ammonia, carbon dioxide, methylene chloride, water brine etc., selection of refrigerating agents	15	CO5

C. TEXT BOOKS

1. Dryden's Outlines of Chemical Technology, 2nd Ed. By M. Gopala Rao & Marshall Sitting, East West Press Pvt. Ltd., New Delhi.

D. REFERENCE BOOKS

1. Shreve's Chemical Process Industries, 5th Ed. By, George F. Austin McGraw Hill International Edition.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Remember	Gain sufficient knowledge about the various fuels and energy sources with applications in industrial processes.
CO2	Understand	Classify Conventional sources of energy requirements and give their importance in present day.
CO3	Understand	Able to acquire the knowledge on various alternate energy technologies and their importance in fulfilling the present-day energy needs
CO4	Apply	Select appropriate utility for heating and cooling application.
CO5	Understand	To study requirement of different utilities for the process, along with its generation and it's effective utilization.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	3	2	2	2	2	2	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	2	2	2	2	2	2	2	3	3	3	3	3
Avg	3	2.6	2.8	2.6	2.8	2.8	2.6	2.6	2.6	2.8	2.6	3	3	3

DIPLOMA CEHMICAL SEMESTER – III
SUBJECT: PLANT DESIGN, MANAGEMENT & ECONOMICS (DK-318)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4		60	40	0	0	100

B. TECH. SEMESTER – V (EC)

SUBJECT: (EC507) POWER ELECTRONICS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

A. COURSE OBJECTIVES

This course involves understanding of the power electronics circuits which can enable students to interpret, analyze, design, and apply power electronics based circuits. The subject understanding is useful to the students for different power applications by offering deep insight into characteristics and functioning of various power semiconductor devices.

To prepare students for analysis and designing power converter circuits for different power applications by offering deep insight into characteristics and functioning of various power semiconductor devices.

B. DETAILED SYLLABUS

NO TOPIC

[1] Introduction to Power Electronics:
Overview of Power Electronics, Power Semiconductor Devices, Control Characteristics of Power Devices, Characteristic & Specifications of Switches, Types of Power Circuits, Reverse Recovery Characteristics, Types of Power Diodes, Freewheeling Diodes, Structure and Volt-Current Characteristics of Power MOSFETS, COOLMOS, SITs, Structure and Volt-Current Characteristics of IGBTs, SiC – MOSFET, SiC – IGBT.

[2] Thyristors:
Thyristor Characteristics, Two Transistor Model of Thyristor, Thyristor Turn-on, Thyristor Turn-off, Types of Thyristors, Series & Parallel Connection of Thyristors, di/dt& dv/dt Protection, Gate Drive Circuits.

[3] Uncontrolled and Controlled Rectifiers:
Multiphase Star Rectifiers, Three-Phase Bridge Rectifiers, Three-Phase Bridge Rectifier With RL Load, 3-Phase Rectifier Design, Principal of Phase Controlled Converter, Single Phase Semi Converter, Single Phase Full Converter, Three Phase Half Wave Converters, Three Phase Semi Converter, Three Phase Full Converter. (Without Analysis for RL Load), Power Factor Improvement, Pulse Width Modulation using IGBT, Single Phase Sinusoidal PWM using IGBT, Three Phase PWM Control using IGBT.

[4] Inverters:
Principal of Operation of Pulse Width Modulated Inverters, Performance Parameters, Single-Phase Bridge Inverters, Voltage Control of Single-Phase Inverters, Current Source Inverter, Multilevel Concept, Applications & Features of Multilevel Inverter.

[5] DC-DC Converters:
Principal of Step Down Converter, Principal of Step Up Converter, Performance Parameters, Converter Classification, Switch Mode Buck, Boost, Buck-Boost &Cuk.

[6] AC Controllers:
Principal of On-Off Control, Principal of Phase Control, Cycloconverters, PWM Controlled AC Voltage Controllers.

[7] Protection of Devices & Circuits:
Cooling and Heat Sinks, Snubber Circuits, Reverse Recovery Transients, Supply & Load Side Transients, Current & Voltage Protection, Magnetic Interference, Protection of IGBT.

[8] Dc Drives:

Characteristics of DC Motor, Operating Modes, Single-Phase DC Drives, Breaking Schemes of DC-DC Converter Drives, Closed-Loop Control of DC Drives.

[9] Ac Drives:

Induction Motor Drives, Close-Loop Control of Induction Motors, Synchronous Motor Drives, Stepper Motor Control, Basics of DC Drives and Comparison with AC Drives.

[10] Power Supplies:

Switched-Mode Power Supplies, UPS, CVT.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Power Electronics circuits, Devices and Applications, Muhammad H. Rashid, 3rd Edition, Pearson Education and PHI.
2) Power Electronics, M. D. Singh and K. B. Khanchandani, 2nd Edition, TheMcGrow Hill.
3) Power Electronics, Dr.P.S.Bhimbhara, 4th Edition, Khanna Publication.
4) Power Electronics, B. R. Gupta & V. Singhal, 2nd Edition, S. K. Kataria& Sons

D. COURSE OUTCOMES

At the end of the course, students should be able to

CO1. Illustrate the construction, operation, working, and characteristics of various power semiconductor devices like MOSFET and IGBT

CO2. Evaluate performance of single phase and three phase controlled rectifier circuits, three phase uncontrolled rectifier circuits

CO3. Analyse the performance of PWM inverters, analyse and design protection circuits

CO4. Fundamental and applications of SCR, DIAC, and TRIAC, operation and design of triggering circuits

CO5. Evaluate thyristor series and parallel network, design of PUT triggering circuit, Evaluate AC voltage controller circuits

CO6. Design DC - DC regulators and chopper circuits, apply basic power electronics converter understanding to realize power electronics applications, evaluate uninterrupted power supply

E. COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3					1		1		
CO2	3	2	2					1		1		
CO3	3	2	2					1		1		
CO4	3	3	3					1		1		
CO5	3	3	3					1		1		
CO6	3	3	2					1		1		
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VI (EC)
SUBJECT: (EC617) AUTOMATED ELECTRONICS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

A. COURSE OBJECTIVES

Automation is playing a key role in Industries. Industries rely heavily on automation for economic viability and mass production. It is important for the students to learn basic of automation, how system works and importance of PLC, SCADA and robotics in automation. This course will provide opportunity to learn industrial automation techniques to understand basic components of automation in Industries, to learn various industry automation techniques, to apply knowledge of automation components for practical application, and to study different systems based on PLC, SCADA and robots in automation.

B. DETAILED SYLLABUS

NO TOPIC

[1] INTRODUCTION
Automation overview, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA), Industrial bus systems: Modbus &Profibus

[2] AUTOMATION COMPONENTS
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, introduction of DC and AC servo drives for motion control.

[3] COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS
Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT).

[4] PROGRAMMABLE LOGIC CONTROLLERS
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flowchart, PLC Communication and networking, PLC selection, PLC Installation, Application of PLC.

[5] DISTRIBUTED CONTROL SYSTEM
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers.

[6] OVERVIEW OF INDUSTRIAL AUTOMATION USING ROBOTS
Basic construction and configuration of robot,Pick and place robot, Welding robot.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Industrial Instrumentation and Control, S. K. Singh, 3rd Edition, Tata McGraw Hill Companies.
2) PC based Instrumentation –Concepts and practice, N. Mathivanan, 3rd Edition, PHI Publications.
3) Programming Logic Controllers -Principles and applications, John W. Webb & Ronald Reis, 5th Edition, PHI Publications.

4) Process Control Instrumentation Technology, C. D. Johnson, 8th Edition, PHI Publications.
5) Programmable logic controller, Dunning & Delmar, 3rd Edition, Thomas Dilmar Publications.
6) Industrial control handbook, Parr & Newman, 3rd Edition, Industry Press.

D. COURSE OUTCOMES

At the end of the course, students should be able to

CO1. To interpret the importance of automation techniques and relate to various control techniques employed in industry process automation working on Industrial bus systems: Modbus &Profibus

CO2. Introduce various elements of programmable logic controllers (PLC) and implement basic digital logic operations

CO3. To acquire different sensor input, signal condition the inputs, analyze the data, make decisions and take action or control

CO4. Design of PLC ladder diagram using timers, counters, comparison instructions, math operations, data handling and control flow instructions, shift and sequencer operations, and file instructions for various real life applications for plant automation

CO5. To understand the elements of computer aided measurement, control hardware, interfaces, Internet of things (IoT) for plant automation

CO6. Illustrate Basic construction and configuration of robots, applications of robots as pick and place robot and welding robot, demonstrate various building blocks of distributed control systems, and compare different modes of control

E. COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2					1		1		
CO2	3	3	3					1		1		
CO3	3	2	1					1		1		
CO4	3	3						1		1		
CO5	3	2	1					1		1		
CO6	3	3	2					1		1		
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VI (EC)
SUBJECT: (EC615) ADVANCED MICROPROCESSORS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

A. COURSE OBJECTIVES

The objective of this course is to introduce performance enhancement techniques for advanced processor architechres, interfacing techniques and real-world applications design using 8086 and ARM7 based microprocessors. To familiarize students with the assembly language and high level programming to optimize machine language code with reference to timing and resource constraints of the system.

B. DETAILED SYLLABUS

NO TOPIC

[1] THE MICROPROCESSOR AND ITS ARCHITECTURE
Internal Architecture, Real mode memory addressing, protected mode memory addressing, memory paging.

[2] ADDRESSING MODES
Data addressing mode, program memory addressing mode, stack memory addressing mode

[3] 8086/8088 HARDWARE SPECIFICATIONS
Pin-outs, pin functions, clock generator, bus buffering and latching, bus timing, ready and the wait state, minimum mode versus maximum mode.

[4] MEMORY INTERFACE
Memory devices, address decoding, 8086 and 8088 memory interface

[5] INTERRUPTS
Basic interrupt processing, Hardware interrupts, Expanding the interrupt structure

[6] THE PENTIUM MICROPROCESSOR
Protected mode, paging mode, virtual 8086 mode, memory management mode with Pentium.

[7] INTRODUCTION TO ARM
Overview of ARM Processor, Fundamental of RISC & CISC, Evolution of RISC, Comparison of RISC & CISC, Design for LPC.

[8] ARM ARCHITECTURE
Architectural inheritance, Programmer's model, ARM development tools, Software Assembler (ARM), 'C' Language Complier, Simulator, Hardware Board, Board organization, Communication with external world. 3-stage pipeline ARM organization, ARM instruction execution, ARM implementation

[9] ARM ASSEMBLY LANGUAGE PROGRAMMING
Data processing instructions, Data transfer instructions, Control flow instructions, Programs based on assembly language. Introduction, Exceptions, Conditional execution, Branch and Branch with Link (B, BL), Branch, Branch with Link and eXchange (BX, BLX), Software Interrupt (SWI), Data processing instructions, Multiply instructions, Count leading zeros (CLZ), Single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions, Multiple register transfer instructions, Swap memory and register instructions (SWP), Status register to general register transfer instructions, General register to status register transfer instructions, Coprocessor instructions.

[10] THE THUMB INSTRUCTION SET
The Thumb bit in the Current Program Status Register (CPSR), The Thumb programmer's

model, Thumb branch instructions, Thumb software interrupt instruction, Thumb data processing instructions, Thumb single register data transfer instructions, Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation, Thumb applications.

[11] INTRODUCTION TO VECTORED INTERRUPT CONTROLLER

IRQ and FIQ using Vectored interrupt controller of LPC23xx

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) The Intel Microprocessors 8086, 8088, 80186, 80188, 80286, 80386, 80486, Pentium, Pentium Pro Processors, Berry B Brey, 6th Edition, Prentice Hall of India.
2) ARM - System-On- Chip Architecture, Steve Furber, 2nd Edition, Prentice Hall of India.
3) Microprocessors and Interfacing-Programming & Hardware, Douglas V. Hall, 2nd Edition, Tata McGraw Hill.
4) IBM PC Assembly Language Programming, Peter Abel, 2nd Edition, Prentice Hall of India.
5) ARM System Developer Guide, AntrewSloss, Dominic Symes, Chris Wright, Morgan Kaufmann.
6) Technical Ref. Manual, ARM7TDMI (3) UM10211 LPC 2364/66/68/78 User Manual, NXP Ltd.

D. COURSE OUTCOMES

At the end of the course, students should be able to

CO1. Being familiar and analyse the architectural aspects of 8086 like specifications, programming model, pipeline, prefetch queue, pin configuration and role of this features to build microprocessor based systems

CO2. Develop assembly language program to satisfy executional requirements as per given problem statement with reference to programming model of 8086, instruction set and simulate and analyse the assembly language and C programs simulation tools

CO3. Determine requirement of hardware components and Design 16-bit memory subsystem with the 8086 as per system specifications

CO4. Demonstrate multitasking environment using interrupt programming and vectored interrupt controller. Use protected mode memory addressing, memory paging to extend addressing capacity of the system.

CO5. Introduce architecture and programming model of ARM7 architecture and compare it with 8086 architecture..

CO6. Develop ARM7 based assembly language and C programs to implement common algorithms and attempt optimization of the code, also use the machine language code templates to generate machine codes for different types of instructions.

E. COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2		2	1	1	2	2		1
CO2	3	3	3	3	3	2	1	1	2	2		1
CO3	3	3	3	3		2	1	1	2	2		1
CO4	3	3	2	3	3	2	1	1	2	2		1
CO5	3	3	3	2		2	1	1	2	2		1
CO6	3	3	2	3	3	2	1	1	2	2		1
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VI (EC)
SUBJECT: (EC611) DIGITAL SIGNAL PROCESSING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

A. COURSE OBJECTIVES

The field of Digital Signal Processing (DSP) continues to evolve and play a central role in modern electronics. In fact, DSP is so ubiquitous that the field is somewhat disappearing as a discrete entity. Many systems developed today related to wireless communication, speech processing, image and video processing, which are now integral part of everyday life of virtually everyone in this world, use powerful DSP concepts as their foundations.

The objective of the course is to offer in depth understanding of time domain and frequency domain analysis of discrete time signals and systems and design of IIR and FIR digital filters with the overview of DSP architectures.

B. DETAILED SYLLABUS

NO TOPIC

[1] DISCRETE SIGNALS
Introduction, Signal and Signal Classification (Analog, Digital), Types of Signal Processing, Advantages and Disadvantages of DSP.
Operations on Discrete Signals, Decimation and Interpolation.

[2] DISCRETE TIME SYSTEMS
System Classification, Digital Filters-Difference Equation, Impulse Response, Stability, Connections.

[3] DISCRETE CONVOLUTION
Discrete Convolution, Convolution of Finite Sequences, Stability of LTI Systems, System Response to Periodic Inputs, Periodic Convolution, Discrete Correlation.

[4] THE Z-TRANSFORM
Definition, Properties, Z-Plane Representation, The Transfer Function, Inverse-Z Transform, System Analysis, Frequency Response.

[5] APPLICATIONS OF Z-TRANSFORM
Time Domain Analysis, Frequency Response - Graphical Interpretation, Application-Oriented Examples: Digital Audio Effects.

[6] IIR FILTER DESIGN
Introduction, IIR Filter Design, Response Matching, Matched-Z Transforms, Mappings, Bilinear Transformation.

[7] FIR FILTERS DESIGN
Linear Phase Requirement and Symmetric Sequences, FIR Design By Fourier Series & Windowing Method.

[8] THE DFT AND FFT
Fourier Series, Fourier Transform, DTFT, DFT - Definitions, Properties, Spectral Smoothing by Time Windows, The FFT, DIT- FFT, DIF-FFT, IDFT, Applications of Overlap-Add Method & Overlap - Save Method.

[9] ADVANCE DSP CONCEPTS
Multirate Signal Processing, Adaptive Signal Processing, Finite Word Length Effect.

[10] APPLICATIONS OF DSP
Speech Processing: Speech Analysis, Speech Synthesis, Speech Recognition, Speaker

Recognition, Image Processing: Extracting The Edges, Blurring The Images, Biomedical Signal Processing: ECG Analysis, Noise Detection And Diagnosis.

[11] DSP PROCESSOR ARCHITECTURE

Introduction to Digital Signal Processors: Characteristics of DSP Algorithms and Hardware Requirements, Von Neumann Architecture, Harvard Architecture, Parallelism And Hardware
Units of Typical Digital Signal Processor. Architectural Details of TMS320C6x.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Analog and Digital Signal Processing, Ashok Ambardar, 2nd Edition, Thomson Brooks-Cole.
2) Digital Signal Processing, G. Proakis&Dimitris G. Manolakis, 3rd Edition, Prentice Hall of India
3) Digital Filters- Analysis, Design and Applications, Andreas Antonion, 2nd Edition, Tata McGraw Hill.
4) Digital Signal Processing - A Computer Based Approach, Sanjit K Mitra, 3rd Edition, Tata McGraw Hill.

D. COURSE OUTCOMES

At the end of the course, students should be able to

CO1. Classify and perform operations on discrete time signals and compare representation of analog and discrete signals
CO2. Classify digital filters and find out their response through difference equations and analyse as well as realize them using z transform
CO3. Find Response of Discrete time LTI Systems using different methods of discrete convolution and check similarity between two functions using correlation between them.
CO4. Design analog filter for Butterworth response for given specifications, and convert it into digital filter using different methods of IIR Filter design.
CO5. Design linear phase FIR Filters using windowing method for given order and desired frequency response.
CO6. Distinguish between FT, DTFT and DFT and obtain spectrum of the given signal using definition of DFT as well as by radix 2 FFT Algorithms.
CO7. Understand special features of DSP processors, fundamentals of adaptive filters and compute truncation error due to finite word length limitations.

E. COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3		1	2	2		1		1		1
CO2	3	3		1	2	2	2	1		1		1
CO3	3	3		1	2	2		1		1		1
CO4	3	3	3	1	2	2	2	1		1		1
CO5	3	3	3	1	2	2	2	1		1		1
CO6	2	1	1	1	2	2		1		1		1
CO7	2	1	1	1	2	2		1		1		1
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VI (EC)
SUBJECT: (EC610) MICROWAVE & ANTENNAS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

A. COURSE OBJECTIVES

The subject aims to provide the student with:

- An understanding of the fundamentals of antennas & the radio frequency networks.
- An ability to design microwave matching networks.
- An understanding of microwave waveguides, passive - active devices, and microwave tubes.
- Design and analysis of radiation parameters of antenna array.

B. DETAILED SYLLABUS

NO TOPIC

[1] TRAMSMISSSION LINE
The Smith Chart & its Applications, Transmission Line Components.

[2] WAVEGUIDES, RESONATOR & COMPONENTS
Rectangular Waveguides, Circular and other Waveguides, Waveguide Coupling, Matching & Attenuation, Cavity Resonator, Auxiliary Components.

[3] MICROWAVE TUBES & CIRCUITS
Microwave Triodes, Multi-Cavity Klystron, Reflex Klystron, Magnetron, Travelling Wave Tube and other Microwave Tubes.

[4] SEMICONDUCTOR MICROWAVE DEVICES & CIRCUITS
Passive Microwave Circuits, Transistor & Integrated Circuits, Varactor and Step Recovery, Diodes and Multipliers, Parametric Amplifiers, Tunnel Diodes and Negative Resistance Amplifiers, Gunn Effect Diodes, Avalanche Effect and Diodes, other Microwave Diodes, Micro-strip Line.

[5] ANTENNAS
Basic Considerations, Radiation from the Hertz Dipole, Near and Far Field Analysis, Radiation Parameters of Antenna, Thin Linear Antenna, Effect of Ground on Antennas, Basic Antenna Parameters, Side Lobe Level of Antenna.Directional High Frequency Antennas, Helical Antennas, Rhombic Antenna, Microwave Frequency Antennas, Horn Antennas, Parabolic Reflector Antenna.

[6] ANTENNA ARRAYS
Array of Point Sources, Broad side & End Fire Array, Array Synthesis, Schelkunoff Zero Placement Method, Binomial Array, Folded dipole, Yagi-Uda Array, Log Periodic Dipole Array Antenna.

[7] SPECIAL ANTENNA
Directional High Frequency Antennas, Helical Antennas, Rhombic Antenna, Microwave Frequency Antennas, Horn Antennas, Parabolic Reflector Antenna.

[8] WAVE PROPAGATION
Electromagnetic Radiation, Propagation of Waves, Ground, Space and Sky Wave Propagation, Scatter propagation, Duct propagation, Multi hop propagation, Fading and Diversity.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Electromagnetic Waves, R. K. Shevgaonkar, Tata McGraw Hill.
2) Microwave Devices and Circuits, S. Y. Liao, 3rd Edition, Prentice Hall of India.
3) Electronic Communication systems, George Kennedy, 3rd Edition, Tata McGraw Hill.
4) Antennas, C. A. Balani, 3rd Edition, Tata McGraw Hill.
5) Antennas & Wave Propagation, K. D. Prasad, 2nd Edition, Khanna Publication.

D. COURSE OUTCOMES

At the end of the course, students should be able to

CO1. Analysis of reflection, impedance transformation and impedance mismatch is discussed. Design microwave matching networks using single-double stub and quarter wave transformer.

CO2. Explain different types of metallic waveguides and their respective modes of propagation.

CO3. Demonstrate the structural and operational characteristics of microwave tubes and devices to identify their applications and demonstrate their characteristics.

CO4. Illustrate the basic philosophy of radiation parameters of antenna and the concept of magnetic vector potential is introduced.

CO5. Design of dipole antenna, antenna array, and other special antennas used in radar and mobile communication.

CO6. Examine communication link for different wave propagation like ground waves, space waves and sky waves.

E. COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	1		2			1			
CO2	3	2	1	1			3				2	
CO3	2	1	1									1
CO4	2	1	1							2		
CO5	3	3	2	3	3		2				1	
CO6	3	3	2	3	3			2				
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VI (EC)
SUBJECT: (EC616) TERM PROJECT (MICROCONTROLLER)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
0	0	2	2	1	-	-	25	25	50

A. COURSE OBJECTIVES

To offer a profound understanding and implementation of Microcontroller based embedded systems in an elementary and integrated manner. At the completion of the course, students will be able to

- Identify, plan, design and implement a small-scale Microcontroller based embedded system.
- Interface Microcontroller(s) with input output peripherals.
- Develop an Integrated system to fulfill the requirements of hardware implementation with the necessary simulation (design, troubleshoot and optimization).
- Design PCB and develop hardware prototype.

B. DETAILED SYLLABUS

NO	TOPIC
[1]	Identify the project definition
[2]	Design and implement hardware and software/ algorithm
[3]	Analyze, troubleshoot and interpret output
[4]	Presentation Skill
[5]	Designing of PCB and implement hardware prototype

C. RECOMMENDED TEXT / REFERENCE BOOKS

Not applicable

D. COURSE OUTCOMES

At the end of the course, students should be able to

CO1. Identify the problem statement that solve societal issues real life problems, through literature survey for project work and arrive at conceptual project statement.

CO2. Decide design specifications and plan for the project work.

CO3. Develop presentation and interpersonal communication skills through project work

CO4. Evaluate outcome and application of project work with appropriate societal, health and safety consideration.

CO5. Analyze, test and troubleshoot designed circuits and codes for desired outcome.

E. COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3		3	1		3	2	1	
CO2	3	3	3	2		1			3			
CO3	2	2	3	3						3		
CO4	3	2	3	2	3	3	2		3	3	3	1
CO5	3	3	3	3	2	3	2		3	3	2	2
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VII (EC)
SUBJECT: (EC702) DATA & COMPUTER COMMUNICATIONS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

A.COURSE OVERVIEW

Computer networks and data communications plays a major role in every aspect of day to day life. The course is designed to impart fundamental knowledge of computer network architecture and major communication protocols. On completion of this course, students are familiarise with the Transmission Media, Flow Control and Error Detection & Correction, understand fundamental concepts in Routing, Addressing & working of Transport Protocols, Administer and maintain a computer network and also gain the knowledge of application layer protocols.

B.DETAILED SYLLABUS

NO TOPIC

[1] INTRODUCTION
The uses of Computer Networks, Network Structure, Network Architecture, OSI Reference Model, Classification of Computer Networks, TCP/IP Protocol Suite, Connectionless Vs Connection Oriented Services, Services & Interface.

[2] THE MEDIUM ACCESS SUBLAYER
The Channel Allocation Problem, Multiple Access Protocols, Collision Free Protocols, IEEE Standard 802.x for LAN and MANs, Bridges.

[3] THE DATA LINK LAYER
Data Link Layer Design Issues, Elementary Data Link Protocols, Sliding Window Protocols.

[4] THE NETWORK LAYER
IPv4 Addressing, Special Addresses, Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Internetworking, Internetworking Devices, The Network Layer in Internet - ARP, IP and ICMP Network Layer Protocols.

[5] THE TRANSPORT LAYER
The Transport Services, Elements of Transport Protocols, The Internet Transport Protocols (TCP and UDP).

[6] THE APPLICATION LAYER
Network Security

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Computer Networks, Andrew S. Tanenbaum, 3rd Edition, Prentice Hall of India
2) Data and Computer Communications, William Stallings, 3rd Edition, Prentice Hall of India
3) Data Communications and Networking, BehrouzA.Forouzan, 3rd Edition, Tata McGraw Hill

D. COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Understand the fundamental underlying principles of computer networking and discuss the functionality along with design issues of OSI and TCP-IP layered network architecture.

CO2. Develop various protocols of data link layer for wired communication and also discuss merits and demerits of several data link layer protocols.

CO3. Understand the fundamentals of various MAC layer protocols and examine the performance of MAC protocols using examples.

CO4. Study the working ofrouting algorithms to calculate the shortest path towards the destination based on different criteria like hope count, delay etc. And also analyse various network layer protocols such as RIP, OSPF.

CO5. Study the functionality the Internet protocol (IP) and also analyse IP header using packet capturing tool.

CO6. Assess the performance evaluation of transmission control protocol, its header and congestion control algorithms using network simulator (NS2).

E. COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	1	1	1							1
CO2	2	2	1	1	1							1
CO3	3	1	2	1	1							2
CO4	2	1	2	1	1							2
CO5	3	2	2	2	1					1		2
CO6	3	3	2	2	2					1		2
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VII (EC)
SUBJECT: (EC722) EMBEDDEDSYSTEMS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

A. COURSE OBJECTIVES

Embedded Systems have become ubiquitous with their important role in various domains ranging from small handheld/portable devices to automobile and other complex time critical systems including IoTs. The design and performance of embedded systems are challenged by resource constraints besides size restriction. Therefore, understanding of suitable processor/microcontroller architecture, means of data transfer along with the basic concepts of responsibilities of Operating Systems is essential in order to address the common design issues.

The offered subject covers ARM Cortex processor with its feature for efficient firmware development as a suitable candidate for the design of embedded systems and very commonly used data transfer protocols like I2C and SPI. Since the operating system is an unavoidable part of any sophisticated embedded system, the subject also includes the topics related to the core responsibilities of operating systems like, process management, scheduling and I/O management.

B. DETAILED SYLLABUS

NO TOPIC

[1] INTRODUCTION TO ARM CORTEX-M PROCESSORS
ARM Cortex-M processors, Advantages of the Cortex-M processors, Applications of the ARM Cortex-M processors, ARM ecosystem

[2] CORTEX-M ARCHITECTURE
Introduction to the architecture, Programmer's model, Behavior of the application program status register

MEMORY SYSTEM
Overview, Memory endianness, Bit-band operations, Memory access attributes

[3] EXCEPTIONS AND INTERRUPTS
Overview, Exception types, Interrupt management

[4] OS SUPPORT FEATURES
Overview of OS support features, Shadowed stack pointer, SVC exception, PendSV exception

[5] I2C PROTOCOL
Overview, I2C bus features, I2C bus hardware configurations, I2C Protocol, Driving I2C bus

[6] SPI PROTOCOL
Overview, SPI operation, Clock polarity and phase in SPI devices, SPI bus configurations

[7] SOFTWARE INTERFACE STANDARD
Overview, Areas of standardization in CMSIS-Core, Organization of CMSIS-Core, using CMSIS-Core Benefits of CMSIS-Core, Various versions of CMSIS

[8] INTRODUCTION TO OPERATING SYSTEMS
Operating System Concepts, System Calls

[9] PROCESSES
The Process Model, Threads, Interprocess Communication, Classical IPC Problems, Process Scheduling

[10] INPUT/OUTPUT

Principles of I/O Hardware & Software, Device Drivers, Device-Independent I/O Software, User-Space I/O Software, Deadlocks, RAM Disks, Disk Hardware and Software, Clock Hardware and Software, Terminal Hardware and Software.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) The Definitive Guide to ARM Cortex -M3 and Cortex-M4 Processors, Joseph Yiu, : 3rd Edition, Newness Press
2) Operating Systems: Design and Implementation, A. S. Tanenbaum, A. S. Woodhull, 3rd Edition, Prentice Hall of India
3) Operating Systems, William Stallings, Edition 6th, Pearson Education
4) The Designers guide to the Cortex-M processor family, Trevor Martin Edition 2nd, Newnes Press

D. COURSE OUTCOMES

At the end of the course, students should be able to

CO1. Understand roles & responsibilities of operating systems and process model of time-sharing multiprogramming environment

CO2. Identify an appropriate approach for solving the problem of accessing shared resources based on busy waiting and/or hardware support

CO3. Analyse different approaches for solving the IPC problems based on programming language mechanisms like semaphores and monitors

CO4. Examine situations/conditions leading to deadlocks while acquiring hardware or software resources and identify an appropriate approach/algorithms to avoid them.

CO5. Compare different scheduling algorithms with reference to scheduling criteria. Also identify the characteristics and time critical requirements of real time tasks and relate with a right real time scheduling algorithm.

CO6. Classify the devices and understand features of the I/O software to effectively utilize the Operating system support. Study different block devices and compare disk arm scheduling algorithms for reducing disk transfer time.

CO7. Apply the fault and exception handling mechanisms of ARM Cortex-M processor to provide a well-defined response to unexpected situations for a robust embedded system. Also implement specific exceptions useful for real time systems. Use software interface standards CMSIS for writing firmware in user friendly environment for easier development and debugging.

CO8. Understand, compare and implement industry standard widely used serial bus protocols like I2C and SPI for application-level use with the help of EDA tool Keil5. Understand features and applications of various profiles of Cortex processors.

CO9. Understand the internal architecture, features and Programmer's model of ARM Cortex-M processor and implement its unique features using assembly language programming.

CO10. Understand memory system in terms of memory endianness and attributes for efficient interfacing with Cortex-M processor. Write optimized code for implementation of atomic operation using bit-band feature of ARM Cortex M processor for efficient implementation of multitasking systems.

E. COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1			2	1	1	2	2		1
CO2	3	3	3	1	2	2	1		2	2		1
CO3	3	3	3	2	2	2	1		2	2		1
CO4	3	3	3	2		2	1		2	2		1
CO5	3	3	3	2	2	2	1	1	2	2		1
CO6	3	3	2			2	1		2	2		1
CO7	3	3	3	1	3	2	1	1	2	2		1
CO8	3	3	3	1	3	2	1	1	2	2		1
CO9	3	3	3			2	1	1	2	2		1
CO10	3	3	3	1	1	2	1	1	2	2		1
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VII (EC)
SUBJECT: (EC720) IMAGE PROCESSING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

A. COURSE OBJECTIVES

This course offers a solid foundation to understand advanced applications such as Computer Vision, Medical image analysis, Surveillance and multimedia image processing. This subject covers the fundamental concepts & key stages of digital image processing including representation, sampling and quantization, image acquisition, image transforms, image enhancement, image filtering and image restoration. Students will also learn advance topics like Image Segmentation & Morphological Operations. They will implement all the techniques using Python language & OpenCV libraries.

B. DETAILED SYLLABUS

NO TOPIC

[1] INTRODUCTION
Digital Image Processing, The Origins of Digital Image Processing, Examples of Fields thatUse Digital Image Processing, Fundamental Steps in Digital Image Processing, Components ofan Image Processing System.

[2] DIGITAL IMAGE FUNDAMENTALS
Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing andAcquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels,Linear and Nonlinear Operations

[3] IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN
Background, Some Basic Gray-Level Transformations, Histogram Processing, Enhancementusing Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters,Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

[4] IMAGE ENHANCEMENT IN THE FREQUENCY DOMAIN
Background, Introduction to the Fourier Transform and the Frequency Domain, SmoothingFrequency-Domain Filters, Sharpening Frequency Domain Filters, Holomorphic Filtering,Implementation.

[5] IMAGE RESTORATION
A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Geometric Transformations.

[6] COLOR IMAGE PROCESSING
Color Fundamentals, Color Models, Pseudocolor Image Processing, Basics of Full-ColorImageProcessing.

[7] MORPHOLOGICAL IMAGE PROCESSING
Preliminaries. Dilation and Erosion. Opening and Closing. The Hit-or-Miss Transformation.Some Basic Morphological Algorithms. Extensions to Gray-Scale Images

[8] IMAGE SEGMENTATION
Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, RegionBased Segmentation, Segmentation by Morphological Watersheds, The Use of Motion inSegmentation.

[9] REPRESENTATION AND DESCRIPTION

Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components forDescription, Relational Descriptors.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Digital Image Processing, Rafael C. Gonzalez& Woods, 3rd Edition, Wesley Publishing Co.
2) Image Processing, Don Pearson, Tata McGraw Hill
3) Digital Picture Processing, AzrielResenfeld, Avinash C. Kak, Academic Press, New York
4) Digital Image Processing, Kenneth R. Castleman, Pearson Education
5) Fundamental of Digital Image Processing, Anil K. Jain, Pearson Education

D. COURSE OUTCOMES

At the end of the course, students should be able to

CO1. Compare different methods for image acquisition, storage, processing and representation in digital devices having different color formats

CO2. Analyse an image in spatial domain and apply spatial enhancement techniques like point processing methods & Image Filtering.

CO3. Interpret & compare the mathematical principles of 2D transform methods for image analysis in frequency domain and apply them for image enhancement.

CO4. Discriminate various segmentation techniques for an image and separating image components for further analysis.

CO5. Compare various noise models for an image, evaluate restoration techniques to remove noise and degradation, and processing image using representation & description techniques.

CO6. Compare morphological image processing methods for various applications

E. COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		2				3						
CO2	3	3	3	3	3	2		1	2	1		
CO3	3	3	3	2	3	2		1	2	1		
CO4	3	3	3	2	3	2		1	2	1		
CO5	3	3	3	2	3	2		1	2	1		
CO6	3	3	3	2	3	2		1	2	1		
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VII (EC)
SUBJECT: (EC723) TERM PROJECT (SOFTWARE)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
0	0	2	2	1	-	-	25	25	50

A. COURSE OBJECTIVES

To offer a profound understanding and implementation of any system or concept using any programming language or software tool.

B.DETAILED SYLLABUS

NO TOPIC

[1] Plan, design and implement Software projects.
[2] Analyze and interpret output.
[3] Presentation Skill
[4] Designing of Flowchart

C. RECOMMENDED TEXT / REFERENCE BOOKS

Not applicable

D. COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Identify the problem statement that solve societal, health and safety issues, through literature survey for project work and arrive at conceptual project design through brainstorming.
CO2. Develop design strategy for the project work.
CO3. Develop presentation and interpersonal communication skills through project work
CO4. Evaluate outcome and application of project work with appropriate societal, health and safety consideration.

COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1			3			3	2	1	
CO2	3	2	3	3					3			
CO3	3	2	3	3	2					3		
CO4	3	2	3	2	2	3	2	2	3	3	3	3
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VII (EC)
SUBJECT: (EC724) WIRELESS COMMUNICATION

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	0	4	4	60	40	-	-	100

A. COURSE OBJECTIVES

In view of fast development in a range of applications depending on cellular systems as well as wireless technology in general, it is essential to understand the fundamentals of cellular concept with in-depth study of the characteristic of hostile wireless channels and design of various techniques to compensate the demerits of the channels.
The offered subject has to include the advance topics like cellular concepts, digital modulation techniques, spread spectrum techniques, speech coders, Adaptive equalizer, diversity, GSM architecture as the attempt of upgrading the quality of wireless communication.
To offer fundamental understanding of various aspects of wireless communication including cellular structure, interference and fading issues with different minimization techniques. The subject makes students aware of various mobile telephony standards like GSM-2G, 2.5G, 3G (WCDMA) and 4GLong Term Evolution (LTE).

B. DETAILED SYLLABUS

NO **TOPIC**

[1] INTRODUCTION TO WIRELESS COMMUNICATION SYSTEM
Evolution of mobile radio communications, Cellular Telephone System.
MODERNWIRELESS COMMUNICATION SYSTEMS
Second generation (2G) cellular networks, Third generation (3G) wireless networks, Bluetooth and personal area network.

[2] THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS
Introduction, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Trunking and grade of service, Improving coverage & capacity in cellular systems.

[3] MOBILE RADIO PROPAGATION
Large scale path loss, Small scale path loss fading and multi path Doppler shift, Fading offset, Level crossing rate, Fade duration.

[4] MODULATION TECHNIQUES FOR MOBILE RADIO
Digital modulation - an overview, Pulse shaping Techniques, Linear modulation techniques, Constant envelope modulation, combined linear and constant envelope modulation (QAM), Multiple Access Techniques, Spread spectrum modulation techniques.

[5] EQUALIZATION, DIVERSITY, AND CHANNEL CODING
Introduction, Fundamentals of equalization, Training , A generic adaptive equalizer, Equalizers in a communications receiver, Survey of equalization techniques, Linear equalizers, Nonlinear equalization, Diversity techniques, RAKE receiver, Interleaving, Fundamentals of channel coding.

[6] SPEECH CODING
Introduction, Characteristics of speech signals, Quantization techniques, Adaptive differential pulse code modulation (ADPCM), Vocoders, Linear predictive coders, choosing speech codec for mobile communications, The GSM codec

[7] MULTIPLE- ACCESS TECHNIQUES FOR WIRELESS COMMUNICATION

Introduction, Frequency division multiple access (FDMA), Time division multiple access, Spread spectrum multiple access, Frequency hopped multiple access (FHMA), Code-division multiple access (CDMA), Hybrid spread spectrum techniques, Space division multiple access(SDMA), Packet radio, Capacity of cellular systems.

[8] GSM SYSTEM

RF specifications, Time slot data structure, Speech frame, Control channels System structure. HLR VLR AUC EIR MSC BSC BTS MS Equalization, Diversity, Channel Coding, Speech Coding.

[9] OVERVIEW OF 3G & 4G

An overview of wireless systems, Techniques for high data rate in 3G, Brief about WCDMA,3GPP Long Term Evolution (LTE)- Goals, System overview, Network structure, Main Features

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Wireless communication, Theodore Rappaport, 2nd Edition, Prentice Hall of India.
2) Wireless Communication, W. C. Y. Lee, 3rd Edition, Tata McGraw Hill.
3) Wireless Communications, Andreas F. Molisch, 2nd Edition, A John Wiley and Sons, Ltd.
4) Wireless Communications and Networking, Vijay Garg, M.K. Publishers

D. COURSE OUTCOMES

At the end of the course, students should be able to

CO1 Determine small scale multipath fading parameters for given operating frequency, speed of mobile and delay spread and compensate the fading using suitable algorithms for linear and non linear equalization

CO2 Analyse and evaluation of cellular system in terms of interference and capacity and system improvement techniques for coverage and capacity

CO3 Understand all types of diversity and Determine average SNR for given number of receive antenna for selection diversity and MRC diversity and Find out output bit rate for speech coders for given block of speech duration, sampling frequency and determine the bandwidth requirement for given type of FEC and modulation technique.

CO4 Compare modulation techniques in terms of bandwidth efficiency and power efficiency.

CO5 Understand GSM architecture and overview of 4G features and illustrate the call establishment process in GSM showing the usage of control channels at every step of data exchange between Mobile station and switching centre.

CO6 Compare the features of 1G, 2G & 3G mobile system, Compute path-loss and received signal strength with given transmit power, antenna gain and distance for largescale fading channel conditions and Compare multiple Access Techniques useful for different generation and Capacity of cellular systems -GSM and CDMA

E. COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1		1	1					
CO2	3	2	1	1		1	1	1				
CO3	3	3	1	1		1	1	1				

CO4	3	3	1	1		2	1	1				
CO5	3	3	3	3		2	1	1				
CO6	3	3	2	2		2	1	1				
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – VIII (EC)
SUBJECT: (AF802) SEMINAR

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
0	0	2	2	2	-	-	50	100	150

A. COURSE OBJECTIVES

Assist the student's development of employer-valued skills such as teamwork communication and attention to detail. Students should design/develop & fabricate the hardware and/or software system. They may also undertake project involving study and analysis of existing electronics systems in the industry and suggesting modifications for revamping the system.

B. DETAILED SYLLABUS

Not applicable

C. RECOMMENDED TEXT / REFERENCE BOOKS

Not applicable

D. COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Enhance capability to acquire and apply fundamental principles of engineering.
CO2. Aware the development in technologies in recent trends in respective fields.
CO3. Correlate theoretical knowledge in practical to integrate any system.
CO4. Provide an opportunity to implement their ideas for the designing of various system.
CO5. Enhance presentation skills of work done.
CO6. Capability and enthusiasm for self-improvement through continuous professional development and life-long learning
CO7. Enhance teamwork and communication skills in professional fields.
CO8. Communicate efficiently.
CO9. Identify, formulate and model problems and find engineering solution based on a systems approach.
CO10. Awareness of the social, cultural, global and environmental responsibility as an engineer.

E. COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1			2	1	1	2	2		1
CO2	3	3	3	1	2	2	1		2	2		1
CO3	3	3	3	2	2	2	1		2	2		1
CO4	3	3	3	2		2	1		2	2		1
CO5	3	3	3	2	2	2	1	1	2	2		1
CO6	3	3	2			2	1		2	2		1
CO7	3	3	3	1	3	2	1	1	2	2		1
CO8	3	3	3	1	3	2	1	1	2	2		1
CO9	3	3	3			2	1	1	2	2		1
CO10	3	3	3	1	1	2	1	1	2	2		1
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

SYLLABI BOOK

BACHELOR OF TECHNOLOGY
ELECTRONICS & COMMUNICATION ENGINEERING

Department of Electronics & Communication Engineering
Faculty of Technology
Dharmsinh Desai University
Nadiad – 387 001, Gujarat, India.

http://www.ddu.ac.in
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With effect from
2021 - 2022

TEACHING SCHEME FOR THE COURSE
B. TECH. ELECTRONICS & COMMUNICATION
(Admission Year 2021)

B.Tech. Semester-1 (2021-2022)

Subject		Teaching Scheme (Hrs/Week)				Credit	Exam Scheme (Marks)				
		Lect	Tut	Prac	Total		Th.	Int.	TW	Prac.	Total
1	Mathematics-I	3	1	0	4	**4**	60	40	-	-	100
2	Basic Electrical Engineering	3	1	2	6	**5**	60	40	50	-	150
3	Programming for Problem Solving I	4	0	3	7	**5.5**	60	40	50	-	150
4	Engineering Graphics & Design	1	0	4	5	**3**	-	-	100	-	100
5	Software Workshop	0	0	2	2	**1**	-	-	50	-	50
						18.5					**550**

B.Tech. Semester-2 (2021-2022)

Subject		Teaching Scheme (Hrs/Week)				Credit	Exam Scheme (Marks)				
		Lect	Tut	Prac	Total		Th.	Int.	TW	Prac.	Total
1	Mathematics-II	3	1	0	4	**4**	60	40	-	-	**100**
2	Programming for Problem Solving II	4	0	3	7	**5.5**	60	40	50	-	**150**
3	Physics	3	1	2	6	**5**	60	40	50	-	**150**
4	Hardware Workshop	0	0	4	4	**2**	-	-	100	-	**100**
5	English	2	0	2	4	**3**	40	-	50	-	**90**
6	Environmental Studies	2	0	0	2	**0**	40	-	-	-	**40**
						19.5					**630**

B.Tech. Semester-3 (2022-2023)

Subject		Teaching Scheme (Hrs/Week)				Credit	Exam Scheme (Marks)				
		Lect	Tut	Prac	Total		Th.	Int.	TW	Prac.	Total
1	Applied Mathematics	3	1	0	4	**4**	60	40	-	-	**100**
2	Linear Electronics - I	4	0	2	6	**5**	60	40	25	25	**150**
3	Electronic Instrumentation	3	1	2	6	**5**	60	40	25	25	**150**
4	Network Analysis	3	1	2	6	**5**	60	40	25	25	**150**
5	Digital Electronics	3	1	2	6	**5**	60	40	25	25	**150**
6	Mathematical Computing Laboratory	0	0	2	2	**1**	**-**	**-**	**25**	**25**	**50**
						25					**750**

B.Tech. Semester-4 (2022-2023)

	Subject	Teaching Scheme (Hrs/Week)				Credit	Exam Scheme (Marks)				
		Lect	Tut	Prac	Total		Th.	Int.	TW	Prac.	Total
1	Signal & Systems	2	1	2	5	**4**	40	40	25	25	**130**
2	Linear Electronics - II	4	0	2	6	**5**	60	40	25	25	**150**
3	Control Theory	3	1	2	6	**5**	60	40	25	25	**150**
4	Electrical Machines & Power	3	0	2	5	**4**	60	40	25	25	**150**
5	Program Elective - 1	3	1	2	6	**5**	60	40	25	25	**150**
6	Universal Human Values	2	1	0	3	**3**	40	-	-	-	**40**
						26					**770**

B.Tech. Semester-5 (2023-2024)

	Subject	Teaching Scheme (Hrs/Week)				Credit	Exam Scheme (Marks)				
		Lect	Tut	Prac	Total		Th.	Int.	TW	Prac.	Total
1	Microcontroller Applications	4	0	2	6	**5**	60	40	25	25	**150**
2	Electronic Communication	3	0	2	5	**4**	60	40	25	25	**150**
3	Electromagnetic Fields	3	1	0	4	**4**	60	40	50	-	**150**
4	Program Elective - 2	4	0	2	6	**5**	60	40	25	25	**150**
5	Open Elective - 1	1	1	2	4	**3**	-	-	50	-	**50**
6	Electronic Circuits Project	0	0	2	2	**1**	-	-	50	-	**50**
7	Technical Communication	1	1	2	4	**3**	-	-	50	-	**50**
						25					**750**

B.Tech. Semester-6 (2023-2024)

	Subject	Teaching Scheme (Hrs/Week)				Credit	Exam Scheme (Marks)				
		Lect	Tut	Prac	Total		Th.	Int.	TW	Prac.	Total
1	Advanced Microprocessor	4	0	2	6	**5**	60	40	25	25	**150**
2	Communication Systems	3	1	2	6	**5**	60	40	25	25	**150**
3	Digital Signal Processing	3	1	2	6	**5**	60	40	25	25	**150**
4	Microcontroller and IoT Project	0	0	2	2	**1**	-	-	50	-	**50**
5	Program Elective - 3	3	1	2	6	**5**	60	40	25	25	**150**
6	Open Elective - 2	2	0	2	4	**3**	40	-	25	25	**90**
						24					**740**

B.Tech. Semester-7 (2024-2025)

Subject		Teaching Scheme (Hrs/Week)				Credit	Exam Scheme (Marks)				
		Lect	Tut	Prac	Total		Th.	Int.	TW	Prac.	Total
1	Data & Computer Communications	4	0	2	6	**5**	60	40	25	25	**150**
2	Software Project	0	0	2	2	**1**	-	-	50	-	**50**
3	Entrepreneurship and IP Strategy	2	0	0	2	**2**	40	-	-	-	**40**
4	Open Elective - 3	2	1	0	3	**3**	40	-	-	-	**40**
5	Program Elective - 4	3	1	0	4	**4**	60	40	-	-	**100**
6	Program Elective - 5	4	0	2	6	**5**	60	40	25	25	**150**
7	Program Elective - 6	4	0	2	6	**5**	60	40	25	25	**150**
						25					**680**

B.Tech. Semester-8 (2024-2025)

Subject		Teaching Scheme (Hrs/Week)				Credit	Exam Scheme (Marks)				
		Lect	Tut	Prac	Total		Th.	Int.	TW	Prac.	Total
1	Industrial Training Project	0	0	24	24	**12**	-	-	50	300	**350**
2	Seminar	0	6	0	6	**6**	-	-	50	100	**150**
						18					**500**

PROGRAM ELECTIVE OPTIONS

Program Elective – 1

CMOS VLSI Design
Introduction to MEMS
Nano Electronics

Program Elective - 2

Power Electronics
Scientific Computing
Bio-Medical Electronics

Program Elective – 3

Microwave & Antennas
Microwave Theory and Techniques
Satellite Communication

Program Elective - 4

Wireless Communication
High Speed Electronics
Fiber Optic Communication

Program Elective – 5

Image Processing
Wireless Sensor Networks
Digital Switching Systems

Program Elective - 6

Embedded Systems
RF Circuit Design
Adaptive Signal Processing

OPENELECTIVE OPTIONS

Open Elective – 1

Audio Video Engineering
Computer Organization & Architecture
Robotics Engineering

Open Elective – 2

Automated Electronics
Power Plant Automation
Smart Instruments

Open Elective – 3

Coding Theory & Compression Techniques
Error Correcting Codes
Radar and Navigation

B.TECH.SEMESTER–I(EC/CE/IT)

SUBJECT: MATHEMATICS - I

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
3	1	0	4	4	60	40	-	-	100

Reference Code BSC102

COURSE OBJECTIVES

The course is designed to provide the basic concepts and principles of mathematics such as improper integrals, matrices, and calculus. It offers a study to compute surface area and volume, express functions in terms of series, the concepts of matrix algebra, vector differential calculus, and to use it as a tool to solve and analyze the engineering problems.

DETAILED SYLLABUS

[1] CALCULUS

Evaluates and involutes, Evaluation of definite and improper integrals; Beta and Gamma functions and their properties, Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule, Maxima and minima.

[2] MATRICES

Matrices, Vectors: addition and scalar multiplication, matrix multiplication; Rank of a Matrix, Linear systems of equations, Determinants, Cramer's Rule, Inverse of a matrix, Gauss Elimination and Gauss Jordan method.

[3] VECTOR SPACES

Eigenvalues, Eigenvectors, Symmetric, Skew-symmetric, and Orthogonal Matrices, Linear Independence of vectors, Diagonalization.

[4] MULTIVARIABLE CALCULUS (DIFFERENTIATION)

Limit, Continuity and Partial derivatives, Directional derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Vector Differential Calculus; Gradient, curl and divergence.

TEXT / REFERENCE BOOKS

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 40th Edition, 2007.
2) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5) Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

6) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
8) V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Understand the concepts of Beta Gamma function used in applications of engineering problems.
CO2. Describe concepts of vector differential calculus for analysing engineering problem.
CO3. Apply the concept of integral calculus for computing improper integrals, surface area and volumes.
CO4. Analyse system of linear equations of engineering problems and can be solved using concepts of matrices.
CO5. Evaluate the optimum value of function of several variables.
CO6. Evaluate solution of eigenvalues and Eigen vectors of different engineering problems.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2		2			1				
CO2	3	2				1	1					
CO3	2	3	2					1	1			
CO4	3	2	3		2			1	1	1		
CO5	2	3	2	2	2				1	1		
CO6	2	2	3	2								
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – I (EC/CE/IT)

SUBJECT: BASIC ELECTRICAL ENGINEERING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
3	1	2	6	5	60	40	50*	-	150

Reference Code ESC101

*TW Marks includes Viva based on TW

COURSE OBJECTIVES

The course impart an in-depth understanding of the fundamental concepts associated with AC and DC circuit analysis used in electrical and electronic devices using basic circuital laws and Theorems. The course also focuses on the analyse relationship between electric and magnetic circuit, importance of magnetic circuit and performance of electrical machines.

To expose the students to the concepts of various types ofelectrical, electronic and magnetic circuits and their applications.

DETAILED SYLLABUS

[1] DC CIRCUITS

Electrical circuit elements (R, L and C), impact of temperature, voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first order RL and RC circuits.

[2] AC CIRCUITS

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections

[3] ELECTRO-MAGNETIC INDUCTION

Introduction, Magnetic effect of electric current, Current carrying conductor in magnetic field, Law of electromagnetic induction, Induced emf, Self-Inductance (L), Mutual Inductance (M), and Coupling coefficient between two magnetically coupled circuits (K), Inductances in series and parallel.

[4] MAGNETIC CIRCUITS

Introduction, Definition of Magnetic quantities, Magnetic circuit, Leakage flux, Fringing effect, Comparison between magnetic and electric circuits

[5] TRANSFORMERS

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections

[6] ELECTRICAL MACHINES

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited DC motor. Construction and working of synchronous generators, Construction, Principles and working theory and Types of DC Motors & Generators, 1-Ph & 3-Ph Induction Motor, AC Generator

TEXT/ REFERENCE BOOKS

1) Basic Electrical, Electronics and Computer Engineering, R. Muthu Subramanian, S. Salvahanan, K. A. Muraleedharan, 2nd Edition, Tata McGraw Hill

2) Electronics Principles, Albert Paul Malvino, 6th Edition, Tata McGraw Hill

3) Electrical Technology (Vol: II), B. L. Theraja , A. K. Theraja, 23rd Edition, R. Chand & Company

4) Basic Electrical Engineering, D.P. Kothari, I. J. Nagrath, 3rd Edition, Tata McGraw Hill

5) Introduction to VLSI Circuit & Systems, John P. Uyemura, 1st Edition, John Willey & Sons Inc.

6) Basic Electrical Engineering, D.C. Kulshreshtha, 1st Edition, Tata McGraw Hill

7) Electrical and Electronics Technology, E. Hughes, 10th Edition, Pearson

8) Electrical Engineering Fundamentals, V.D. Toro, 2nd Edition, Prentice Hall India

9) Fundamentals of Electrical Engineering, L.S. Bobrow, , Oxford University Press

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Apply basic circuital laws (KVL, KCL and Ohm's) and Theorems (Thevenin's and Norton's) for simplifying the complex resistive network to compute node voltages and loop currents for given excitation.

CO2. Predict the behaviour of any electrical and magnetic circuits. An ability to identify, formulate, and solve magnetic circuit problems in electrical machines

CO3. Analyse Single Phase AC Circuits, compute and demonstrate the waveforms and phasor diagram representation of alternating quantities.

CO4. Design low pass, high pass, band pass and band elimination filter networks, Analyse the frequency response of circuits to show the correlation between time domain and frequency domain response specifications.

CO5. Model the Equivalent Circuit of a Transformer for Performance Analysis

CO6. Analyse 3-Phase circuit (star-delta) and compute power for balanced and unbalanced load.

CO7. Discriminate the constructional details, principle of operation and applications of AC and DC machines.

COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2		2			1				
CO2	3	2				1	1					
CO3	2	3	2					1	1			
CO4	3	2	3		2			1	1	1		
CO5	2	3	2	2	2				1	1		
CO6	2	2	3	2								
CO7	1	2										
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B.TECH. SEMESTER – I (EC/CE/IT)

SUBJECT: PROGRAMMING FOR PROBLEM SOLVING - I

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
4	0	3	7	5.5	60	40	50*	-	150

Reference Code ESC201

*TW Marks includes Viva based on TW

COURSE OBJECTIVES

The objectives of teaching this course are

- To impart in-depth understanding of fundamental programming concepts to build C programs.
- To explain conditional branching, iteration/looping, code reusability and pointers using C Programming Language.
- To demonstrate and teach how to code, document, test, and implement a well-structured C program.

DETAILED SYLLABUS

[1] OVERVIEW OF C

Basic structure of C program, compiling and running C program

[2] CONSTANTS, VARIABLES AND DATA TYPES

Types of constants, basic data types, identifier, variable, enum, symbolic constant, typedef, keywords, overflow and underflow

[3] OPERATORS AND EXPRESSIONS

Arithmetic, relational, logical, assignment, bitwise, and sizeof() operators, operator precedence and associativity, expression evaluation

[4] MANAGING INPUT OUTPUT OPERATIONS

getchar() and putchar() functions, formatted I/O using printf() and scanf()

[5] DECISION MAKING AND BRANCHING

if and if...else statement, nested and ladder if...else, conditional operator, switch statement, goto statement with warning

[6] DECISION MAKING AND LOOPING

while, do...while, and for loops, nested loops, break and continue statements

[7] ARRAYS AND STRINGS

Introduction to arrays, declaration, initialization and access of one-dimensional and two-dimensional arrays, Introduction to multi-dimensional and variable length arrays, declaration and initialization of strings, printing and scanning strings to/from standard I/O, string handling functions, list of strings

[8] USER-DEFINED FUNCTIONS

Function prototype and function declaration, function definition, function call, actual and formal parameters/arguments, return type and return statement, Nested function call, recursion, scope, visibility, and lifetime of variables.

[9] STRUCTURES AND UNIONS

Defining structure, declaring and initializing structure variables, typedef, accessing structure members, copying and comparing structure variables, nested structures, arrays and structures, structures and functions, unions

[10] POINTERS

Introduction, accessing address of a variable, declaration and initialization of pointer variables, Accessing variable using pointer, chain of pointers, scale factor and pointer expressions, pointers and arrays, pointer to array Vs array of pointers, passing arrays and strings to the function, array of pointers, pointers and functions, pointers and structures, const pointer vs pointer to const

TEXT / REFERENCE BOOKS

1) Programming in ANSI C by Balagurusamy, 8th Ed., Tata McGraw Hil
2) Programming with C by Byron Gottfried, 3rd Ed., McGraw Hill Education
3) The C Programming Language by Kernighan and Ritchie, 2nd Ed., PHI Learning
4) Expert C Programming: Deep C Secrets by Peter Van Der Linden, Pearson Education
5) Let Us C by YashvantKanetkar, 12th Ed., BPB Publication
6) Programming in C by Ashok N. Kamthane, 2nd Ed., Pearson Education

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Use and understand language syntax and concepts for C Programming.
CO2. Comprehend and use C Programming concepts to solve algorithmic and logical problems.
CO3. Analyse the given problem and to formulate appropriate C language solution based on definitive language concept(s).
CO4. Design a flowchart or a diagram for given problem and create C programs using decision making, branching, looping, user defined function, array, structure, pointers, etc.
CO5. Apply concepts to write, compile, debug, execute, and document C programs with different test cases using appropriate tool(s).

COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		1	2								
CO2		3			2	2			2		1	1
CO3			2	1	2			2		1	1	1
CO4				3	2	1			1	1		
CO5					3				2			
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B.TECH.SEMESTER–I(EC/CE/IT)

SUBJECT:ENGINEERINGGRAPHICSANDDESIGN

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
1	0	4	5	3	-	-	100*	-	100

Reference Code ESC102

*TW Marks includes Viva based on TW

COURSE OBJECTIVES

The objectives of this course are:

- To Understand the drawing importance in Engineering.
- To Describe the 3-Dimensional object in a different 2-Dimensional view.
- To Develop skills in Reading and Interpretation of Engineering Drawings.
- To enhance drawing skills through hands-on training in a CAD lab using engineering software.

DETAILED SYLLABUS

[1] INTRODUCTION TO ENGINEERING DRAWING

Introduction to Engineering Drawing Covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales –Plain, Diagonal and Vernier Scales.

[2] ORTHOGRAPHIC PROJECTIONS

Orthographic Projections Covering, Principles of Orthographic Projections-Conventions Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

[3] PROJECTIONS OF REGULAR SOLIDS

Projections of Regular Solids Covering, those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

[4] SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS

Sections and Sectional Views of Right Angular Solids Covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

[5] ISOMETRIC PROJECTIONS

Isometric Projections Covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

[6] OVERVIEW OF COMPUTER GRAPHICS

Overview of Computer Graphics Covering, listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software.

[7] CUSTOMIZATION & CAD DRAWING

Customization & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

[8] ANNOTATIONS, LAYERING & OTHER FUNCTIONS

Annotations, layering & other Functions Covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wire frame models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

TEXT / REFERENCE BOOKS

1) Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House

2) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

3) Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

4) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

5) (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES

At the end of the course, students should be able to

CO1. Understand and interpret engineering drawings so that concepts can be communicated graphically more effectively.

CO2. Demonstrate correct usage of methods, concept, and theories to illustrate and solve problems of conics, lines, planes, solids, surfaces, and many more.

CO3. Choose a suitable standard projection method, break down a complex 3D problem into various orthographic and sectional orthographic views, and highlight missing features.

CO4. Practical Exposure to computer-aided software to generate isometric projection and compose standard components of different streams

B.TECH.SEMESTER–I(EC/CE/IT)

SUBJECT:SOFTWAREWORKSHOP

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
0	0	2	2	1	-	-	50*	-	50

Reference Code ESC202

*TW Marks includes Viva based on TW

COURSE OBJECTIVES

Creating sound back ground for use of Linux operating system helps the students for their future endeavor in the study of programming subjects and Project work. By offering this course, the department encourages the student to use Open source software such as Linux OS, Scilab and Latex. The laboratory covers fundamentals and high-level architecture of Linux operating system. The laboratory offers hands-on experience for Linux Installation, various commands and driver installation. Hands on experience for writing pseudo code for given problem and writing shell scripts are inclusive in this study. The broad objective of this course is to understand the basic concepts of Linux OS and study the usages of Linux commands. Also to understand the basics of C programming language

DETAILED SYLLABUS

[1] OPERATINGSYSTEMBASICS

Introduction to Operating System and Linux Architecture

[2] SOFTWAREINSTALLATION

Installation of open source/freeware software using package manager for programming/simulation.

[3] SHELLCOMMANDS

Linux usage, commands & shell scripting. Command structure and general purpose utility

[4] FILE HANDLING

basic of file handling. The file system, Handling ordinary files, File attributes and permission, file system details

[5] SHELLSCRIPTING

Basic Shell commands, Looping and Branching,

[6] SHELLUTILITIES

Find command and shell, simple filters, advance filters.

[7] EDITORS

VI editor for basic text editing, LATEX for scientific documents and report writing.

TEXT / REFERENCE BOOKS

1) Unix : Concepts and Applications, Sumitabha Das, 4th Edition, Tata McGraw Hill

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Store files, surf internet, carry out documentation work using Linux OS and Use Linux commands to perform file management and data security tasks.
CO2. Create articles and reports having multiple chapters and references using Latex typesetting.
CO3. Install open source software such as drivers of Hardware devices as well as other application like Scilab for mathematical computation.
CO4. Develop pseudo code for given problem statements.
CO5. Develop various shell scripts for any given problem statements along with use of filters.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2				3			3		1		3
CO2	2	2			3					1		
CO3					3	3				3		
CO4	2				3			3		1		3
CO5	2	2			3					1		
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER II (EC/CE/IT)

SUBJECT:MATHEMATICS-II

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
3	1	0	4	4	60	40	0	0	100

Reference Code BSC301

COURSE OBJECTIVES

The course is designed to understand and apply the basic concepts of first order and higher order differential equations, numerical methods, Laplace transforms, multiple integrals, and vector integral calculus. It covers solving the initial value problems to address engineering applications.

DETAILED SYLLABUS

[1] FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS AND INTRODUCTION TO HIGHER ORDER DIFFERENTIAL EQUATIONS

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type, second order linear differential equations with variable coefficients, Method of variation of parameters, Cauchy-Euler equation.

[2] NUMERICAL METHODS

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods, Runge-Kutta method of fourth order for solving first order equations, Solution of algebraic and transcendental equations: Newton Raphson's Method, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

[3] MULTIVARIABLE CALCULUS (INTEGRATION)

Multiple Integration: Double integrals (Cartesian), Change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Triple integrals (Cartesian), Scalar line integrals,Vector line integrals, Scalar surface integrals, Vector surface integrals, Theorems of Green, Gauss and Stoke's.

[4] LAPLACE TRANSFORM

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions, Finding inverse Laplace transform by different methods, Convolution theorem. Evaluation of integrals by Laplace transform, Solving ODE by Laplace Transform method.

TEXT / REFERENCE BOOKS

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 40th Edition, 2007.
2) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Ed.,Pearson, 2002.
3) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4) W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.

5) S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
6) E. A. Coddington, An Intro. to Ordinary Differential Equations, Prentice Hall India, 1995.
7) J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc- Graw Hill, 2004.
8) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Understand effective mathematical tools for the solution of first order ordinary differential equations.
CO2. Extend their learning of differential calculus: Methods to solve and analyse higher order differential equations.
CO3. Analyse and evaluate the accuracy of common numerical methods such as Newton's Raphson's, False position and so on.
CO4. Derive numerical methods for integration and the solution of linear and nonlinear differential equations.
CO5. Evaluate and Differentiate multivariate functions in all directions such as differentiation, integration and solve applied problems involving vector-valued functions.
CO6. Investigate ordinary differential equations using Laplace transform.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2				3			3		1		3
CO2	2	2			3					1		
CO3					3	3				3		
CO4	2				3			3		1		3
CO5	2	2			3					1		
CO6					3	3				3		
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – II (EC/CE/IT)

SUBJECT: PROGRAMMING FOR PROBLEM SOLVING - II

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
4	0	3	7	5.5	60	40	50*	-	150

Reference Code ESC201

*TW Marks includes Viva based on TW

COURSE OBJECTIVES

To make students familiar with the difference between object-oriented programming and procedural programming. In addition, the student should acquire skills for programming using advanced C++ features such as composition of objects, operator overloading, dynamic memory allocation, inheritance and polymorphism, file I/O, exception handling, etc.

DETAILED SYLLABUS

[1] BASICS OF C++

Overview, Program structure, keywords, identifiers, constants, data types, symbolic constants, declaration of variables, operators, namespaces, control structures, dynamic memory – C style – malloc(), calloc(), realloc() and free() Vs C++ style - new and delete keywords, reference and pointer

[2] FUNCTIONS IN C++

main function (variations in signature), function prototype, inline functions, call and return by reference, default parameters, function overloading

[3] INTRODUCTION TO OBJECT ORIENTED PROGRAMMING

Procedural Vs Object Oriented Programming, Principles of OOP, Benefits and applications of OOP

[4] CLASSES AND OBJECTS – ENCAPSULATION AND ABSTRACTION

Introduction, private and public members, Defining member functions, static members, Objects as function arguments and return type, friend functions, const member functions, Constructors and their types, Destructor, Operator overloading, type conversion

[5] INTRODUCTION TO C++ STRING CLASS

[6] INHERITANCE

Introduction, types of inheritance – single, multiple, multilevel, hierarchical, and hybrid inheritance, Protected members, overriding, virtual base class

[7] POLYMORPHISM

Introduction, Pointers and Objects, this pointer, pointer to derived classes, virtual and pure virtual functions, dynamic binding

[8] INPUT/OUTPUT

Introduction to streams, standard I/O stream objects, stream classes, unformatted and formatted I/O, manipulators

[9] EXCEPTION HANDLING

Basics of exception handling, try-catch-throw, rethrowing exceptions, user defined exceptions

[10] TEMPLATES

Basics of class templates and function templates

TEXT / REFERENCE BOOKS

1) Object-Oriented programming with C++, Seventh Ed., by E Balagurusamy, TMH publication
2) The C++ Programming Language, Fourth Ed., by Bjarne Stroustrup, Addison-Wesley publication
3) Object-Oriented Programming in C++, Fourth Edition, by Robert Lafore, SAMS publication
4) Accelerated C++: Practical Programming by Example, First Edition, by Andrew Koenig and Barbara E. Moo, Addison-Wesley publication
5) C++ Black Book, First edition, by Steven Holzner, Paraglyph Press
6) C++: The Complete Reference, Fourth Edition, by Herbert Schildt, McGraw Hill Education

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Design and analyse the programming applications using object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design.
CO2. Define the solutions for real-time problems using Object Oriented concepts.
CO3. Apply advanced features of C++ specifically stream I/O, templates and operator overloading which influences the performance of programs.
CO4. Design object oriented software solutions for small systems involving multiple classes and objects. Implement solutions in C++.
CO5. Test and debug C++ implementations. Apply generic programming for real time applications
CO6. Explain the benefits of object oriented design and understand when it is an appropriate methodology to use.
CO7. Classify procedural, non-procedural and object oriented programming language.
CO8. Analyse the process of handling errors or exceptions.
CO9. Apply advanced features of C++ specifically Inheritance, and polymorphism which exhibit the opportunity to reuse the code functionality and fast execution time

COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3			1			1	2
CO2	3	3	3	2	3			1			1	2
CO3	3	3	3	2	3			1			1	2
CO4	3	3	3	2	3	1		1			1	2
CO5	3	3	3	2	3			1			1	2
CO6	3	2	3	2	3		2	1			1	2
CO7	3	1	3	2	3			1			1	2
CO8	3	3	1	2	3			1			1	2
CO9	3	3	3	2	3			1			1	2
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER II (EC/CE/IT)
SUBJECT:PHYSICS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
3	1	2	6	5	60	40	50*	-	150

Reference Code BSC101

*TW Marks includes Viva based on TW

COURSE OBJECTIVES

The course provide the in-depth understanding of the concepts associated with Semiconductor, Optoelectronics, Communication, Oscillators and Basic Switching devices. It also serves the basic design ideas around rectification and amplification. The course focuses on modulation techniques and its components. The overall aspects of basic physics application in electronics with practical approach are covered in this subject. This course also includes the analog modulation & demodulation techniques (AM, FM and PM) and digital modulation (ASK, FSK and PSK).

DETAILED SYLLABUS

[1] SEMICONDUCTORS

Intrinsic and extrinsic semiconductors, Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic & other devices.

[2] DIODE

Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator, Special purpose diodes.

[3] LIGHT-SEMICONDUCTOR INTERACTION

Radiative transitions and optical absorption, LED and LASER, Photo detectors.

[4] ACTIVE COMPONENTS AND APPLICATIONS

BJT:Structure and input-output characteristics of a BJT, The Unbiased Transistor, Transistor Currents , Biased Transistor, a single stage voltage divider biasing, Emitter Bias, The CE Connections, The Base Curve, Collector curve, Transistor approximation Variation in current Gain, The Load Line, The Operating point, Recognizing Saturation, BJT as a switch & Amplifiers, LED Drivers.

[5] OSCILLATORS

General form of oscillator, Sinusoidal oscillator, phase shift oscillator, Crystal Oscillator.

[6] MOSFET

MOS physics and mode of operations, nFET current-voltage relationship, MOS pass characteristics and CMOS inverter, Dynamic RAM (DRAM) 1T bit-cell.

[7] FIBER OPTICS

Fiber Optics and Optoelectronics, Historical Developments, A Fiber-Optic Communication System, Advantages of Fiber-Optic Systems, Ray Propagation in Optical Fibers, Fundamental Laws of Optics, Ray Propagation in Step-Index Fibers, Ray Propagation in Graded-Index Fibers

[8] COMMUNICATION SYSTEMS

Communication system components, Analog modulation- AM, FM,PM. Digital modulation- ASK, FSK, PSK

TEXT / REFERENCE BOOKS

1) Electronics Principles, Albert Paul Malvino, 6thEdition, Tata McGraw Hill
2) David Griffiths, Introduction to Electrodynamics
3) S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4) R.P Khare, Fiber Optics and Optoelectronics, Oxford University Press
5) Sanjay Sharma, Communication Systems: Analog and Digital
6) Halliday and Resnick, Physics
7) W. Saslow, Electricity, magnetism and light
8) Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
9) B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
10) Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
11) P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997)
12) Behrouz A. Forouzan, Data communication and networking.
13) B. P lathi, Modern Digital and Analog Communication Systems, Third edition.

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Illustrate intrinsic and extrinsic semiconductors and their applications. Demonstrate carrier generation and recombination.
CO2. Design half wave, full wave rectifier circuit and voltage regulator circuit using Zener diode, PN diode and NPN, PNP transistors.
CO3. Analyze Transistor input output characteristics, biasing circuits, Compute load line and calculate the operating point. Identify the working region of the transistor circuit. Implement a transistor as a switch.
CO4. Analyze structure of the oscillator. Discriminate Sinusoidal oscillator, Phase shift oscillator and Crystal oscillator.
CO5. Assess the performance & characteristics of Opto-electronic semiconductor devices like LED, LASER, Photo detectors
CO6. Devising the ray optics propagation in step index and graded index fiber. Synthesizing the use of optoelectronics in fiber optic communications.
CO7. Relating the requirement of modulation. Comparison of analog and digital modulation techniques with the needs of system components. Illustrating and relating AM, FM, PM, ASK, FSK, PSK modulation techniques with their diagrams.
CO8. Distinguish the behaviour of NMOS, PMOS, CMOS, DRAM, for their VI characteristics

and review those with effects of doping, temperature and regulation.

COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-							
CO2	3	3	3	-	1							
CO3	3	3	2	2	-							
CO4	2	3	2	-	1							
CO5	2	2	2	-	1							
CO6	2	2	3	2	-							
CO7	2	3	1	1	-							
CO8	2	2	2	2	-							
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER II (EC/CE/IT)
SUBJECT:HARDWAREWORKSHOP

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
0	0	4	4	2	-	-	100*	-	100

Reference Code ESC202

*TW Marks includes Viva based on TW

COURSE OBJECTIVES

Operating the test and measuring electronic instruments is essential in the entire study of electronics and communication branch. Study of circuit simulators, PCB design software, Raspberry pi and Arduino boards help student in creating foundation for development of successful projects in higher semesters. Course covers study and hands on test and measuring instruments, operation of Raspberry pi and Arduino boards, circuit implementation on bread boar and simulators, Linux operating system and website development.

DETAILED SYLLABUS

[1] ELECTRONICCOMPONENTS

Digital Multi-meter, Power Supply, Function Generator, Cathode Ray Oscilloscope, Digital Oscilloscope, Measurement of Phase Difference in single phase circuit, Various Electrical and Electronics component like LED, LDR, Photo-diode, MOSFET, MCB and Relay.

[2] COMPUTERHARDWARE

Introduction to a personal computer and its basic peripherals, installation of Operating System Software and the required device drivers. Students are suggested to perform similar tasks on the Laptop scenario wherever possible.

[3] PERIPHERALS

Programming of Computer Ports & Interfacing of Electronic Components, Cables and Connectors like RJ45, RS232 and CRO probe.

[4] INTERNET

Introduction to Internet & World Wide Web modules, Making a PC Internet ready: Introduction to Internet and TCP/IP, Ethernet Connection, WiFi connection, configure TCP/IP (IP, Gateway, DNS, and Proxy), and use of ping command, Information sharing and data transfer over Local Area Network and Internet.

[5] WEBINFRASTRUCTURE

Basic Components of Web Sites, Front end & back end tools and technology. HTML & CSS, Developing, Configuring and deploying a website.

[6] IOTBOARDSANDCIRCUITSIMULATION

Introduction to IOT boards like Arduino, Raspberry Pie etc. Interfacing, Circuit designing and PCB designing.

[7] MINIPROJECT

Student will develop a mini project related to the topics listed above.

TEXT / REFERENCE BOOKS

1) Electronic Components and Materials Principles, Dr.MadhuriA Joshi, 2nd Edition, Shroff Publishers & Distributors PVT. LTD.

2) A Textbook of Computer Hardware and Networking, JyotikaDeshmukh, D J Publications

3) Learning Web Design, Jennifer Robbins, 4th edition, O'Reilly Media

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Operate Power supplies, Function Generators, Cathode Ray Oscilloscope and Digital Storage Oscilloscope to provide dc bias and observe the circuit parameters. Confidently

CO2. Implement given circuit on NI-Multisim circuit simulator, on bread board and using Proteous PCB designing software prepare physical PCB for hardware project (fixed DC power supply , water level detector)

CO3. Understand the usage of BNC, USB, RS232, RJ45, VGA, and HDMI connectors and make CRO probe and LAN cable using necessary wires and connectors

CO4. Install Linux OS and the required drivers, and configure the network connection to transfer a file over LAN or Internet and Operate Arduino and Raspberry Pi IoT boards.

CO5. Understand the basic components of a websites and develop a website using HTML and CSS.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3				3	1	1	1	1	1		2
CO2	2				3	1	1	1	1	1		1
CO3	3	2	3		3	1	1	1	1	1		2
CO4	2		3		3	1	1	1	1	1		1
CO5	3	2	3		3	1	1	1	1	1		2
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B.TECH. SEMESTER II (EC/CE/IT)

SUBJECT:ENGLISH

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
2	0	2	4	3	40	-	50*	-	90

Reference Code HSMC201

*TW Marks includes Viva based on TW

COURSE OBJECTIVES

This course will help students of engineering develop their Linguistic skills. Beginning with Vocabulary Building the course proceeds towards the Sentence Formation and Paragraph Formation which will help them to enhance their Writing skills and Communicative skills as well. Understanding the common errors, and nature and style of writing will mould students' Writing competency for their professional growth in the world of competition. Understanding Paralinguistic features like stress, intonation, rhythm and so on will improve their Speaking skills to be efficient and confident for academic and professional purposes.

DETAILED SYLLABUS

[1] VOCABULARY BUILDING

The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.

[2] BASIC WRITING SKILLS

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

[3] IDENTIFYING COMMON ERRORS IN WRITING

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés

[4] NATURE AND STYLE OF SENSIBLE WRITING

Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion

[5] WRITING PRACTICES

Comprehension, Précis Writing, Essay Writing

[6] ORAL COMMUNICATION

(This unit involves interactive practice sessions in Language Lab) Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common, Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations

TEXT / REFERENCE BOOKS

1) Practical English Usage. Michael Swan. OUP. 1995.
2) Remedial English Grammar. F.T. Wood. Macmillan.2007
3) On Writing Well. William Zinsser. Harper Resource Book. 2001
4) Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5) Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Understand the vocabulary and their root forms to enhance vocabulary level
CO2. Enhance their Writing in effective way
CO3. Rectify common errors in their Speaking and Writing
CO4. Develop efficiency in writing
CO5. Be competent at Public Speaking and Interviews
CO6. Acquire Proficiency in all four skills of Language

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3				3	1	1	1	1	1		2
CO2	2				3	1	1	1	1	1		1
CO3	3	2	3		3	1	1	1	1	1		2
CO4	2		3		3	1	1	1	1	1		1
CO5	3	2	3		3	1	1	1	1	1		2
CO6	2		3		3	1	1	1	1	1		1
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – II (EC/CE/IT)
SUBJECT: ENVIRONMENTAL STUDIES

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Pract.	Total
2	0	0	2	0	40	--	--	--	40

Reference Code MC-II

COURSE OBJECTIVES

Identify and analyze the current issues related to environment and propose appropriate economical solutions for sustainable developmental activities.

DETAILED SYLLABUS

[1] THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, scope and importance & Need for public awareness

[2] NATURAL RESOURCES

Renewable and non-renewable resource: Natural resources and associated problems**,** Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams, and their effects on forests and tribal people ,Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefit and problems, Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies, Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Role of an individual in conservation of natural resources. Equitable use of resources of sustainable lifestyles

[3] ECOSYSTEMS

Concept of an ecosystem, Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

[4] BIODIVERSITY AND ITS CONSERVATION

Introduction definition: Genetic, species and ecosystem diversity,Bio-geographical classification of India, Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity, habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity

[5] ENVIRONMENTAL POLLUTION

Definition, Causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste management, causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides

[6] SOCIAL ISSUES AND THE ENVIRONMENT

From unsustainable to sustainable development, Urban problems related to energy,Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people: its problems and concerns. Case studies, Environmental ethics: Issues and possible solutions, Climate change: Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies, Wasteland reclamation, Consumerism and waste products, Environment Protection Act: Air (Prevention and Control of Pollution) Act, Water (Prevention &Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness

[7] HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations, population explosion, Family Welfare Program, environment and human health, human rights, Value education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environmental and human health, Case studies

[8] FIELD WORK

Visit to a local area to document environmental assets (river/forest/grassland/hill/mountain), Visit to a local polluted site - Urban/Rural/Industrial/Agricultural, Study of common plants, insects, birds, Study of simple ecosystems – pond, river, hill, slopes etc.

TEXT / REFERENCE BOOKS

1) ErachBharucha Textbook of Environmental Studies; Second Edition, Universities Press: Hyderabad, 2013.

2) Rajagopalan, R. Environmental Studies; Oxford University Press: India, 2015.

3) Varandani, N. S. Basics of Environmental studies; Lambert Academic Publishing: Germany, 2013.

4) Rao, C. S. Environmental Pollution Control Engineering; Wiley publishers: New Delhi, 2006.

5) Clark, R. S. Marine Pollution; Clanderson Press Oxford: Bath, 2001.

6) Cunningham, W.P.; Cooper; Gorhani, T. H. E.; Hepworth, M.T., Environmental Encyclopedia; Jaico Publ. House: Mumbai, 2001.

7) De, A. K. Environmental Chemistry; Wiley Eastern: New Delhi, 2006.

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

CO2. Identify, formulate, review research literature, and analyse complex engineering problems

reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

CO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

CO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems

CO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

CO6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

CO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3				3	1	1	1	1	1		2
CO2	2				3	1	1	1	1	1		1
CO3	3	2	3		3	1	1	1	1	1		2
CO4	2		3		3	1	1	1	1	1		1
CO5	3	2	3		3	1	1	1	1	1		2
CO6	2		3		3	1	1	1	1	1		1
CO7	2		3		3	1	1	1	1	1		1
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – III (EC)
SUBJECT: APPLIED MATHEMATICS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	-	-	100

COURSE OBJECTIVES

The course is designed to provide comprehensive knowledge of complex numbers, linear differential equations of higher order, and partial differential equations for solving the initial value problems. It focuses on in-depth understanding of concepts associated with probability, discrete and continuous probability distributions, and relationship between independent variable and dependent variable. This course is extensively useful in engineering and its applications.

DETAILED SYLLABUS

[1] PROBABILITY AND STATISTICAL METHODS

Probability, permutation, combination, total probability, conditional probability, Baye's theorem, binomial distribution, Poisson distribution, normal distribution, uniform distribution, calculation of errors: probable error and standard error, coefficient of correlation, rank correlation, lines of regression.

[2] COMPLEX NUMBERS

Definition, elementary operations, properties, Argand diagram, modulus, amplitude, De-Moivre's theorem, expand $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ in powers of $\sin\theta$, $\cos\theta$, and $\tan\theta$ respectively, expand $sin^m\theta$, $cos^m\theta$, $or sin^m\theta \cdot cos^m\theta$ in a series of sines or cosines of multiples of θ.

[3] LINEAR DIFFERENTIAL EQUATIONS & IT'S APPLICATION

Linear differential equations of higher order with constant coefficients, equations reducible to linear equations with constant coefficients, simultaneous linear equations with constant coefficients, application to engineering problems: electric circuits.

[4] PARTIAL DIFFERENTIAL EQUATIONS

Introduction, formation, equations solvable by direct integration, solution of linear equations of first order, and non-linear equations of first order, Charpit's method, homogenous linear equations with constant coefficient, rules to find the complementary function and the particular integral, non-homogenous linear equations with constant coefficients.

TEXT / REFERENCE BOOKS

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 40th Edition,2007.
2) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint,2010.
4) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2010.

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Understand and represent the complex numbers in Argand diagram.
CO2. Analyse and understand the basic concepts and terminologies of probability and probability distribution functions.
CO3. Evaluate and examine the linear regression between two variables.
CO4. Extend their learning of differential calculus: methods to solve and analyse the higher order differential equations.
CO5. Model physical processes using ordinary and partial differential equations and characterize the solution of initial value problem.
CO6. Investigate and apply the ordinary differential equations in engineering problems.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3				3	1	1	1	1	1		2
CO2	2				3	1	1	1	1	1		1
CO3	3	2	3		3	1	1	1	1	1		2
CO4	2		3		3	1	1	1	1	1		1
CO5	3	2	3		3	1	1	1	1	1		2
CO6	2		3		3	1	1	1	1	1		1
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – III(EC)

SUBJECT: LINEAR ELECTRONICS – I

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

COURSE OBJECTIVES

Devices such as diodes, transistors, FETs, MOSFETs are the building blocks of electronic circuits. Electronic devices have become an important part of our day-to-day life. Consumer electronics products such as refrigerators, washing machines, gadgets like mobile phones, laptops, calculators are based on these devices(either discrete or in a chip form). Similarly industrial electronics, industrial automation and motion control, medical applications etc. are not possible without these electronic devices. So clear understanding of these devices is necessary. In this subject the physics of these devices, characteristics of these devices and the basic applications are covered. The objective of this course is to offer a detail understanding of the basic physical structure, principles of operation, electrical characteristics and circuit models of semiconductor devices like, various diodes, BJT, FET and fabrication of integrated-circuits.

DETAILED SYLLABUS

[1] SEMICONDUCTOR DIODE

Mobility and conductivity, Mass-action law, Charge densities in a semiconductor, Generation and recombination of charges, Diffusion, The continuity equation, Injected minority carrier charge, Potential variation within graded semiconductor, The Temperature Dependence of the V/I Characteristics, Diode Resistance, Space- Charge, or Transition Capacitance CT, Charge controlled Description, Diffusion Capacitance, Junction Diode Switching Times, Breakdown Diodes, Tunnel Diodes, Sampling gate.

[2] BIPOLAR JUNCTION TRANSISTORS

Introduction to Transistor, Transistor Switching Times, ,Transistor Hybrid Model, The h Parameters, Analysis of Transistor Amplifier Circuit Using h Parameters, Conversion Formula For The Parameters of the Three Transistor Configurations, The Hybrid Pi Common Emitter Transistor Model at high Frequency, Hybrid Pi Conductance's, Hybrid Pi Capacitances, Step Response of an Amplifier, Bandpass of Cascaded Stages.

[3] TRANSISTOR BIASING & THERMAL STABILIZATON

The Operating Point of a BJT, Bias Stability, Self-Bias or Emitter Bias, Stabilization against Variations in Ico, VBE and β, Bias compensation, biasing technique for linear integrated circuits, Thermistor &Sensistor Compensation

[4] FIELD EFFECT TRANSISTOR

Construction & characteristics of JFETs, Transfer characteristics, Depletion type MOSFET, MOS Device structure, physical operation, VI characteristics, MOSFET circuits at DC, MOSFET as an Amplifier and switch, Biasing, Small signal operation and Models, Single stage MOS amplifiers Common Gate, Common Source, Common Drain

[5] FREQUENCY RESPONSE OF AMPLIFIERS

MOSFET internal capacitance and high frequency Model, Frequency Response of CS amplifier, MOSFET Current mirror circuits, Miller's theorem, CMOS Implementation of CS amplifier, Cascode amplifiers, CS with source degeneration

TEXT / REFERENCE BOOKS

1) Integrated Electronics, Jacob Millman& Christos C. Halkias, 1st Edition, Tata McGraw Hill
2) Electronic Devices &Circuit Theory, Robert L. Boylstead&LouisNashelsky, 8th Edition, Prentice Hall of India.
3) Integrated Circuits, K. R. Botkar, 9th Edition, Khanna Publications

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Student can compute the maximum temperature; a reverse biased diode can tolerate for a given reverse bias voltage and wattage capacity of the diode
CO2. Student can design a voltage regulator circuit for a given output voltage and load current
CO3. Student can compute transistor amplifier's voltage gain, current gain, input impedance, and output impedance using h parameters values of a given transistor.
CO4. Student can design a self-bias circuit for a given spread in Ico, VBE and β of a transistor for a given maximum variation in operating point.
CO5. Student can design biasing circuits for FETs.
CO6. Student can calculate voltage gain, input resistance, and output resistance for a given MOS amplifier circuit.
CO7. Student can calculate higher cut off frequency and lower cut off frequency in order to obtain the bandwidth of amplifier.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	-	-	-	-	1	-	1	-	-
CO2	3	1	3	-	-	-	-	1	-	1	-	-
CO3	3	3	-	-	-	-	-	1	-	1	-	-
CO4	3	2	3	-	-	-	-	1	-	1	-	-
CO5	3	2	3	-	-	-	-	1	-	1	-	-
CO6	3	2	3	1	-	-	-	1	-	1	-	-
CO7	3	2	3	-	-	-	-	1	-	1	-	-
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – III (EC)
SUBJECT: ELECTRONICS INSTRUMENTATION

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	2	5	5	60	40	25	25	150

COURSE OBJECTIVES

Troubleshooting of electronic circuits is an essential requirement of service sector industry. This course will develop skills for measurement of electrical parameters of various systems using measuring instruments. Students will analyse construction, operation & design of Voltmeters, Ohmmeters, Ammeters, Power factor meter, Energy meter, Instrument transformer, CRO, DSO, transducers for temperature, pressure, level and flow measurement, P, PI PD and PID controller. Moreover, they can design and analysis fundamental method for measurement of resistance, inductance, capacitance and frequency. The objective of this course is to offer profound understanding of operating principles, working and applications of various instruments for measurement of electrical parameters with reference to electrical & electronic systems.

DETAILED SYLLABUS

[1] DIRECT-CURRENT INDICATING INSTRUMENTS

Suspension Galvanometer, Torque and Deflection of the Galvanometer, Permanent-Magnet Moving Coil Mechanism, DC Ammeters, DC Voltmeters, Voltmeter Sensitivity, Voltmeter-Ammeter Method of Measuring Resistance, Series-Type Ohmmeter Shunt-Type Ohmmeter, Multimeter or VOM, Calibration of DC Instruments, Alternating-Current Indicating Instruments, Thermo Instruments, Electrodynamometers in Power Measurements Watt-hour Meter, Power-Factor Meter, Instrument Transformers.

[2] BRIDGES AND THEIR APPLICATION

Introduction, Wheatstone Bridge, Kelvin Bridge, Guarded Wheatstone Bridge, AC Bridges and their Application, Comparison Bridges, Maxwell Bridge, Hay Bridge, Schering Bridge, Unbalance Conditions, Wien Bridge, Wagner Ground Connection, Potentiometer.

[3] ELECTRONIC INSTRUMENTS FOR MEASURING BASIC PARAMETERS

Amplified DC Meter, AC Voltmeter using Rectifiers, True RMS- Responding Voltmeter, Electronic Multimeter, Considerations in Choosing an Analog Voltmeter, Differential Voltmeters, Digital Voltmeters, Component Measuring Instruments, Q Meter, Vector Impedance Meter, Vector Voltmeter, RF Power and Voltage Measurement.

[4] OSCILLOSCOPES

Introduction, Oscilloscope, Block Diagram, Cathode Ray Tube, CRT Circuits, Vertical Deflection System, Delay Line, Multiple Trace, Horizontal Deflection System, Oscilloscope Probes and Transducers, Oscilloscope Techniques, Special Oscilloscopes.

[5] CONTROL ACTIONS AND CONTROLLERS

Control Actions like P, PI, PD & PID, Electronic Controllers, Characteristics of Different types of Control Valves.

[6] INDUSTRIAL INSTRUMENTATION

Measurement Schemes for Temperature, Pressure, Level & Flow with their Industrial Applications, Distributed Control System (DCS), and Programmable Logic Controller.

TEXT / REFERENCE BOOKS

1) Electrical & Electronic Measurement & Measuring Instruments, A. K. Sawhney, 17th Edition, Dhanpat Rai & Co.

2) Electronic Instrumentation and Measurement Technique, Wlliam D. Cooper & Albert D. Helfrick, 5thEdition , Prentice Hall of India

3) Electronics Measurement & Instrumentation, R. K. Rajput, 1st Edition, Prentice Hall of India

4) Electronic Instrumentation, H. S. Kalsi, 2nd Edition, Tata McGraw Hill

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Design & analyse DC Ammeter, DC Voltmeter, Series type ohmmeter and Shunt type ohmmeter for given specification.

CO2. Analyse construction & operation of instrument for measuring voltage, current, power factor and energy.

CO3. Design & analyse Wheatstone bridge and kelvin's double bridges for measurement of low & medium value of resistance.

CO4. Design & analyse AC bridges for measurement of primary and secondary parameters of components.

CO5. Compare and select amplified DC meter, AC voltmeter using rectifier, True rms responding voltmeter and electronic Multimeter for improving accuracy of measurement.

CO6. Illustrate the operation of various oscilloscope for measuring voltage, frequency and phase.

CO7. Describe the working principle, of level, flow pressure and temperature measurement transducer.

CO8. Compare P, PI, PD & PID, PLC & DCS and design ladder logic for PLC controller

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2	3				3	1		1
CO2	3	1										1
CO3	3	3	3	2	3				3	1		1
CO4	3	3	3	2					3	1		1
CO5	3	1										1
CO6	3	3			3							1
CO7	3	1	1									1
CO8	3	2	3				1					1
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – III (EC/IC)
SUBJECT: NETWORK ANALYSIS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	2	5	5	60	40	25	25	150

COURSE OBJECTIVES

This course is designed to provide a complete overview of electric circuit analysis used in electronics engineering. The students can analyse electrical networks by understanding application of basic laws, theorems and transforms. The concept of this subject is useful to the students for understanding the concept of stability of the circuit and its frequency domain analysis. The students can inculcate capability to analyze electrical networks by understanding basic laws, theorems and transforms.

DETAILED SYLLABUS

[1] DEVELOPMENT OF THE CIRCUIT CONCEPT
Introduction, Charge and Energy, The Relationship of Field and Circuit Concepts, The Capacitance Parameter, The Inductance Parameter, The Resistance Parameter, Units and scaling, Approximation of a Physical System as a circuit.

[2] CONVENTIONS FOR DESCRIBING NETWORKS
Reference Directions for Current and Voltage, Active Element Conventions, the Dot Convention for Coupled Circuits, Topological Description of Networks.

[3] NETWORK EQUATIONS
Kirchhoff's Laws, The Number of Network Equations, Source Transformations, Examples of the Formulation of Network Equations Loop Variable Analysis, Node Variable Analysis, Determinants: Minors and the Gauss Method, Duality.

[4] FIRST ORDER DIFFERENTIAL EQUATIONS
General and particular solutions, Time constants, the integrating factor, More Complicated Networks.

[5] INITIAL CONDITIONS IN NETWORKS
Why Study Initial Conditions? Initial Conditions in Elements, Geometrical Interpretation of Derivatives, A Procedure for Evaluating Initial Conditions, Initial State of a Network.

[6] DIFFERENTIAL EQUATIONS
Second order equations, Internal Excitation, Higher order equations ;Internal Excitation, Networks Excited by External Energy Sources, Response as related to the s-Plane Location of Roots, General Solutions in terms of S,Q and ωn.

[7] THE LAPLACE TRANSFORMATION
Introduction, The Laplace Transformation, Some Basic Theorems for the Laplace Transformation, Examples of the solution of problems with the Laplace Transformation, Partial Fraction Expansion, Heaviside's Expansion Theorem, Examples of Solutions by the Laplace Transformation.

[8] TRANSFORMS OF SPECIAL SIGNAL WAVEFORMS

The Shifted Unit Step Function, The Ramp and impulse Functions, Waveform Synthesis, The Initial and Final Value of f (t) from F(s), The Convolution Integral, Convolution as Summation.

[9] IMPEDANCE FUNCTIONS AND NETWORK THEOREMS

The concept of Complex Frequency, Transform Impedance and Transform Circuits, Series and Parallel Combinations of Elements, Superposition and Reciprocity, Thevenin's Theorem and Norton's Theorem.

[10] NETWORK FUNCTIONS: POLES AND ZEROS

Terminal Pairs or Ports, Network Functions for One Port and Two port. The Calculation of Network Function (1) Ladder Networks (2) General Networks, Poles and Zeros of Network Functions, Restrictions on Pole and Zero Locations for Driving-Point Functions, Restrictions on Pole and Zero locations for Transfer Functions, Time-domain Behaviour from the Pole & zero plot, Introduction to band pass, low pass, high pass and band reject filters.

[11] TWO PORT NETWORKS

Relationship of two port variables, short circuit admittance parameters, the open circuit impedance parameters, transmission parameters, the hybrid parameters, relationship between parameter sets, parallel connection of two port networks.

TEXT / REFERENCE BOOKS

1) Network Analysis, M.E. Van Valkenburg, 3rd Edition, Prentice Hall of India Private Limited
2) Network Analysis and Synthesis, U. A. Patel, 3rd Edition, Mahajan Publication House.
3) Circuit Theory - Analysis & Synthesis, A. Chakraborty, 1st Edition, Dhanpatrai publication

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Apply KVL, KCL and Ohm's Laws to complex RLC networks to find response in any part of the network in form of node voltages and loop currents for given excitation
CO2. Compute response of the network for given excitation using classical (solving differential equations) as well as transform methods
CO3. Understand behaviour of mutually coupled coils and determine direction of induced current using dot convention
CO4. Design RLC series network to generate response with specific frequency for given step input.
CO5. Use Laplace transform method to find out response of the network to given waveforms
CO6. Apply Thevenin's and Norton's theorem to complex RLC networks in order to simplify the network and determine load voltage / current.
CO7. Find out two port parameters for given passive network and determine existence of reciprocity and symmetry of the network and also find out over all parameters for series or cascade connected individual networks.
CO8. Design stable electrical network with the help of poles and zeros.

COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2					2					2
CO2	3	2								1		
CO3	1	3					1					2
CO4	3	2						2		1		
CO5	3	3										1
CO6	2	2	3	2			3					
CO7	1	3						1		3		
CO8	3	2	2		3							3
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – III (EC/IC)
SUBJECT: DIGITAL ELECTRONICS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	2	6	5	60	40	25	25	150

COURSE OBJECTIVES

The objective of this course is to provide the concepts associated with the digital logic and circuit design that are basic building blocks of a digital computer system. To apply the laws involved in the Boolean algebra for the simplification of logic functions and minimization of hardware requirements. To design and analyse of combinational and sequential circuits involved in the different digital circuits and systems.

DETAILED SYLLABUS

[1] INTRODUCTION TO LOGIC CIRCUITS
Logic Gates & Networks, Truth Tables, Boolean Algebra, Synthesis using AND, OR and NOT Gates, NAND – NOR Logic Networks, Sum of Products and Product of Sums Forms, Introduction to Verilog.

[2] IMPLEMETATION TECHNOLOGY
Transistor Switches, NMOS & CMOS Logic Gates, Negative Logic Systems, Introduction to PAL, PLA, CPLD & FPGAs, Voltage Levels in Logic Gates, Noise Margin, Dynamic Operation & Power Dissipation in Logic Gates, Fan-in and Fan-out, Transmission Gates, Transistor-Transistor Logic, Emitter - Coupled Logic.

[3] OPTIMIZED IMPLEMENTATION OF LOGIC FUNCTIONS
Karnaugh Map Strategy for Minimization, Minimization of POS Forms, Multiple Output Circuits, Multilevel Synthesis, Analysis of Multilevel Synthesis.

[4] COMBINATIONAL CIRCUITS
Multiplexers, Decoders, Encoders, Code Converters, Arithmetic Comparison Circuits

[5] SEQUENCIAL CIRCUITS
Basic Latch, Gated SR Latch, Gated D Latch, Master Slave & Edge Triggered D Flip-Flops, T & JK Flip Flops, Registers, Counters, Reset Synchronization, BCD- Ring –Johnson Counters.

[6] SYNCHRONOUS SEQUENCIAL CIRCUITS
Basic Design Steps, Mealy State Model, Design of Counter, FSM as an Arbiter Circuit, Analysis of Synchronous Sequential Circuits.

TEXT / REFERENCE BOOKS

1) Fundamentals of Digital Logic with Verilog Design, Stephen Brown &ZvonkoVrenesic, Tata McGraw Hill
2) Digital Logic and Computer Design, Morris Mano, Prentice Hall of India
3) Fundamental of Digital Circuits, Anand Kumar, Prentice Hall of India

COURSE OUTCOMES

At the end of the course, students should be able to

CO1. Analyse and calculate parameters such as noise margin, input –output voltages, fan-out, and speed power product, power dissipation for ECL and TTL logic families. Implement the Boolean functions using CMOS gates.
CO2. Attempt SOP to POS conversion (& vice versa) for implementation of Boolean expressions using AND-OR-INVERT functions as well as universal gates. Also to optimize the Boolean expressions either by applying Boolean algebra or by using minimization techniques as K-Map method and Tabulation Method with "don't care" conditions up to 6 variables.
CO3. Implement various combinational circuits like Multiplexers, Decoders, Encoders, Code Converters, and Arithmetic Comparison Circuits using basic gates. Design and Implement basic combinational blocks of a digital computer using multiplexers, decoder, PLA, PAL and verify the circuit implementations with the help of simulation tool.
CO4. Implement a basic memory element using flip-flops and understand the characteristics of various flip-flop designs and compare them with respect to their timing relationship, hardware requirement and limitations.
CO5. Differentiate Combinational and Sequential circuits. Design and analyse FSMs using sequential circuits. Reduce hardware requirement of FSMs by minimizing state table. Analyse Mealy and Moore machine designs using timing waveforms.
CO6. Construct sequential circuits like asynchronous/ synchronous counters, shift registers and counters for timing signal generation.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	2		1	1					
CO2	3	3	3	2		1	3				1	1
CO3	3	3	2	1		1	3				1	1
CO4	3	3	3	1		1	1				1	1
CO5	3	1	3	3	3	2	3		1		1	
CO6	3	3	3	2	3	1	3		1		2	
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – III (EC)
SUBJECT: MATHEMATICAL COMPUTING LABORATORY

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
0	0	2	2	1	-	-	25	25	50

COURSE OBJECTIVES

Availability of simulation tools help students to visualize mathematical concepts studied as part of in Mathematics subjects and understand its relevance to their core engineering. Considering wide spread use of Python as a programming language, students should have hands on practices on this language at early stage of engineering studies. The objective of the course is to fulfil the requirements by implementing the mathematical formulas and concepts through Python programming.

DETAILED SYLLABUS

[1] INTRODUCTION TO PYTHON
Introduction to syntax & programming environment, Functions, Looping and plotting.

[2] SIMULATIONS
AC analysis of circuit, Power factor calculations, Matrix operations, Linear equations solving using matrix operations, Fourier Series, Limit and Partial derivative solutions and KCL and KVL application on network circuits are included.

TEXT / REFERENCE BOOKS

1) Principles of Electronics, V. K. Mehta &Rohit Mehta, 11th Edition, S. Chand & Company.
2) Electrical & Electronic Measurement & Measuring Instruments, A.K. Sawhney, 17th Edition, Dhanpat Rai Publishing.
3) Digital logic and Computer Design, M. M. Mano, Pearson Education India.

COURSE OUTCOMES

At the end of the course, students should be able to

CO1. Write python codes including necessary features such as looping and functions, run and troubleshoot the same.
CO2. Write python code to implement mathematical formulas and show the results with single and multiple graphs in single and / or multiple plots
CO3. Find circuit parameters and response in the Resistive network using KVL and KCL using python.
CO4. Write python code to execute mathematical formula for derivative and limit of a given function and synthesize the periodic waveform for given Fourier series representation of a signal.

COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		1	1	3	1	1	1		1	2	
CO2	2		1	1	3	1	1	1		1	2	
CO3	2	2	1	1	3	1	1	1		1	2	2
CO4	2	2	1	1	3	1	1	1		1	2	2
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – IV (EC)
SUBJECT: SIGNAL& SYSTEMS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	1	2	5	4	40	40	25	25	130

COURSE OBJECTIVES

Signals and systems is a topic that forms an integral part of engineering systems in many diverse areas like communication, image processing, speech processing etc. This subject offer in depth understanding of time domain and frequency domain analysis of continuous time and discrete time signals and systems.

DETAILED SYLLABUS

[1] INTRODUCTION
Signals and systems as seen in everyday life, and in various branches of engineering and science. Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability

[2] LINEAR SHIFT- INVARIANT SYSTEMS
Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs. Characterization of causality and stability of linear shift invariant systems, System representation through differential equations and difference equations, Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation

[3] THE FOURIER TRANSFORM
The Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT), Parsvale's Theorem, The idea of signal space and orthogonal bases

[4] THE z – TRANSFORM
The z-Transform for discrete time signals and systems- Eigen functions, region of convergence, z-domain analysis. State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role.

TEXT / REFERENCE BOOKS

1) B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.
2) A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India,1997.
3) J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
4) H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.

5) S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
6) A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
7) M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Characterize and analyse the properties of continuous and discrete time signals and systems.
CO2. Explain input output relationship for linear shift invariant system and interpret the convolution operator for continuous and discrete time system
CO3. Analyze the continuous and discrete time system using differential equations using classical methods and transform methods in presence of different input signals
CO4. Apply Fourier series and Fourier Transform on continuous time signals and systems.
CO5. Compute response of the passive network for given excitation using classical as well as transform methods.
CO6. Demonstrate discrete time signal in frequency domain through discrete time Fourier Transform. Illustrate its efficient computation by FFT Algorithms.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	1						1		
CO2	3	3	2	1								
CO3	3	3	2	1								
CO4	3	3	2	1								
CO5	3	3	2	1	1	1						
CO6	3	3	2	1								
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – IV (EC)
SUBJECT: LINEAR ELECTRONICS – II

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	0	2	6	5	60	40	25	25	150

COURSE OBJECTIVES

This course involves the in-depth understanding of the analog electronics circuits which can enable students to interpret, analyses, design, and apply electronics and communication-based circuits. This core subject understanding is useful to the students in the projects and in the field of Power Electronics, Electronics Communication, and audio-video engineering. The objective of this course is to offer in-depth understanding of the analysis, design, and applications for analog electronics circuits.

DETAILED SYLLABUS

[1] POWER CIRCUITS AND SYSTEMS

Amplifier Classification, Distortion in Amplifiers, Large-Signal Amplifiers, Harmonic Distortion, Efficiency of a Class A Amplifier, Push-Pull Amplifiers, Class B amplifiers, Class AB Operation, Regulated Power Supplies, Series Voltage Regulator.

[2] FEEDBACK AMPLIFIER CHARACTERISTIC

Classification of Amplifiers, The Feedback Concept, The Transfer Gain with Feedback, General Characteristics of Negative-Feedback Amplifiers, Input Resistance, Output Resistance, Method Analysis of a Feedback Amplifier, Voltage-Series Feedback, Current-Series Feedback, Current-Shunt Feedback, Voltage-Shunt Feedback.

[3] OSCILLATORS USING TRANSISTOR

Sinusoidal Oscillators, The Phase-Shift Oscillators, Resonant-Circuit Oscillators, A General Form of Oscillator Circuits, Colpitt's Oscillator, Hartley's Oscillator, Clapp's Oscillator, Crystal Oscillators.

[4] OPERATIONAL AMPLIFIER CHARACTERISTICS

Differential Amplifier, DC and AC Analysis of Bipolar Differential Amplifier, The ideal Operational Amplifier, Inverting and Non-Inverting Amplifiers, Op-Amp Parameters, Measurement of Op-Amp Parameters, General Description of Various Stages of Op-Amp, Open-Loop and Closed-Loop Frequency Response, Op-Amp Stability, Frequency Compensation.

[5] LINEAR APPLICATIONS OF OP-AMP

Summing and Difference Amplifiers, Integrator and Differentiator, Current-to-Voltage Converters, Voltage-to-Current Converters, Current Amplifiers, Voltmeters and Current Meters, Instrumentation Amplifiers, Transducer Bridge Amplifiers, Ideal and Realistic Frequency Response of Various Filters, Basic First-Order Low-Pass and High-Pass Filters, First Order Wideband Band Pass Filters (Phase-Shifter), Second-Order Low-Pass Filters, Second-Order High-Pass Filters, Second-Order Band-Pass Filters, Second-Order Band-Reject Filters.

[6] NON-LINEAR APPLICATIONS OF OP-AMP

Precision Half-Wave Rectifiers, Precision Full Wave Rectifiers, Log Amplifiers, Antilog Amplifiers, Zero Crossing Detector, Level Detectors, Voltage Magnitude Comparator and Window Detector, Basic Peak Detectors Using Op-Amps and Comparators, Basic Sample and Hold Circuits, Digital to Analog (D/A) Converters, Analog to Digital (A/D) Converters.

[7] WAVE SHAPING & WAVEFORM GENERATORS

The Op-Amp as Voltage Comparator, Some Applications of a Comparator using Op-Amp, Schmitt Trigger Circuit, Basic Triangular Wave Generator, Astable and MonostableMultivibrator Using Op-Amp, Introduction to 555 Timer, Timer 555 Used in Astable and Monostable Mode.

TEXT / REFERENCE BOOKS

1) Integrated Electronics, Millman&Halkians, Tata McGraw Hill

2) Op - Amp and Linear Integrated Circuits, RamakantA. Gayakwad, 4th Edition, Pearson Education

3) Integrated Circuits, K. R. Botkar, 9thEdition, Khanna Publications

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Analyse class A, Class B, Class AB and Push-Pull amplifier in terms of operating characteristics, harmonic distortion and power efficiency.

CO2. Design regulated power supply to provide constant voltage with specified minimum load current for the given specification.

CO3. Computation of transfer gain, input and output impedance of various types of negative feedback amplifiers.

CO4. Design analog circuits using OPAMPs for specific applications like comparator, DAC, volt and current meters

CO5. Develop OPAMP circuits to perform mathematical operations like addition, subtraction, multiplication, division, integration, differentiation, logarithm, antilogarithm

CO6. Design different types of waveform generators using discrete components and OPAMP and IC 555 like astable and Monostable Multivibrator

CO7. Design analog active filters using OPAMP and Sinusoidal Oscillator for given frequency and gain.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3						1		1		
CO2	3	2	3					1		1		
CO3	3	2		2	2			1		1		
CO4	3	3	3					1		1		
CO5	3	2	3					1		1		
CO6	3	3	3					1		1		
CO7	3	2	3					1		1		
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – IV (EC)
SUBJECT: CONTROL THEORY

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	2	6	5	60	40	25	25	150

COURSE OBJECTIVES

The objective of this course is to introduce basics of control theory and establish the fundamentals of devices in control applications as required by electronics engineering students. To introduce different types of systems and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms equivalent electrical models for analysis. To employ time domain analysis to predict and analyze transient performance parameters of the system for various standard input test functions. Demonstrate system stability concept and learn methods for examining system stability in both time and frequency domains including determining the system stability margins.

DETAILED SYLLABUS

[1] INTRODUCTION
Open-loop and closed loop control system, Servomechanism, Historical development of control system, sampled data & digital control system, Multivariable control system, Application in non-engineering field.

[2] MATHEMATICAL MODELS OF PHYSICAL SYSTEMS
Introduction, Differential equation of physical systems, Transfer functions, Block diagram algebra, signal flow graph. (Note: Problems on electrical, mechanical & electromechanical systems only.)

[3] FEEDBACK CHARACTERISTICS OF CONTROL SYSTEMS
Feedback and non feedback systems, reduction of parameter variations by use of feedback, control over system dynamics by use of feedback, effects of disturbance signals by use of feedback, lineraizing effect of feedback, regenerative feedback, Basics of Feed forward Control System with example.

[4] TIME RESPONSE ANALYSIS AND CONCEPTS OF STABILITY
Introduction, standard test signals, time response of first order system, time response of second order system, steady state errors and error constants, effects of adding zero to a system, design specifications and constructions for second and higher order systems, performance indices, examples, concepts and conditions for stability, Huwitz's and Routh's stability criteria, relative stability criteria.

[5] THE ROOT LOCUS TECHNIQUE
Introduction, Rules of construction of root loci, sketching of root locus and applications

[6] FREQUENCY DOMAIN ANALYSIS & STABILITY
Freq. domain specifications, correlation bet time & frequency domain specifications, Bode plot, Polar plot, Nichols chart, Nyquist stability criterion, Constant M& N circles

TEXT / REFERENCE BOOKS

1) Feedback Control Systems, D. K. Theckedath , R. A. Barapate, Tech-Max Publication.
2) Control System Engineering, U. A. Patel, Mahajan Publication House.
3) Modern Control Engineering, K. Ogata, 4th Edition, Prentice Hall of India

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Study and define the different configurations of control systems, i.e how subsystems are connected between the input and output. To evaluate the range of system gain to ensure the stability of the system.
CO2. Introduce different types of physical systems and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.
CO3. Analysethe system using Bode plot for the estimation of the relative stability of the system in terms of the gain margin and phase margin
CO4. Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions. Design the second order systems for the given performance indices of time domain.
CO5. Evaluate the closed loop stability of the control systems using Nyquist and polar plot.
CO6. Illustrate the impact of the variations in the system gain on the location of closed loop poles in the s-plane.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3						1		1		
CO2	3	2	3					1		1		
CO3	3	2		2	2			1		1		
CO4	3	3	3					1		1		
CO5	3	2	3					1		1		
CO6	3	3	3					1		1		
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – IV (EC)

SUBJECT: ELECTRICAL MACHINES & POWER

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	0	2	5	4	60	40	25	25	150

COURSE OBJECTIVES

This course provides fundamental concepts associated with working and analysis of electrical machines. This also includes concepts to analyse the mechanism of electrical power generation, transmission and distribution. This course teacheson how to identify and troubleshoot electrical faults in switchgear. The objective of this course is toexpose the students to the concepts of various types of electrical machines and their applications. Besides to introduce them with the fundamental of generation, transmission and distribution of the electrical power and power system protection.

DETAILED SYLLABUS

[1] DC MACHINES

DC Generator & DC Motor

Operating Principle and Types of DC generator &motor, Losses in DC Generator, Power Stages in DC Generator, Maximum Efficiency and Power in DC Generator, Generator Characteristics, Speed control of DC motor

[2] AC MACHINES

Single Phase Transformer

Working Principle, Construction, Characteristics of an Ideal Transformer, EMF Equation, Transformer Load Analysis, Transformer Parameters, Equivalent Circuit, Open Circuit & Short Circuit Tests, Efficiency, Regulation, All day efficiency, Parallel Operation of transformer.

Three Phase Induction Motors

Working Principle, Construction, Relation between Torque & Rotor Power Factor, Starting Torque and Running Torque of Motor, Effect of Change in Supply Voltage on Starting Torque, Torque Slip Characteristics, Induction Motor as a Generator, Power Stages, Starting Methods of Induction Motor, Speed Control of Induction Motors

Single Phase Motors

Introduction and Broad Classifications, Self-Starting Mechanism, AC Series Motor and Universal Motors.

Alternators

Working Principle, Construction, Factors Affecting Alternator Size, Alternator on Load, Synchronous Reactance, Vector Diagrams, Voltage Regulation by EMF Method, Parallel Operation of Alternators.

[3] ELECTRICAL POWER GENERATION

Schematic Arrangement of Various Power Plants - Thermal, Hydro, Nuclear, Diesel and Gas Turbine Based Power Plant, Structure of Electric Power System, Load Curves, Important Terms and Factors, Load Duration Curves, Types of Loads, Wind energy: types, power in the wind, types of wind turbine generators, Solar Energy: types of solar cell, A generic photovoltaic cell, from cells to modules to array, physics of shading, Introduction to major types of PV system, Maximum Power point tracker, Concentrating Solar Power (CSP) Technologies, Introduction to smart grid

[4] POWER FACTOR IMPROVEMENT

Power Triangle, Disadvantages and Causes of Low Power Factor, KVAR Calculations, Importance of Power Factor Improvement, Most Economical Power Factor.

[5] TRANSMISSION LINE & UNDER GROUND CABLES

Classification of Transmission Line & Under Ground Cables, Main Components, Conductor Materials, Types of Insulators, String Efficiency and Its Improvement, Construction of underground Cables

[6] INTRODUCTION TO SWITCH GEAR

Essential Features of Switchgear, Switchgear Equipment - Circuit Breaker, Fuses, Relay, Principle and Methods of *arc* Quenching in Circuit Breaker, Desirable Characteristics of Fuse Element, Fuse Element Materials, Theory of Protective Relays, Fundamental Requirements of Protective Relay, Calculation of Relay Operating Time, The Bus Bar Arrangement, Faults in Power System.

TEXT / REFERENCE BOOKS

1) Electrical Technology (Vol: II), B. L. Theraja& A. K. Theraja, 23rd Edition, S. Chand & Company Ltd.
2) Principles of Power System, V. K. Mehta &Rohit Mehta, 4th Edition, S. Chand & Company Ltd.
3) Theory and Performance of Electrical Machine, V.B. Gupta, 13th Edition, Laxmi Publications
4) Electrical Engineering, R.K. Rajput, 1st Edition, Laxmi Publications
5) Course in Power System, J. B. Gupta, 10th Edition, S. K. Kataria& Sons.
6) Switchgear and Protection, J. B. Gupta, 2nd Edition, S. K. Kataria& Sons.

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Analyse important parameters such as induced emf, equivalent circuit, losses, efficiency and regulation of transformer.
CO2. Evaluate synchronous reactance of an alternator and regulation of an alternator. Discriminate magnetic effects like magnetising, demagnetising and cross magnetising on operation of an alternator based on various loads. Evaluate important parameters such as induced emf, equivalent circuit, losses, and efficiency of DC generator.
CO3. Explain starter mechanism and importance in induction motor. Explain split phase mechanism to make single phase induction motor self-starting and classify types of single phase induction motors. Evaluate important parameters such as motor slip, torque, losses, and efficiency of induction motor.
CO4. Compare and conclude merits and demerits of conventional and non-conventional electrical energy generation power plants
CO5. Analyse effect of power factor improvement in AC electrical power system. Compute the most economical power factor and net saving after power factor correction. Analyse and compute diversity factor, load factor, demand factor and average load of load curve.
CO6. Illustrate relay and circuit breaker coordination to protect electrical system. Choose required protective devices like fuses, circuit breakers, relays or isolator switch to protect against electrical faults. Choose the best material considering conductivity, tensile strength, durability, cost, life, fault frequency and safety for underground and overhead transmission line. Calculate efficiency, string efficiency and regulation of transmission lines.

COURSE MATRIX

Course Outcome (CO's)	Program Outcomes (PO's)											
	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1						1	2		
CO2	3	2	2		1				2	1		
CO3	3	2							1	1		
CO4	3									1		
CO5	3						2					
CO6	2	2	2			1	1	1				1
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – IV (EC)
SUBJECT: CMOS VLSI DESIGN

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	2	6	5	60	40	25	25	150

COURSE OBJECTIVES

Very large scale integration (VLSI) is the process of creating an integrated circuit (IC) by combining millions of transistors together in a small silicon chip. In this subject, students learn to design, analyse and optimize the digital logic circuitry it in terms of PDA (Power, Delay and Area) and understand the architectural choices and performance trade-offs involved in designing and realizing the CMOS circuits. This course teaches the importance of testability and basic techniques for test vector generation. This course provides an overview of chip design techniques using programmable devices. This course offers a profound understanding of the design, simulations and functionl verification of complex digital VLSI circuits (using EDA tools like ALTERA/XILINX).

DETAILED SYLLABUS

[1] LOGIC DESIGN WITH MOSFETS
Complexity and Design, Basic Concepts, Types of IC, VLSI Design Flow, MOSFET as a Switching Element, Basic and Complex Logic Gates in CMOS, Transmission Gate Circuits, Clocking and Dataflow Control.

[2] FABRICATION OF CMOS INTEGRATED CIRCUITS
Physical Structure of CMOS Integrated Circuits, CMOS Patterning – Silicon Layout and Stick Diagrams, Fabrication of CMOS Integrated Circuits – Process Flow and Design Rules, Layout of Basic Structures, FET Sizing.

[3] ELECTRICAL CHARACTERISTICS OF CMOS LOGIC
MOS Physics,FET RC Model, DC and Transient Characteristics of CMOS Gates, Power Dissipation, Analysis of Complex Logic Gates.

[4] DESIGNING HIGH SPEED CMOS LOGIC NETWORKS
Driving Large Capacitive Loads, Delays Estimate for Logic Cascade, Delay Optimization Using Logical Effort, Branching Effort, Advanced Techniques in CMOS Logic Circuits.

[5] ADVANCED CMOS CIRCUITS
BiCMOS Drivers, Mirror Circuits, Pseudo-nMOS, Tri-state Circuits, Clocked CMOS, Dynamic CMOS Logic Circuits, Domino Logic Cell Dual-Rail Logic Networks. (DCVSL, CPL)

[6] THE DESIGN OF VLSI SYSTEM
Memories and Programmable Logic, Interconnect Delay Modelling, Crosstalk, Interconnect Scaling, Floor Planning and Routing, Input and Output Circuits, Power Distribution and Consumption, Low Power Design Considerations, VLSI Clocking and System Design, Reliability and Testing of VLSI Circuits.

[7] INTRODUCTION TO HDL

Introduction to Verilog & System Verilog, Basic Building Blocks & Datatypes, Randomization.

TEXT / REFERENCE BOOKS

1) Introduction to VLSI Circuits& Systems, John P. Uyemura, John Wiley & Sons Inc.
2) CMOS logic Circuit Design, John P. Uyemura, Springer Private limited
3) Digital Integrated Circuits - A Design Perspective, J.M. Rambaey, A. Chandrakassan& B. Nikolic, 2nd Edition, Prentice Hall of India.
4) Principles of CMOS VLSI Design - A System Perspective, N. H. E. Weste& K. Eshraghian, 2nd Edition, Prentice Hall of India.
5) Modern VLSI design - System On Chip Design, W. Wolf, 3rd Edition, Pearson Asia
6) Introduction to System Verilog, Ashok D Mehta, Springer.
7) Introduction to Verilog HDL, Samir Palnitkar, PHI

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Identify conduction state of given MOSFET and derive RC model by recognizing physical properties of MOSFET.
CO2. Prepare schematic and Si layout of CMOS digital logic circuitry and compare their physical design parameters with the reference Inverter design.
CO3. Describe pros & cons of various IC fabrications processes and also appraise requirements of various design rules. Assess switching performance & reliability of CMOS Digital Logic circuits.
CO4. Apply logical effort theory for improving the Speed of CMOS logic cascade and understand advanced techniques for logic implementation using FET & BJTs.
CO5. Designing of high density structure like memory array to enhance its performance. Understand system-level physical design of VLSI chip.
CO6. Test the CMOS based circuits using various testing methods to identify physical defects in a given chip.

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3		3		3	1						
CO2	3	2				1			1	2		
CO3	3		2		2					2		
CO4	2		3			1						
CO5	1		2									
CO6	3		2			1						
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

B. TECH. SEMESTER – IV (EC)
SUBJECT: UNIVERSAL HUMAN VALUES

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	1	0	3	3	40	0	0	0	40

COURSE OBJECTIVES

This course is intended to provide a much needed orientational input in value education to the young enquiring minds. It presents a universal approach to value education by developing the right understanding of reality (i.e. a worldview of the reality "as it is") through the process of self-exploration. The whole course is presented in the form of a dialogue whereby a set of proposals about various aspects of the reality are presented and the students are encouraged to self-explore the proposals by verifying them on the basis of their natural acceptance within oneself and validate experientially in living. The prime focus throughout the course is toward affecting a qualitative transformation in the life of the student rather than just a transfer of information. While introducing the holistic worldview and its implications, a critical appraisal of the prevailing notions is also made to enable the students discern the difference on their own right.

DETAILED SYLLABUS

[1] INTRODUCTION TO VALUE EDUCATION
Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations

[2] HARMONY IN THE HUMAN BEING
Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health

[3] HARMONY IN THE FAMILY AND SOCIETY
Harmony in the Family – the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order

[4] HARMONY IN THE NATURE/EXISTENCE
Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

[5] IMPLICATIONS OF THE HOLISTIC UNDERSTANDING – A LOOK AT PROFESSIONAL ETHICS
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

TEXT / REFERENCE BOOKS

1) Dr. Rajneesh Arora ,Dr.Shishir Gaur , Dr.Ruchir Gupta , Student Induction ProgramHandbook v2AICTE NCC-IP sub-committee. (e-version)

2) Dr. Rajneesh Arora , Dr.Shishir Gaur, Sh. BP Singh, Sh. Rajul Asthana and Sh. JitenderNarula, Universal Human Values-I (UHV-I) Mentors' Manual, Version 2.1, AICTENCC-IP sub-committee. (e-version), July 2020

3) UHV Handouts 1 to 5, AICTE NCC-IP sub-committee. (e-version).https://drive.google.com/drive/folders/1eZ6R-VrAFvHwlQ91iDaPkLhk9CPjCH_o?usp=sharing

4) RR Gaur, R Asthana and GP Bagaria, Class Notes on UNIVERSAL HUMAN VALUESAND ETHICS, Part 1 to Part 4, AICTE NCC-IP sub-committee. (e-version).

COURSE OUTCOMES

At the end of the course,students should be able to

CO1. Become familiar with the ethos and culture of the institution
CO2. Set a healthy daily routine, create bonding in batch as well as between faculty members and students
CO3. Get an exposure to a holistic vision of life, develop awareness, sensitivity and understanding of the Self---family---Society---Nation---International---Entire Nature
CO4. Facilitate them in creating new bonds with peers and seniors who accompany them through their college life and beyond
CO5. Overcome weaknesses in some essential professional skills
CO6. Practice professional ethics and holistic strategies for Transition towards Value-based Life and Profession

COURSE MATRIX

Course Outcome (CO's)	**Program Outcomes (PO's)**											
	Domain Specific (PSO)					**Domain Independent (PO)**						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3		3		3	1					3	
CO2	3	2		3		1			1	2		
CO3	3	3	2		2					2		
CO4	2		3			1					3	
CO5	3		2	3				3			2	
CO6	3		2			1						
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

Dharmsinh Desai University

Faculty of Technology

Department of Information Technology

Detailed Syllabus Book

Detailed Syllabus for Master of Technology (Information Technology) course

Department of Information Technology,
Faculty of Technology,
Dharmsinh Desai University, Nadiad – 387 001, Gujarat, India.
Website: http://www.ddu.ac.in

DHARMSINH DESAI UNIVERSITY, NADIAD

TEACHING SCHEME AND DETAIL SYLLABUS FOR M. Tech. (INFORMATION TECHNOLOGY)

FOR THE BATCH 2016 – 2018

SR NO.	SEMESTER	CREDIT	TOTAL MARKS
1	SEM – I	25	750
2	SEM – II	25	750
3	SEM – III	12	500
4	SEM – IV	12	500
	TOTAL	**74**	**2500**

SEM-I		Teaching Scheme			Credit Structure				Exam Scheme				
SUB. CODE	**SUBJECT NAME**	**LEC.**	**TUT.**	**PRAC.**	**L**	**T**	**P**	**TOTAL**	**THE.**	**SESS.**	**PRAC.**	**T/W**	**TOTAL**
MF101	Algorithm Analysis & Design	3	1	2	3	1	1	5	60	40	25	25	150
MF104	Software Design & Engineering	3	1	2	3	1	1	5	60	40	25	25	150
MF105	Advanced Network Programming	3	1	2	3	1	1	5	60	40	25	25	150
Program Elective-I													
MF103	Distributed Computing	3	1	2	3	1	1	5	60	40	25	25	150
MF108	Natural Language Processing	3	1	2	3	1	1	5	60	40	25	25	150
Program Elective-II													
MF102	Data Mining	3	1	2	3	1	1	5	60	40	25	25	150
MF107	Mobile Computing	3	1	2	3	1	1	5	60	40	25	25	150
	TOTAL	15	5	10	15	5	5	25					750

SEM-II		Teaching Scheme			Credit Structure				Exam Scheme				
SUB. CODE	SUBJECT NAME	LEC.	TUT.	PRAC.	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
MF203	Advanced Operating System Concepts	3	1	2	3	1	1	5	60	40	25	25	150
Program Elective-III													
MF210	Advanced Artificial Intelligence	3	1	2	3	1	1	5	60	40	--	50	150
MF206	Parallel Computing	3	1	2	3	1	1	5	60	40	25	25	150
Program Elective –IV													
MF204	Service Oriented Computing	3	1	2	3	1	1	5	60	40	25	25	150
MF207	Computer Vision and Audio Processing	3	1	2	3	1	1	5	60	40	25	25	150
Program Elective- V													
MF205	Information and Network Security	3	1	2	3	1	1	5	60	40	25	25	150
MF211	Digital Image Processing	3	1	2	3	1	1	5	60	40	25	25	150
Program Elective-VI													
MF202	Evolutionary Computing	3	1	2	3	1	1	5	60	40	25	25	150
MF209	Grid Computing	3	1	2	3	1	1	5	60	40	25	25	150
	TOTAL	15	5	10	15	5	5	25					750

SEM-III		Teaching Scheme			Credit Structure				Exam Scheme				
SUB. CODE	SUBJECT NAME	LEC.	TUT.	PRAC.	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
MF311	Dissertation-I	--	--	24	--	--	8	8	--	--	250	150	400
MF312	Research Methodology	--	--	2	--	--	2	2	--	--	25	25	50
MF313	Pedagogic Practice-I	--	--	4	--	--	2	2	--	--	--	50	50
	TOTAL	--	--	30	--	--	12	12					500

SEM-IV		Teaching Scheme			Credit Structure				Exam Scheme				
SUB. CODE	SUBJECT NAME	LEC.	TUT.	PRAC.	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
MF401	Dissertation-II	--	--	26	--	--	10	10	--	--	300	150	450
MF402	Pedagogic Practice-II	--	--	4	--	--	2	2	--	--	--	50	50
	TOTAL	--	--	30	--	--	12	12					500

MF101 – Algorithms Analysis and Design (Core) (w. e. f. July 2014)
SEM-I (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Introduction: Mathematical Notations, Elementary algorithmic and Efficiency of algorithms: Examples.
2) Framework for Analysis of Algorithms & Asymptotic Notations
3) Algorithm Design Technique - Divide & Conquer
4) Algorithm Design Technique - Greedy algorithms
5) Algorithm Design Technique- Dynamic Programming
6) Graph Algorithms
7) Combinatorial Search and Optimization Techniques (DFS, Brach & Bound, Backtracking).
8) NP-Completeness
9) Approximation Algorithms
10) Probabilistic algorithms

[B] RECOMMENDED TEXTBOOKS

1) G. Brassard, P.Bratley, "Fundamentals of Algorithmics", (PHI).
2) T. H. Cormen, C. E. Leiserson, R. L. Rivest "Introduction to Algorithms", PHI.

[C] REFERENCE BOOKS

1) Ellis Horowitz and Sartaz Sahani "Fundamentals of Computer Algorithms", Computer Science Press.
2) A.V. Aho, J. E. Hopcroft, J. D. Ulman "The Design & Analysis of Computer Algorithms", Addison Wesley.
3) "Design and analysis of algorithms", P.H. Dave, H. B. Dave, Pearson Education, 2008.

MF104 – Software Design and Engineering (Core) (w. e. f. July 2011)
SEM-I (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Overview of Object-Oriented Systems Development: Systems Development Life Cycle: Unified Approach, Object-Oriented Methodology, Unified Modeling Language.
2) Object Orientation: Object, Class and instance, inheritance, polymorphism.
3) Concepts of Object-Oriented Analysis: Object-Oriented Analysis Requirements Model (Use case), Object Analysis, Object Relationship Analysis.
4) Concepts of Object-Oriented Design: Dynamic Models, Object Interaction Diagrams and State Diagrams.
5) UML diagrams: Use case, class, object, sequence, state-chart, component, deployment.
6) Elements of Design Patterns: Various Design patterns, Design Heuristics.
7) Frameworks: Introduction to Document/View framework, Introduction to MVC based Web application development framework, Controller framework, View framework, model framework (spring, hibernate, JSF, etc).
8) Software Quality: Quality measurement, metric, testing techniques, verification and automated testing.

[B] RECOMMENDED TEXTBOOKS

1) Ali Bahrami, "Object Oriented Systems Development", Tata McGraw Hill, 1999.
2) Martin Fowler, "UML Distilled", Second Edition, Prentice Hall of India / Pearson Education, 2002.
3) Selected research papers (Latest Advancement in the field)

[C] REFERENCE BOOKS

1) Ivar Jacobson, Object Oriented Software Engineering, A Use Case Driven Approach, Addison Wesley
2) James Rumbaugh Et Al., Object Oriented Modeling And Design, Prentice Hall
3) Ivar Jacobson, Object Oriented Software Engineering, A Use Case Driven Approach, Addison Wesley
4) Grady Booch, Object Oriented Analysis & Design, 2nd Ed., Benjamin/Cummings

MF105 – Advanced Network Programming (Core) (w. e. f. July 2011)
SEM-I (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Basics Concurrency Programming Skills: Multithreading (UNIX and Java), Mutex And Semaphore (Unix and Java)
2) Inter Process Communication: Pipe, FIFO, Shared Memory and Message Queue
3) Basic Socket Programming: System calls (TCP and UDP related), TCP Socket, state transition diagram Connection establishment, termination, TCP Client Server Programming (Unix and Java), UDP client server Programming (Unix and Java)
4) TCP Layered Architecture: TCP/IP stack, Protocols (TCP, IP, UDP), Introduction to ARP, RARP, Broadcasting and Multicasting, ICMP, IGMP. MSS, MTU, Fragmentation, TCP output, UDP output.
5) Socket Options: SO_BROADCAST, SO_ERROR, SO_KEEPALIVE, SO_LINGER, use of shutdown, SO_RCVBUF, SO_SNDBUF, TCP_NODELAY
6) I/O Multiplexing for Concurrent Programming
7) DNS and its programming: DNS, Get host by name, get host by address, get serv by name, get serv by port.
8) Introduction to advance sockets: Ioctl, sysctl, broadcasting, ping, traceroute. Networking Tools: Tcpdump, ping, netstat, ethereal, nmap
9) Advancements in Network Architecture: Wireless Ad-hoc network and Mobile. Ad-hoc Network, Peer to Peer
10) Security in Network

[B] RECOMMENDED TEXTBOOKS

1) UNIX Network Programming, Volume-1 By Richard Stevens, Second Edition, PHI publication
2) UNIX Network Programming, Volume-2 By Richard Stevens, Second Edition, PHI publication
3) Selected research papers (Latest advancements in the field).

[C] REFERENCE BOOKS

1) TCP/IP Illustrated Vol I, W. R. Stevens

MF103 – Distributed Computing (Program Elective-I) (w. e. f. July 2011)
SEM-I (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Introduction to Distributed Computing, From Super Computers to clusters from parallel super computers to clusters, From clusters to meta computing system
2) Programming Models, Message Passing, PVM, MPI, Client-Server model, Code Shipping, Proxy Computing, Intelligent Mobile Agents
3) Implementation Approaches, Java based approach (Remote Procedure Call & RMI), CORBA, Web Service
4) Issues in DC: Clock Synchronization, Load Distribution (Load Sharing & Load Balancing concepts), Distributed File System, Deadlocks in distributed systems & Process Migration Concepts, Fault tolerant computing & Security in DC (Kerberos, Digital Certificate Based)
5) Computational Grids & Middleware Supports, Globus communication model Globus resource management, Globus meta computing Directory Service
6) Scheduling in Meta Computing Systems, High performance scheduling High-throughput scheduling, Resource scheduling
7) Measuring the efficiency or effectiveness of either an entire distributed system or a certain component or algorithm within a distributed system.

[B] RECOMMENDED TEXTBOOKS

1) G. F. Colouris & J. Dollimore, Distributed Systems: Concepts & Design Addison Wesley,
2) Distributed Operating Systems: Concepts and Design by Pradip Sinha, IEEE Press
3) Selected research papers (Latest advancements in the field).

[C] REFERENCE BOOKS

1) P. L. McEntre, Distributed Computing : Concepts & Implementation, IEEE Press
2) High Performance Cluster Computing: Architectures and Systems, Vol. 1 Rajkumar Buyya, Prentice Hall.

MF108 – Natural Language Processing (Program Elective-I) (w. e. f. July 2014)
SEM-I (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Introduction and Mathematical Foundation
2) Linguistic Essentials, Corpus based work
3) Collocations
4) Statistical Inference: n-gram Model over sparse data
5) Word Sense disambiguation
6) Lexical Acquisition, Markov Model, Part of Speech Tagging
7) Probabilistic Context Free Grammar, Probabilistic Parsing
8) Statistical Alignment and Machine Translation
9) Clustering, Information Retrieval, Text Categorization

[B] RECOMMENDED TEXTBOOKS

1) Foundations of Statistical Natural Language Processing, Chris Manning and Hinrich Schütze, MIT Press. Cambridge, May 1999.
2) Selected research papers (Latest Advancement in the field).

MF102– Data Mining (Program Elective-II) (w. e. f. July 2011)
SEM-I (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Basic Mathematics: Linear Algebra, Statistics and Probability Theory
2) Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Preprocessing, Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation,
3) Data Mining Primitives, Languages, and System Architectures: Data Mining, Primitives, Data Mining Query Languages, Designing Graphical User Interfaces Based on a Data Mining Query Language Architectures of Data Mining Systems,
4) Concepts Description: Characterization and Comparison: Data Generalization and Summarization- Based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating between Different Classes, Mining Descriptive Statistical Measures in Large Databases
5) Mining Association Rules in Large Databases: Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses, From Association Mining to Correlation Analysis, Constraint-Based Association Mining
6) Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods, Prediction, Classifier Accuracy. Evaluating the classifier, Counting the Cost, Combining Multiple Classifier
7) Cluster Analysis Introduction: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, SOM Clustering, Outlier Analysis.

[B] RECOMMENDED TEXTBOOKS

1) Data Mining – Concepts and Techniques - JIAWEI HAN; MICHELINE, KAMBER.
2) Mining the Web –Soumen Chakrabarti
3) Selected research papers (Latest advancements in the field).

[C] REFERENCE BOOKS

1) DATA MINING: Practical Machine Learning tools and Techniques-Ian H Witten & Eibe Frank
2) Data Mining: Know it All –Soumen Chakrabarti
3) Hand Book of Statistical Analysis and Data Mining Applications-Robert Nisbet, John Elder

MF107 – Mobile Computing (Program Elective-II) (w. e. f. July 2011)
SEM-I (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Wireless transmission- Frequencies of radio transmission, signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread spectrum, Cellular system
2) Telecommunication System- GSM, Digital Enhanced Cordless Telecommunication (DECT)
3) Wireless Medium Access control and CDMA- based communication – Medium access control, Introduction to CDMA-based systems, Spread spectrum in CDMA systems, coding methods in CDMA
4) Wireless LAN – Infra red vs. radio transmission, infrastructure and ad hoc networks, IEEE 802.11, Bluetooth
5) Mobile network layer – Mobile IP, Dynamic host configuration protocol, Mobile ad-hoc networks, Wireless sensor networks
6) Mobile transport layer – Traditional TCP, Classical TCP improvements, snooping TCP, Mobile TCP, TCP over 2.5/3G wireless networks
7) Mobile internet connectivity – WAP 1.1, Layers of WAP, Wireless Application Environment, WML and WMLScript , wireless telephony application, WAP 2.0 architecture , XHTML-MP(Extensible Hypertext Markup Language Mobile profile)
8) Mobile Operating System, Mobile file system, Security in mobile computing
9) Wireless network simulator such as ns2

[B] RECOMMENDED TEXTBOOKS

1) Mobile Communication By Jochen Schiller (Pearson Education) 2003

[C] REFERENCE BOOKS

1) Mobile Computing By Raj Kamal (oxford)
2) Wireless Communications and Networks W. Stallings, Pearson education publishing 2002

MF203 – Advanced Operating System Concepts (Core) (w.e.f.July 2011)
SEM-II (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Operating Systems: Serial Processing, Batch Processing, Multi-programmed batch systems, Time Sharing systems, system structure, characteristics of modern OS
2) OS Organization OS structures (monolithic, layered, Micro-kernel, Virtual Machine)
3) Interrupt, signal and Exception Handling
4) Multiprocessors and Locking
5) Processes and Control: Various process State models, Process description, Process, control
6) Scheduling: Multiprocessor and real time scheduling
7) Threads and multi-core programming:
- Threads: Concept of Threads, User Level Thread, Kernel Level

Thread, Relation between threads and processes,
- Multi-core programming: Introduction to architecture (HT, multi-core),

Design patterns for parallel programming, multi-core programming concepts, and exercise
8) Memory Management: Paging and Segmentation
9) Files and Disk I/O: File system interface and implementation, Modules, Device Drivers,

[B] RECOMMENDED TEXTBOOKS

1) "Operating Systems (Internals and Design Principles)", William Stallings, Fourth Edition, PHI publication.
2) Parallel Programming in C with MPI and OpenMP, Michael Quinn, Mc Graw Hill
3) Selected research papers (Latest Advancement in the field).

[C] REFERENCE BOOKS

1) “The Design Of The UNIX O/S", Maurice J.Bach, PHI publication

2) "Modern Operating Systems", Tannenbaum, PHI publication

3) “Advanced Programming in the UNIX Environment” (2nd Edition), W. Richard Stevens, Stephen A. Rago, Addison Wesley.

MF210 – Advanced Artificial Intelligence (Program Elective-III) (w. e. f. July 2014)
SEM-II (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	--	50	150

[A] DETAILED SYLLABUS

1) Introduction, problem solving- solving problems by searching, informed search, adverbial search.
2) Knowledge and reasoning -propositional logic, first order logic inferences, ontological engineering, reasoning with default information, truth maintenance systems
3) Planning and acting in real world
4) Uncertain knowledge and reasoning
5) Machine learning: types of learning – examples, characteristics, comparative analysis of various types of learning methodologies
6) Reinforcement learning.
7) Natural language Processing and understanding- issues, phases /steps of NLP.
8) Probabilistic language processing- models, information retrieval, information extraction, machine translation.

[B] RECOMMENDED TEXTBOOKS

1) Artificial intelligence: A modern approach by Stuart Russell and Peter Norvig, 3rd edition. Pearson Education
2) Selected research papers (Latest Advancement in the field).

[C] REFERENCE BOOKS

1) Artificial Intelligence by Eliane Rich, Kevin Knight, Shivashanker B Nair, 3rd edition, the McGraw hill companies
2) Artificial intelligence: structures and strategies for complex problem solving, by George F Luger, Fourth edition, Pearson education

MF206 – Parallel Computing (Program Elective-III) (w. e. f. July 2011)
SEM-II (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Parallel Programming Models: Shared variable Model, Message passing model Data parallel model, Object oriented model, Functional & logic model
2) Dependence Analysis of Data Arrays: Iteration space & dependence analysis, Subscript separability & partitioning, Categorized dependence tests
3) Parallel program development & environments: Parallel programming environment Shared variable program structures, Message passing program development, Mapping algorithms onto parallel computers, Synchronization & multiprocessing models.
4) Analysis of parallel algorithms: Complexity analysis of parallel (searching, sorting, merging, selection, etc) on different types of architecture, Latency, communication costs & other performance issues.
5) Case studies on FFT, matrix multiplication, SVD, etc.

[B] RECOMMENDED TEXTBOOKS

1) Quinn, Parallel Computing [TMH]
2) Sashi Kumar, Introduction to Parallel Processing [PHI]
3) Selected research papers (Latest Advancement in the field).

[C] REFERENCE BOOKS

1) Wilkinson, Parallel Programming [Pearson]
2) Hwang, Advanced Computer Architecture [TMH]

MF204 – Service Oriented Computing (Program Elective-IV) (w. e. f. July 2011)
SEM-II (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Introduction to Service Oriented Architecture, Value of SOA, Characteristics of SOA
2) SOA Concepts, XML Standards (with Example), Web Services (with Example), SOAP, WSDL, UDDI
3) Basic SOA Architecture, Services, Service orchestration and composition, Quality (QoS) and reliability of web services, Brokering and integration, BPEL, ESB, SOA Life Cycle
4) Service-Oriented Semantic Computing, Semantic web – SAWSDL, WSMO, OWL-S, Software agent, Service discovery – UDDI, JUDDI, Ontological engineering (with Example) – RDF, OWL, Reasoning and Reasoner – Jena and Pellet, Inference Engine.

[B] RECOMMENDED TEXTBOOKS

1) Understanding SOA with Web Services by Eric Newcomer and Greg Lomow Paperback publication
2) Service-Oriented Computing: Semantics, Processes, Agents by Munindar P. Singh and Michael N. Huhns, John Wiley & Sons, Ltd., 2005
3) Selected research papers (Latest Advancement in the field).

[C] REFERENCE BOOKS

1) Semantic Web Programming by John Helber, Metthew Fisher, Ryan Blace, Andrew Perez-Lopez Wiley Publishing.

MF207 – Computer Vision and Audio Processing (Program Elective- IV) (w. e. f. July 2011)
SEM-II (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Computer Vision: Introduction, Image representation and properties
2) Computer Vision: Segmentation, Border detection, Watershed, Mean shift, Active, contour.
3) Computer Vision: Shape representation and description.
4) Computer Vision: Object recognition, Knowledge based, statistical, neural network based, etc.
5) Computer Vision: Image understanding
6) Computer Vision: Motion Analysis Event detection and tracking
7) Audio processing: Introduction, Basics signal processing Discrete Expression of Signals. Z-TRANSFORM. Transfer Function and Frequency Response Function of Linear Systems. Discrete Fourier Transform. Transfer Function Models and Wave Equations. Statistical Models for Acoustical Transfer Functions.
8) Pattern Recognition in acoustic signal processing
9) Event detection, tracking in audio signal, speech and speaker recognition

[B] RECOMMENDED TEXTBOOKS

1) Image Processing Analysis and Machine Vision Milan Sonka, Vaclav Hlavac, Roger Boyle (Thomson) 3rd Edition.
2) Fundamentals of Acoustic Signal Processing Mikio Tohyama, Tsunehiko Koike Elsevier 1998
3) Selected research papers (Latest Advancement in the field).

[C] REFERENCE BOOKS

MF211 – Digital Image Processing (Program Elective-V) (w. e. f. July 2014)
SEM-II (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Introduction: Fundamentals, Applications; Image processing system components, Image sensing and acquisition, Sampling and quantization, Neighbours of pixel adjacency connectivity, regions and boundaries; Distance measures
2) Image Enhancement: Frequency and Spatial Domain, Contrast Stretching, Histogram Equalization, Low pass and High pass filtering.
3) Image Restoration: Noise models, mean, order—statistics, adaptive filters. Band reject, Band pass and notch filters.
4) Colour Image Processing: Colour models; Pseudo colour; colour transformation, segmentation
5) Wavelets and Multi-resolution Processing: Image pyramids, subband coding, Harr transform; multi resolution expression, Wavelet transforms.
6) Image Compression: Fundamentals; models; error free and lossy compression; standards.
7) Morphological Image Processing: Boundary extraction; region filtering; connected component extraction; convex hull; Thinning; Thickening; skeletons; pruning; image segmentation

[B] RECOMMENDED TEXTBOOKS

1) Digital Image Processing, Second Edition by Rafel C. Gonzalez and Richard E. Woods, Pearson Education
2) Selected research papers (Latest advancements in the field).

[C] REFERENCE BOOKS

1) Digital Image Processing by Bhabatosh Chanda and Dwijesh Majumder, PHI

MF205 – Information and Network Security (Program Elective-V) (w. e. f. July 2011)
SEM-II (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks
2) Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC
3) Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service
4) Email privacy: Pretty Good Privacy (PGP) and S/MIME.
5) IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.
6) Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).
7) Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3. Intruders, Viruses and related threats.
8) Firewall Design principles, Trusted Systems. Intrusion Detection Systems.
9) Databank Security, ISO Security Standards
10) Information Hiding and IPR Protection

[B] RECOMMENDED TEXTBOOKS

1) Cryptography and Network Security (Principal and Practices) by William Stallings Pearson Education.
2) Security in Computing by Charles Pfleeger & Shari Lawrence Pfleeger 4th Edition PRENTICE HALL
3) Selected research papers (Latest Advancement in the field).

[C] REFERENCE BOOKS

1) Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W. Manzuik and Ryan Permeh, wiley Dreamtech
2) Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.
3) Network Security - Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI.

MF202 – Evolutionary Computing (Program Elective-VI) (w. e. f. July 2011)
SEM-II (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Introduction to Neural Network, Biological model, Multi-layer perception, types of neural networks, learning algorithms Supervised, Unsupervised, re-enforcement, application of neural networks
2) Introduction to Evolutionary Computing, Implementation of biological process Evolutionary Algorithm Techniques GA, Genetic Programming, Evolutionary Programming, GEP, Applications of EA
3) Introduction, Collective intelligence, examples from nature. Algorithms (ANT Colony, PSO, Stochastic Diffusion Search, etc.) Application of SI simulating crowd, ANT based Routing
4) Artificial Immune System

[B] RECOMMENDED TEXTBOOKS

1) Evolutionary Algorithms in Theory and Practice: Evolution Strategies, Evolutionary Programming, Genetic Algorithms by Tomas Back Oxford Univ. Press.
2) Swarm Intelligence –Christian Blum & Deniel Merkle Springer Press.
3) Neural Networks: A Comprehensive Foundation, Simon Haykin, PHI
4) Selected research papers (Latest Advancement in the field).

[C] REFERENCE BOOKS

1) Neural Network, Fuzzy Logic, and Genetic Algorithms - Synthesis and Applications, by S. Rajasekaran and G.A. Vijayalaksmi Pai, (2005), Prentice Hall, (Unit II).

MF209 – Grid Computing (Program Elective –VI) (w. e. f. July 2011)
SEM-II (1st Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
3	1	2	3	1	1	5	60	40	25	25	150

[A] DETAILED SYLLABUS

1) Why computational grids? A discussion of the need, potential users and techniques for use of grids. Grid requirements of end users, application developers, tool developers, grid developers, and system managers. Grid Architecture
2) Networking Infrastructure, Protocols and Quality of Service. Computing Platforms. Operating Systems and Network Interfaces. Languages and Libraries for the Grid.
3) Grid Scheduling, Resource Management, Resource Brokers, Resource Reservations. Security, Accounting and Assurance.
4) The Globus Toolkit: Core systems and related tools such as the Message Passing Interface communication library, the Remote I/O (RIO) library, and the Nimrod parameter study library, Legion and related software, Condor and the Grid, Open Grid Service Architecture and Data Grids, Grid Portal Development
5) Application Types: geographically distributed, high-throughput, on demand, collaborative, and data intensive supercomputing, computational steering, real-time access to distributed instrumentation systems.
6) Introduction to cloud computing – Architecture, IaaS, PaaS, SaaS, Cloud Deployment Models, Virtualization in Cloud Computing, Parallelization in Cloud Computing

[B] RECOMMENDED TEXTBOOKS

1) Joshy Joseph & Craig Fellenstein, "Grid Computing", Pearson/PHI PTR-2003
2) Grid Computing: Making The Global Infrastructure a Reality by Fran Berman (Editor), Geoffrey Fox (Editor), Anthony J.G. Hey (Editor), John Wiley & Sons; (April 8, 2003), ISBN 047085319.
3) The Grid 2: Blueprint for a New Computing Infrastructure by Ian Foster and Carl Kesselman, Morgan Kaufmann Nov 2003, ISBN: 1558609334.
4) Selected research papers (Latest Advancement in the field).

[C] REFERENCE BOOKS

MF311 – Dissertation – I
SEM-III (2nd Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
--	--	24	--	--	08	08	--	--	250	150	400

[A] DETAILED SYLLABUS

Each student will take up a project/problem involving analysis, design, implementation, and evaluation of the proposed solution. The project may involve hardware, software, or any combination of them related to live problems in the fields of study. The project should involve research component for which they are expected to produce research outcome by following appropriate research methodology. They are expected to go through in-depth and critical study, which would produce literature review, analysis and findings of problem & existing solutions, and appropriate proposal/solution.

The student needs to report to the guide periodically for monitoring and guidance. As part of term work, students need to prepare a dissertation report containing the record of work carried out on the project.

Students are to be examined based on viva and/or demonstration. Students should arrange for demonstration of the project work, if any.

MF312 – Research Methodology (w. e. f. July 2011)
SEM-III (2nd Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
--	--	2	--	--	2	2	--	--	25	25	50

[A] DETAILED SYLLABUS

1) Research Methodology: Type of Research, Research Approach, Research Process, Criteria for good Research, Defining Research Project, Performing Literature Surveys & Finding Relevant Information, Research Design & Implementation, Evaluation and Interpretation of Results.

2) Technical & Scientific Writing: Report Writing, Thesis Writing, Writing Technical Paper.

MF313 – Pedagogic Practice – I
SEM-III (2nd Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
--	--	4	--	--	2	2	--	--	--	50	50

[A] DETAILED SYLLABUS

Students need to conduct lectures on relevant topics. The students will be evaluated based on the following:

- Knowledge on the topics
- Presentation/Teaching Methodology
- Ability to deal with Questions

MF401 – Dissertation – II
SEM-IV (2nd Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	TUTORIAL	PRACTICAL	L	T	P	TOTAL	THE.	SESS.	PRAC.	T/W	TOTAL
--	--	26	--	--	10	10	--	--	300	150	450

[A] DETAILED SYLLABUS

Each student needs to implement the proposal/solution and to evaluate the proposal based on state-of-the-art criteria/parameters of evaluation, related to the project/problem selected during Dissertation-I.

The student needs to report to the guide periodically for monitoring and guidance. As part of term work, students need to prepare a dissertation report containing the record of work carried out on the project.

Students are to be examined based on viva and/or demonstration. Students should arrange for demonstration of the project work, if any.

MF402 – Pedagogic Practice – II
SEM-IV (2nd Year)

Department of Information Technology
Faculty of Technology, Dharmsinh Desai University

Teaching Scheme			Credit Structure				Exam Scheme				
LECTURE	**TUTORIAL**	**PRACTICAL**	**L**	**T**	**P**	**TOTAL**	**THE.**	**SESS.**	**PRAC.**	**T/W**	**TOTAL**
--	--	4	--	--	2	2	--	--	--	50	50

[A] DETAILED SYLLABUS

Students need to conduct lectures on relevant topics. The students will be evaluated base on the following:

- Knowledge
- Presentation/Teaching Methodology
- Ability to deal with Questions

Dharmsinh Desai University

Faculty of Technology

Department of Instrumentation and Control Engineering

Detailed Syllabus Book

Detailed Syllabus for Under Graduate Course of

Instrumentation and Control Engineering

Faculty of Technology Dharmsinh Desai University, Nadiad

B.TECH. [IC] CBCS w.e.f AY 2016

Department of Instrumentation & Control Engineering
Faculty of Technology,
Dharmsinh Desai University, Nadiad – 387 001,
Gujarat state, India.
Website: *http://www.ddu.ac.in*

Dharmsinh Desai University

Faculty of Technology

Department of Instrumentation and Control Engineering

Teaching, Credit and Exam scheme

Semester I

SEMESTER- I [IC]												
SUBJECT CODE	SUBJECT	TEACHING SCHEME			CREDIT STRUCTURE		TOTAL CREDIT	Exam Scheme (Marks)				
		LECT	TUT	PRA	L+T	P		Theory (3 hrs)	Sessional (1 hrs 15 min)	Practical	T/W	Total
AF-111	Mathematics-I	4	0	0	4	0	4	60	40	--	--	100
AF-114	Engineering Mechanics	3	0	2	3	1	4	60	40	25	25	150
AX-115	Elements of Mechanical Engineering	4	0	2	4	1	5	60	40	25	25	150
AF-122	Basic Electrical & Electronic Engineering	4	0	2	4	1	5	60	40	25	25	150
AX-123	Programming in 'C'	4	0	2	4	1	5	60	40	25	25	150
AF-126	Workshop-I	0	0	2	0	1	1	--	--	50	--	50
AM-110	Engineering Economics and Principles of Management	3	0	0	3	0	3	60	--	--	40	100
							27					**850**

Dharmsinh Desai University

Faculty of Technology

Department of Instrumentation and Control Engineering

Teaching, Credit and Exam scheme

Semester II

SEMESTER- II [IC]												
SUBJECT CODE	SUBJECT	TEACHING SCHEME			CREDIT STRUCTURE		TOTAL CREDIT	Exam Scheme (Marks)				
		LECT	TUT	PRA	L+T	P		Theory (3 hrs)	Sessional (1 hrs 15 min)	Practical	T/W	Total
AF-201	Mathematics-II	4	0	0	4	0	4	60	40	--	--	100
AF-214	Mechanics of Solids	3	0	2	3	1	4	60	40	25	25	150
CT-216	Electronic Work Shop	0	0	2	0	1	1	--	--	--	50	50
CT-212	Engineering Graphics	4	0	3	4	1.5	5.5	60	40	--	50	150
AF-212	Electronics Principles	4	0	2	4	1	5	60	40	25	25	150
AX-223	Advanced C Programming	4	0	2	0	1	5	60	40	25	25	150
ES-210	Environmental Sciences	3	0	0	3	0	3	60	--	--	40	100
							27.5					**850**

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Department of Instrumentation and Control Engineering

Teaching, Credit and Exam scheme

Semester III

SEMESTER- III [IC]												
SUBJECT CODE	**SUBJECT**	**TEACHING SCHEME**			**CREDIT STRUCTURE**		**TOTAL CREDIT**	**Exam Scheme (Marks)**				
		LECT	**TUT**	**PRA**	**L+T**	**P**		**Theory (3 hrs)**	**Sessional (1 hrs 15 min)**	**Practical**	**T/W**	**Total**
AF-301	Mathematics-III	4	0	0	4	0	4	60	40	--	--	100
AF-310	Financial and Managerial Accounting	3	0	0	3	0	3	60	--	--	40	100
CI-308	Linear Electronics-I	4	0	2	4	1	5	60	40	25	25	150
IC-301	Electronic Measurement	4	0	2	4	1	5	60	40	25	25	150
EL-304	Network Analysis	4	0	2	4	1	5	60	40	25	25	150
IC-302	Digital Electronics	4	0	2	4	1	5	60	40	25	25	150
							27					**800**

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Semester IV

SEMESTER- IV [IC]												
SUBJECT CODE	**SUBJECT**	**TEACHING SCHEME**			**CREDIT STRUCTURE**		**TOTAL CREDIT**	**Exam Scheme (Marks)**				
		LECT	**TUT**	**PRA**	**L+T**	**P**		**Theory (3 hrs)**	**Sessional (1 hrs 15 min)**	**Practical**	**T/W**	**Total**
AF-401	Mathematics-IV	4	0	0	4	0	4	60	40	--	--	100
IC-407	Control Theory	4	0	2	4	1	5	60	40	25	25	150
CI-418	Linear Electronics-II	4	0	2	4	1	5	60	40	25	25	150
IC-406	Power Electronics	4	0	2	4	1	5	60	40	25	25	150
CI-416	Electrical Machines and Power	4	0	2	4	1	5	60	40	25	25	150
IC-408	Control Technology: Components and Systems	4	0	2	4	1	5	60	40	25	25	150
							29					**850**

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Teaching, Credit and Exam scheme

Semester V

SEMESTER- V [IC]												
SUBJECT CODE	**SUBJECT**	**TEACHING SCHEME**			**CREDIT STRUCTURE**		**TOTAL CREDIT**	**Exam Scheme (Marks)**				
		LECT	**TUT**	**PRA**	**L+T**	**P**		**Theory (3 hrs)**	**Sessional (1 hrs 15 min)**	**Practical**	**T/W**	**Total**
IC-514	Micro Processor and Micro Controller	4	0	2	4	2	5	60	40	25	25	150
IC-519	Industrial Electronics & Drives **Program Elective-I**	4	0	2	4	1	5	60	40	25	25	150
IC-515	Simulation Tools **Program Elective-I**							60	40	25	25	150
IC-516	Measurement Techniques	4	0	2	4	1	5	60	40	25	25	150
IC-517	Process Measurement	4	0	2	4	1	5	60	40	25	25	150
IC-518	Communication Systems	4	0	2	4	1	5	60	40	25	25	150
AF-501	Professional Communication-I	1	0	2	1	1	2	50	--	50	--	100
							27					**850**

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Teaching, Credit and Exam scheme

Semester VI

SEMESTER- VI [IC]												
SUBJECT CODE	**SUBJECT**	**TEACHING SCHEME**			**CREDIT STRUCTURE**		**TOTAL CREDIT**	**Exam Scheme (Marks)**				
		LECT	**TUT**	**PRA**	**L+T**	**P**		**Theory (3 hrs)**	**Sessional (1 hrs 15 min)**	**Practical**	**T/W**	**Total**
IC-610	Micro Controller Applications	4	0	2	4	1	5	60	40	25	25	150
IC-611	Instrumentation Systems	4	0	2	4	1	5	60	40	25	25	150
IC-619	Smart Instruments **Program Elective-II**	4	0	2	4	1	5	60	40	25	25	150
IC-620	Analytical Instrumentation **Program Elective-II**											
IC-612	Power Plant Automation **Program Elective-II**											
IC-613	Process Instrumentation and Control	4	0	2	4	1	5	60	40	25	25	150
IC-616	Automation systems Integration	4	0	2	4	1	5	60	40	25	25	150
AF-601	Professional Communication-II	1	0	2	1	1	2	50	--	50	--	100
							27					**850**

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Teaching, Credit and Exam scheme

Semester VII

SEMESTER- VII [IC]

SUBJECT CODE	SUBJECT	TEACHING SCHEME			CREDIT STRUCTURE		TOTAL CREDIT	Exam Scheme (Marks)				
		LECT	TUT	PRA	L+T	P		Theory (3 hrs)	Sessional (1 hrs 15 min)	Practical	T/W	Total
IC-709	Biomedical Instrumentation	4	0	2	4	1	5	60	40	25	25	**150**
IC-710	Advanced Control Theory & System Design	4	0	2	4	1	5	60	40	25	25	**150**
IC-711	Digital Signal Processing **Program Elective-III**	4	0	2	4	1	5	60	40	25	25	**150**
IC-712	Modeling, Simulation and Evolutionary Techniques **Program Elective-III**	4	0	2	4	1	5	60	40	25	25	**150**
IC-713	Embedded Systems **Program Elective-III**	3	1	2	4	1	5	60	40	25	25	**150**
IC-714	Process Control	4	0	2	4	1	5	60	40	25	25	**150**
IC-715	Robotics Engineering	4	0	2	4	1	5	60	40	25	25	**150**
IC-716	Industrial Exposure and Practices	0	0	6	0	3	3	--	--	25	25	**50**
							28					**800**

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Teaching, Credit and Exam scheme

Semester VIII

SEMESTER- VIII [IC]												
SUBJECT CODE	SUBJECT	TEACHING SCHEME			CREDIT STRUCTURE		TOTAL CREDIT	Exam Scheme (Marks)				
		LECT	TUT	PRA	L+T	P		Theory (3 hrs)	Sessional (1 hrs 15 min)	Practical	T/W	Total
AF-801	Project and Industrial Training	0	0	28	0	14	14	--	--	300	100	**400**
AF-802	Seminar	0	0	8	0	4	4	--	--	-	100	**100**
							18					**500**

Total Credit for B.Tech I.C Engineering Programme = 210.5

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MATHEMATICS-I (AF-111)

SEM-I (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	-	-	60	40	-	--	100	4	--	--	4

A. OBJECTIVES OF THE COURSE

- Ability to analyse and solve problems in both familiar and unfamiliar situations including those in real-life contexts with better accuracy.
- Able to apply knowledge of key theories, concepts, tools and techniques of Mathematics to solve structured and unstructured Engineering problems.
- Understand and be able to use the language, symbols and notation of mathematics
- Use different forms of mathematical representation (formulae, diagrams, tables, charts, graphs and models)
- Generate and/or analyze information, find relationships and patterns, describe these mathematically as general rules, and justify or prove them.

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B. DETAILED SYLLABUS
DIFFERENTIAL CALCULUS :

Applications of differential calculus to geometrical problems,equation of tangent & normal, angle between two curves, subtangent, subnormal, length of tangent & length of normal,pedal equation, radius of curvature of plane curves in cartesian, polar and parametric equations, radius of curvature at origin by newton's method and by method of expansion.

SUCCESSIVE DIFFERENTATION :

Leibnitz's theorem, Maclaurin's theorem, Taylor's theorem, Applications to obtain expansion of functions.

INTEGRAL CALCULUS:

Curve Tracing, applications for finding area, length of arc, volume and surface area of solids of revolutions.

REDUCTION FORMULA FOR

sin x dx, cos x dx, sin x cos x dx , tan x dx and cot x dx etc.

BETA AND GAMMA FUNCTION:

Definition, properties, relation between Beta and Gamma functions, use in evaluation of definite integrals.

ELLIPTIC AND ERROR FUNCTIONS:

Definitions and Properties and use in evaluation of definite integrals.

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FIRST ORDER DIFFERENTIAL EQUATION:

Formation of differential equations, general and particular solution, equations of first order & first degree of the type variables separable, homogenous, reducible to homogenous, linear & exact and reducible to these forms. Application to geometrical and physical problems.

C. LEARNING OUTCOMES

- To answer at least about the convergence or divergence of integral when integral is not easily evaluated using techniques known.
- Able to evaluate the volume and surface area of the solid generated by revolving the solids by Integration.
- Apply the knowledge of differential equation to solve some practical problems such as electrical circuits, Newton's Law of cooling and problem related to orthogonal trajectories.
- Apply the knowledge of differentiation to obtain the series of function.
- Able to evaluate curvature of the given function.

D. RECOMMENDED TEXTBOOKS

1) Engineering Mathematics-II By : Shanti Narayan, S. Chand & Company (PVT.) Ltd. Ram nagar, Delhi

2) Higher Engineering Mathematics. By : Dr. B.S.Grewal, Khanna publishers, Delhi

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E. REFERENCE BOOKS

1) Engineering Mathematics-I, By : Shanti Narayan, S. Chand & Company (PVT.) Ltd.

2) Applied Mathematics, By : P.N. & J.N. Wartikar,

3) Engineering Mathematics-I By : I.B. Prasad

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

Not applicable

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ENGINEERING MECHANICS (AF-124)

SEM-I (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
3	-	2	60	40	25	25	150	3	--	1	4

B. DETAILED SYLLABUS

A. STATICS :
Introduction, engineering and S.I. units, accuracy in engineering calclations, Vectors composition and resolution, concept of Rigid Body. Resultant of a force system:
i) Concurrent Coplanner Force System

ii) Non concurrent Coplanner Force System
(a) parallel and (b) non parallel Using analytical as well as graphical methods. iii) Simple cases of concurrent force system in space. Concept of internal force, free body diagram. Equilibrium of force system listed above. Friction : Friction on an inclined plane, ladder friction, wedge friction, screw friction, belt and rope drive. Centre of gravity of lines, plane figures, volumes, bodies and Pappu's Theorem. Principle of Virtual Work and its application. Types of Beams, Types of Supports, Support Reaction for statically determinate beams.
B. DYNAMICS:
Rectilinear motion, Circular motion, Projectiles, Relative velocity, Instantaneous centre in plane motion. Laws of Motion, Motion along an inclined plane, Principle of conservation of Momentum, Mass Moment of Inertia in Rotational Motion, Motion of connected

bodies, Impulse and Momentum, Impact, work power and Energy, D Alembert's principle, vibrations of SDOF systems. Motion along a smooth curve and super elevation.

C. LEARNING OUTCOMES

After completion of the course students should be able to:

1. Understand and describe concept of rigid body
2. Describe resultant force systems using analytical and graphical methods
3. Describe concept of internal forces
4. Describe various types of motions like rectilinear, circular. Projectile etc.
5. Understand and describe laws of motion and its applications

D. Text Books:

1. Mechanics for Engineers - Statics By : F.P.Beer and E.R.Johnston Jr.
2. Mechanics for Engineers - Dynamics By :F.P.Beer and E.R.Johnston Jr.
3. Engineering Mechanics: Statics & Dynamics By: A.K.Tayal

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ELEMENTS OF MECHANICAL ENGINEERING (AX-124)

SEM-I (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES OF THE COURSE:

Students belonging to all branches of engineering are made to learn certain fundamental topics related to mechanical engineering so that they will have a minimum understanding of mechanical processes and basic equipment like boilers, compressors, I.C. engines, refrigeration and air conditioning etc...

B. DETAILED SYLLABUS

1 INTRODUCTION

Systems of units, Pure and working substance, properties of substance, energy, thermodynamic system, surroundings and system boundary, Path and point functions, Thermodynamic equilibrium, law of conservation of energy, Specific heat capacity, thermodynamic process and cycle

2 PROPERTIES OF STEAM:

Distinction between gas and vapour, Steam formation, Sensible heat, Latent heat, Total heat and super heat of steam, Condition of steam, Dryness fraction, Properties of steam i.e. Enthalpy, Internal energy, Density and Specific volume, Critical pressure and temperature of steam, External work of evaporation and internal latent heat. Combined separating and throttling calorimeter

3 PROPERTIES OF GASES

Zeroth, first and second laws of thermodynamics, laws of perfect gases (Boyle's law, Charle's law, Regnault's law, Joule's law), Characteristic equation of gas, gas constants, internal energy, specific heat at constant pressure and specific heat at constant volume, relationship between specific heats, thermodynamic processes of perfect gases (constant volume, constant pressure, constant temperature, isentropic and polytropic)

4 FUELS AND COMBUSTION

Introduction, Classification of Solid fuels, Liquid Fuels, Gaseous fuels, LPG, CNG and bio fuels, Calorific values, Combustion of fuels, Minimum air required for combustion of fuels

5 REGRIGERATION AND AIR CONDITIONING

Introduction, Evaporation, Refrigerating effect, Unit of refrigeration and COP, Important refrigerants, Refrigerating systems i.e. Air refrigerating system, Ammonia absorption refrigerating system and Vapour compression refrigerating system, Analysis of vapour compression refrigeration system, i.e. COP, mass flow rate, heat rejected from condenser, power consumption etc. Window and split air conditioners: principles and working

6 BOILERS

Introduction, Classification, Cochran & Babcock-Wilcox boiler, Evaporation in boiler, Equivalent evaporation, Boiler efficiency, Functioning of boiler mountings and accessories. Boiler draught, Classification and comparison of boiler draught systems

7 I. C. ENGINES

Prime mover and its classification, advantages of I.C. engines over E.C. engines, classification of I.C. engines, thermodynamic air cycles i.e. Carnot cycle, Constant volume OTTO cycle and Diesel cycle, Air standard efficiency, construction and working of 2–stroke

and 4–stroke cycle engines, p-v diagrams, I.C. engine performance. Calculations of Indicated power, brake power, efficiencies, specific fuel consumption

8 AIR COMPRESSORS

Introduction, Classification, Working of reciprocating air compressors, air compressor terminology, Work of compression, Reciprocating compressor efficiency, Introduction and classification of rotary air compressors, Comparison between reciprocating and rotary compressor

C. LEARNING OUTCOMES

After successful completion of this course, students belonging to all branches of Engineering would be able to understand fundamental aspects related to important mechanical processes and basic equipment like boilers, compressors, I.C. engines etc...

D. RECOMMENDED TEXTBOOKS

1. Elements of Heat Engines (S.I. Units) Vol. 1, R. C. Patel & C. J. Karamchandani, Acharya Book Depot, Vadodara

2. Elements of Mechanical Engineering, A. V. Mehta, Everest publishing house, Pune

3. Elements of Mechanical Engineering, P. S. Desai & S. B. Soni, Atul Prakashan, Ahmedabad

E. REFERENCE BOOKS

1. Heat Engine, P. L. Ballaney, Khanna Publishing Company

2. A course in Thermal Engineering, Domkundwar, S and Kothandaraman, C. P., Dhanpat Rai and Sons

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD

Term work/ Practicals contents shall be based on above syllabus contents.

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WORKSHOP – I (AF-136)

SEM-I (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
--	-	2	--	--	--	50	50	--	--	1	1

A. OBJECTIVES OF THE COURSE:

Students belonging to all branches of engineering are made understand workshop layout, importance of various sections/shops of workshop, General safety rules and work procedure of work shop

Students belonging to all branches of engineering are made understand importance or workshop practice in engineering and are given exposure to use practically by themselves of basic tools and equipment used for performing basic operations related to carpentary, tin smithy and plumbing individually.

B. DETAILED SYLLABUS

1 INTRODUCTION TO WORKSHOP

Workshop layout, importance of various sections/shops of workshop, type of jobs done in each shop, General safety rules and work procedure of work shop

2 TIN SMITHY (ONE JOB)

Tin smithy tools like –hammers, stakes, scissors etc. sheet metal operations such as shearing, bending, joining, safety precautions, demonstration of various operations

3 CARPENTRY (ONE PRACTICE JOB AND ONE JOINT JOB)

Carpentry tools like –saw, planner, chisels, hammers, pallet, making gauge, vice, tee square, rule etc., carpentry operations such as marking, sawing, planning, chiselling, grooving, boring, joining, type of woods and carpentry hardware, safety precaution, demonstration of various operations by using hardware

4 PIPE FITTING (ONE JOB)

Pipe fitting tools, pipe fitting operations such as marking, cutting, bending, threading, assembling, dismantling etc. Types of various spanners such as flat, fix, ring box-adjustable etc, Safety precautions, demonstration of various operations.

C. LEARNING OUTCOMES

After successful completion of this course, students belonging to all branches of engineering would be able to understand and able to use themselves of basic workshop tools used in carpentry, tin smithy and plumbing.

D. TEXT BOOKS

1. Manual Developed by Mechanical Engineering Department.
2. Work shop technology, A. K. Hajrachaudhari & S. K. Hajrachaudhari

E. REFERENCE BOOKS

1. ITB Hand book, Engineering industry training board
2. Work shop Technology Vol. I & II, Gupta & Kaushik

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BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (AF-122)

SEM-I (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES

To expose the students to the concepts of various types of electrical, electronic and magnetic circuits and their applications.

B. DETAILED SYLLABUS

[1] FUNDAMENTALS OF CURRENT ELECTRICITY AND DC CIRCUITS

Introduction, Computation of Resistance at constant temperature, Temperature dependence of Resistance, Computation of Resistance at different temperatures, Ohm's law statement, Illustration and limitation, Kirchhoff's laws-statement and illustration, Resistance in parallel and current division technique, Method of solving a circuit by Kirchhoff’s laws.

[2] MAGNETIC CIRCUITS

Introduction, Definition of Magnetic quantities, Magnetic circuit, Leakage flux, Fringing effect, Comparison between magnetic and electric circuits.

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[3] ELECTROMAGNETIC INDUCTION

Introduction, Magnetic effect of electric current, Current carrying conductor in magnetic field, Law of electromagnetic induction, Induced emf, Self-Inductance (L), Mutual Inductance (M), and Coupling coefficient between two magnetically coupled circuits (K), inductor in series.

[4] AC FUNDAMENTALS

Introduction, Waveform terminology, Concept of 3-phase emf generation, Root mean square (RMS) or effective value, Average Value of AC, Phasor representation of alternating quantities, Analysis of AC circuit.

[5] SINGLE PHASE AC CIRCUITS

Introduction, j operator, Complex algebra, Representation of alternating quantities in rectangular and polar forms, RL series circuit, RC series circuit, RLC series circuit, Admittance and its components, Simple method of solving parallel AC circuits, Resonance.

[6] ELECTRICAL MACHINES

Working principles of DC machine, Transformer, Three phase Induction Motor.

[7] DIODE THEORY

Semiconductor theory, Conduction in crystals, Doping source, The unbiased diode, Forward bias, Reverse bias, Linear devices, The diode graph, Load lines, Diode approximations, DC resistance of a diode.

[8] DIODE CIRCUITS

The sine wave, The transformer, The half wave rectifier, The full wave rectifier, The bridge rectifier, The capacitor input filter, Diode clipper and clamper circuit.

[9] SPECIAL PURPOSE DIODES

The Zener diode, The Zener regulator, Optoelectronic devices

C. LEARNING OUTCOMES

At the completion of the course, students will be able to …

- Analyse the various electric and magnetic circuits.
- Understand 1-phase and 3-phase supply terminology.
- Understand the effect of R, L and C in single phase ac circuit.
- Compare various diode circuits and rectifier circuits.
- Understand significance of resonance in series and parallel RLC circuit.
- Identify the various parts of electrical machines and their working.

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D. TEXTBOOKS

1. Basic Electrical, Electronics and Computer Engineering Authors : R. Muthusubramanian, S. Salivahanan, K. A. Muraleedharan Edition : 2nd Edition Publisher : Tata McGraw Hill

2. Electronics Principles Authors : Albert Paul Malvino Edition : 6 th Edition Publisher : Tata McGraw Hill

E. REFERENCE BOOKS

1. Electrical Engineering Authors : B. L. Theraja Edition : 23 rd Edition Publisher : S. Chand & Company Ltd

2. Electrical Machines Authors : B. L. Theraja Edition : 23 rd Edition Publisher : S. Chand & Company Ltd

F. LIST OF EXPERIMENTS

1. Basic Electronic Devices
2. Verification of Ohm's Law
3. Resistance, Inductance and Power Factor of Single Phase Circuit
4. Charging and Discharging of a Capacitor
5. R-L and R-C Circuit
6. Resonance in R-L-C Series Circuit
7. Diode Characteristic
8. Half Wave and Full Wave and Bridge Rectifier Circuits
9. Clipper Circuit and Clamper Circuit

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PROGRAMMING IN C (AX-123)

SEM-I (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES

Introduction of C programming. In addition, students should acquire skills for programming using C features such as Operators, Decision Making And Branching and Looping, Arrays, Character Strings and User Defined Functions, etc.

B. DETAILED SYLLABUS

[A] INTRODUCTION : Introduction to Computer Hardware & OS, Introduction to DOS commands & languages, Introduction to Programming in C

[B] CONSTANTS, VARIABLES AND DATA TYPES: Constants , Variables & Data types in C, Declaration & Initialization of C variable, Basic C programs , Defining symbolic constants

[C] OPERATORS AND EXPRESSIONS : Operators in C, Operators in C & The ? : operator, Arithmetic Expressions & Precedence Rule, Type conversion in C, Mathematical Functions

[D] MANAGING INPUT AND OUTPUT OPERATORS: Reading / Writing characters, Formatted Input operations, Formatted Output operations

[E] DECISION MAKING AND BRANCHING: Decision making with If & If .. Else statements, If .. Else statements (Nested …. Ladder), The Switch & go to statements

[F] DECISION MAKING AND LOOPING: The while statement, The break statement & The Do.. While loop, The FOR loop, Jump within loops – Programs

[G] ARRAYS : Development of simple programs using loops, Introduction to one dimensional array, Array Programs

TERM WORK: The laboratory and termwork will be based on above topics.

C. LEARNING OUTCOMES

At the completion of the course, students will be able to …

1. Get familiar with C programming language.
2. Understand Basics features of C Language.
3. Implement programming solutions using other features of the C language including Operators, Arrays, Character Strings and User Defined Functions.

D. Text Books:

1 PROGRAMMING IN ANSI C By E. BALAGURUSAMY 2nd Edition TMH Publications

E. Reference Books:

1 Let us C. By : Yashwant Kanitkar

2. Programming in C By: Venugopal

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F. LIST OF EXPERIMENTS

- Write and Execute a Simple C Program.
- Demonstrate standard Input /Output Functions.
- Defining appropriate Operators and Expressions.
- To study various Formatted Input /Output operations.
- Implementing Decision Making and Branching (IF…Else).
- Implementing Decision Making and Branching (Switch…Case).
- Develop a C program using goto and continue.
- Implementing Decision Making and Looping (While and Do…While).
- Implementing Decision Making and Looping (for).
- Demonstrate use of Single Dimensional Array.
- Demonstrate use of Multidimensional Array.
- Use of Character Array as a String.
- Develop a C program with the help of User-Defined Functions.

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ENGINEERING ECONOMICS AND PRINCIPLES OF MANAGEMENT (AM-110)

SEM-I (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
3	-	-	60	--	40	--	100	3	--	--	3

Objective: The need to understand the basics concepts of economics & management are important for the allocation of scarce resources of economy and proper utilization to generate the required products and services. Demand analysis and consumer behavior are the factors which teach about the equilibrium price. Types of markets, product pricing and factor pricing leads to a better understanding of a particular product or service demanded by the consumers. Production cost and revenue analysis is important for operation of a profitable business. Monetary & fiscal policies are important for the understanding of consumption, government expenditure, investment, exports and imports. It also educates us about the ways in which the government generates revenue and handles its expenditure for a stable economy.

Learning Outcomes:

After completion of this course students will be able to understand:

- Students will understand the definitions of economics, micro & macroeconomics, utility, money, wealth, consumer and producer surplus
- Students will understand demand, function of demand, elasticity, factors of production, supply & demand equilibrium

- Students will understand types of markets, price discrimination, dumping and kinked demand curve
- Students will understand production, short & long run production function, cost analysis, fixed cost, variable cost, revenue, breakeven analysis
- Students will understand monetary policy, fiscal policy, banking, instruments of monetary policy, liberalization, globalization, privatization, role of government in policy making and business cycles

Detailed Syllabus:

Unit 1- Basic concepts and definitions: **(4 lectures)**

1. Marshall, Robbins and Samuelson's definition of economics
2. Positive and normative economics, micro and macroeconomics
3. Utility, goods and services
4. Money and wealth
5. Consumer and Producer surplus

Unit 2- Demand analysis and consumer behavior: **(6 lectures)**

6. Demand function
7. Law of demand
8. Elasticity of demand and its types
9. Price, income and cross-elasticity

10. Measures of demand elasticity

11. Factors of production

12. Advertising elasticity

13. Law of supply and demand, equilibrium between demand and supply

Unit 3- Markets, product pricing and factor pricing: **(9 lectures)**

14. Concepts of perfect competition

15. Monopoly and monopolistic competition (meaning and characteristics)

16. Control of monopoly

17. Price discrimination and dumping

18. Concept of Duopoly and Oligopoly

19. Kinked demand curve (price leadership model with reference to oligopoly)

Unit 4- Production cost & revenue analysis: **(8 lectures)**

20. Production and production function

21. Short run & long run production function

22. Cost analysis

23. Various concepts of cost

24. Total fixed cost, total variable cost

25. Average fixed cost, average variable cost, average cost & marginal cost opportunity cost

26. Basic concepts of revenue

27. Relationship between average revenue and marginal revenue

28. Breakeven analysis; meaning and explanation

Unit 5- Money: **(9 lectures)**

29. Meaning, functions, types, monetary policy

30. Meaning, objectives, tools, fiscal policy

31. Meaning, objectives, tools, Banking; meaning, types, functions, central bank- RBI, it's function, concepts, Cash reserve ratio, bank rate, repo rate, reverse repo rate, statutory liquidity ratio, functions of central & commercial banks, inflation, deflation, stagflation, monetary cycles, new economic policy, liberalization, globalization, privatization, fiscal policy of the government.

Termwork: **(40 marks)**

- Students will be required submit assignment based on topics covered in the syllabus such as calculation of breakeven point, demand analysis of a product or service, GDP, and inflation.

Text Books:

- Ahuja, H. L. Modern economics; S.Chand: New Delhi, 2002
- Dewett, K. K. Modern economics theory; S Chand: New Delhi, 2006
- Seth, M. L. Monetary economics; Lakshmi Narain Agarwal: Agra, 2018

Reference Books:

- Paneerselvam, R. Engineering economics; PHI publication: New Delhi, 2014
- Robbins, S.; Decenzo, D. A. Fundamentals of management: Essential concepts and applications; Pearson education: New Jersey, 2015
- Mankiw, N. G. Economics: Principles of economics; Cengage learning: USA, 2017
- Williamson, T. R. Introduction to economics; D.C. Health & Company: Chicago, 1923

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MATHS – II (AF-201)

SEM-II (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	-	60	40	--	--	100	4	--	--	4

A. OBJECTIVES OF THE COURSE

- Ability to analyse and solve problems in both familiar and unfamiliar situations including those in real-life contexts with better accuracy.
- Able to apply knowledge of key theories, concepts, tools and techniques of Mathematics to solve structured and unstructured Engineering problems.
- Understand and be able to use the language, symbols and notation of mathematics
- Use different forms of mathematical representation (formulae, diagrams, tables, charts, graphs and models)
- Generate and/or analyze information, find relationships and patterns, describe these mathematically as general rules, and justify or prove them.

B. DETAILED SYLLABUS

PARTIAL DIFFERENTIATION & ITS APPLICATIONS :

Partial derivatives, Homogenous functions Euler's theorem, Total derivatives-Differentiation of implicit functions, Change of variables, errors and approximations, Maxima & Minima of functions of two variables, Lagrange's method of undetermined multipliers.

MULTIPLE INTEGRALS & THEIR APPLICATIONS :

Double integrals, definition evaluation, change of order of integration, double integrals in polar co-ordinates, area enclosed by plane curves, Triple integrals, change of variables, volume of solids.

INFINITE SERIES :

Introduction, Definitions, Convergence, divergence and Oscillation of a series, P-test, Comparision test, Ratio test, Root test, Higher ratio test, Rabbe's test, Log test, Alternating Series, Leibnitz's rule.

COMPLEX NUMBER :

Definition, elementary operations, Argan's diagram, De-Moivre's theorem, and its applications To expand Sinné, Cosné in powers of siné, cosé respectively, To expand sinné , Cosn and Sinmé. Cosné in a series of Sines or Cosines of multiples of é, Hyperbolic functions, Formulae of hyperbolic functions,Inverse hyperbolic functions, Logarithm of complex quantities.Separation of real and imaginary parts. C + iS method.

LAPLACE TRANSFORMS :

Introduction, Definition Transforms of elementary functions, properties of Laplace transforms, Inverse transforms, Note on partial fractions, Transforms of derivatives, Transforms of integrals. Multiplication and division by t, convolution theorem.

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C. LEARNING OUTCOMES: At the end of the course student should be able to

- Obtain Laplace transform of standard Mathematical functions.
- Evaluate Partial Derivatives and apply the knowldege to solve some practical problems such has constrined optimization problems and other problems involving Partial Differentiation.
- Understand the concept of Multiple Integration and its applications viz. Area and Volume.
- Obtain the bahaviour of Infinte series.
- Evaluate Exponential,Trignometric and Hyperbolic Functions of a complex number

D. RECOMMENDED TEXTBOOKS

1) Higher Engineering Mathematics By : Dr. B.S. Grewal, Khanna publisers,Delhi.

E. REFERENCE BOOKS

1) Applied Mathematics for Engineers and Physicists. By : Pipes & Harvill,Mc-Graw Hill Kogakusha Ltd.

2) Applied Mathematics By : P.N. & J.N. Wartikar

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

Not applicable

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MECHANICS OF SOLIDS (AF-214)

SEM-II (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
3	-	2	60	40	25	25	150	3	--	1	4

[A] SIMPLE STRESSES AND STRAINS :
Introduction, stress, strain, tensile, compressive and shear stresses, Elastic limit, Hooke's law, Poisson's Ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus, Bars of Varying sections, Extension of tapering rods, Bars of uniform strength, temperature stresses, Hoop stress, stress on oblique sections, State of simple shear, Relation between Elastic constants.

[B] MECHANICAL PROPERTIES OF MATERIALS:
Ductility, Brittleness, Toughness, Malleability, Behavior of ferrous and non ferrous metals in tension and compression, shear and bending tests, Standard test pieces, Influence of various parameters on test results, True and nominal stress, Modes of failure, Characteristic stress-strain curves, Strain hardening, Hardness, Different methods of measurement, Izod, Charpy and tension impact tests, Fatigue, Creep, Correlation between different mechanical properties, Effect of temperature. Testing machines and special features, Different types of extensometers and compressometers, Measurement of strain by electrical resistance strain gauges.

[C] BENDING MOMENT AND SHEAR FORCE :
Bending moment, shear force in statically determinate beams subjected to uniformly distributed, concentrated and varying loads. Relation between bending moment, shear force and rate of loading.

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[D] MOMENT OF INERTIA :
Concept of moment if Inertia, Moment of Inertia of plane areas, polar moment of Inertia, Radius of gyration of an area, Parallel Axis theorem, Moment of Inertia of composite Areas, product of Inertia, Principal axes and principal Moments of Inertia.
[E] STRESSES IN BEAMS:
Theory of simple bending, Bending stresses, moment of resistance, modulas of section, Built up and composite beam section, Beams of uniform strength, Distribution of shear stress in different sections.

[F] TORSION :
Torsion of circular. solid and hollow section shafts, shear stress angle of twist, torsional moment of resistance, power transmitted by a shaft, keys and couplings, combined bending and torsion, close coiled helical springs.

[G] PRINCIPLE STRESSES AND STRAINS :
Compound stresses, principle planes and principle stresses, Mohr's circle of stress, priciple strains, Angle of obliquity of resultant stresses, principle stresses in beams, principle stresses in shafts subjected to bending, torsion and axial force.

Text Books :
1. Strength of Materials By: Timoshanko (Vol.1 & 2)
2. Strength of Material By: Popov
3. Mechanics of structure By: Junnarkar S.B.
4. Strength of Materials By:S.Ramamrutham.

INTENDED LEARNING OUTCOMES:
After completion of the course students should be able to:
1. Understand the concept of stress and strain
2. Describe various mechanical properties of materials
3. Describe bending moment and shear force, moment of inertia
4. Describe stresses in beams

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ELECTRONIC WORKSHOP (CT-217)

SEM-II (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
--	-	2	--	--	50	--	50	--	--	1	1

- Introduction to Electrical Components : Switches, MCB, ELCB, Tube-light, Bulb, parallel connection of electrical components, wiring in fan and motor
- Introduction to Electronic Components : active and passive components
- Use of basic source & measuring instruments (Power supply, function generator, CRO, DMM)
- Measure voltage, current, frequency, phase difference, power, power factor for single and three phase supply
- Identify various types of ports, cables and connectors
- Linux installation
- Network cabling and crimping for wired and wireless network

- PCB layout design (like proteus) Software installation and layout design using the same ◦ Solder and de-solder electronic components on PCB ◦ Identify and rectify open circuit and short circuit faults in PCB/system.
- Test assembled electronic circuit for various parameters and faults

MINI Project :

Apart from above experiments a group of students has to undertake a mini project. Following are some examples for the same :

- To design a device for charging small battery during door opening and closing.
- To design a mobile charger using solar PC cell panel for offices and house hold.
- To design/develop an electronic weighing machine.
- To design/develop an electronic lock for house in the workshop.
- To design/develop and innovative electrical bell using electronics components

Ref. Books :

1) Electronic Principles, Albert Malvino and David J. Bates , McGraw Hill (7th Edition)

2) Electronic Devices, Thomas L. Floyed, Pearson (7th Edition)

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ELECTRONICS PRINCIPLES (AF-212)

SEM-II (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES

To present a perceptive understanding of the fundamentals of a bipolar junction transistor and its application. Further, nurturing the ability to design and analyze the performance of transistor amplifier using different types of biasing techniques. Expose the students to the concepts of various types of digital circuit as well as concept of signal and systems.

B. DETAILED SYLLABUS

[1] BIPOLAR JUNCTION TRANSISTOR

The unbiased transistor, The biased transistor, Forward-reverse bias, The CE connection, Transistor characteristics, The Base and Collector curves.

[2] TRANSISTOR FUNDAMENTALS

DC load lines, Base bias, Emitter bias, The Operating Point, The Transistor switch.

[3] TRANSISTOR BIASING

Voltage divider bias, VDB analysis, VDB load line, Two-supply emitter bias, other types of bias, PNP Transistors.

[4] AC MODELS

Base biased amplifier, Coupling and bypass capacitors, The superposition theorem for amplifiers, AC resistance of the emitter diode, AC beta, The grounded emitter amplifier, The AC model of a CE stage, Introduction to h - Parameters & Comparison with T & PI models.

[5] VOLTAGE AMPLIFIERS

Voltage gain, The loading effect of input impedance, Multistage amplifiers, Swamped amplifier.

[6] CC AND CB AMPLIFIERS

The CC amplifier, the AC model of an Emitter Follower, Types of coupling, Direct coupling, Darlington connections.

[7] CLASS A AND B POWER AMPLIFIERS

The AC load line of a CE amplifier, AC load lines of other amplifier, Class A operation.

[8] OSCILLATORS

Theory of sinusoidal oscillation.

[9] FREQUENCY DOMAIN

The Fourier series, The spectrum of a signal, Frequency spectrum of periodic signal

[10] FREQUENCY MIXING

Nonlinearity, Medium-signal, operation with one sine wave, Medium signal operation with Two sine waves.

[11] AMPLITUDE MODULATION

Basic idea, Percent modulation, AM spectrum, the envelope detector, the super heterodyne Receiver.

[12] DIGITAL CIRCUITS

Number systems, Complements, Error detecting codes, Boolean algebra, Logic gate ICs, RTL & DTL logic circuits, and Simple Combinational circuits, Half adder, Full adder

C. LEARNING OUTCOMES

At the completion of the course, students will be able to …

- Analyse and designing of the various transistor amplifier circuits.
- Understand the importance of R_E, R_C, C_B and C_E in transistor circuit.
- Compare various biasing techniques and its importance in design of circuit.
- Understand significance of feedback in amplifier circuit.
- Build their notion about the digital electronics circuit and its applications.
- Gain insight of the signal and its frequency spectrum for random signal.
- Understand the concept of the modulation and its application in wireless communication.

D. TEXT BOOK:

(1) Electronic Principles (Third Edition) By : Albert Paul Malvino Tata McGraw Hill Publishing Co.Ltd, New Delhi.
(2) Basic Electrical, Electronics & Computer Engg. By-R.Muthusubramanian, S.Salivahanan, K.A.Muraleedharan. Tata McGraw Hill Co, Ltd, New Delhi.

E. REFERENCE BOOKS

1. Electronic Devices and Circuit Theory Authors: Robert Boylestad and Louis Nashelsky Edition : 7th Edition

Publisher : Prentice Hall of India

2. Digital Electronics Authors : Anand Kumar Edition : 1st Edition Publisher : Prentice Hall of India

F. LIST OF EXPERIMENTS

1. Study and performance of different types of logic gates.
2. Performance verification of NAND and NOR as universal gate.
3. Application of transistor as a switch.
4. Computation of voltage gain in transistor as an amplifier.
5. Significance of Emitter Resistance (RE) and Collector Resistance (RC) on voltage gain of CE amplifier.
6. Multistage amplifier using BJT.
7. Study loading effect on multistage amplifier using emitter follower as a buffer.
8. Analysis of common base configuration of transistor amplifier.
9. Binary to Gray code and Gray to Binary code conversion using combinational circuit.

10. Performance analysis of Half adder and Full adder using basic logic gates.
11. Combinational circuit analysis of half and full subs tractor using basic logic gates.
12. Study of amplitude modulation for different modulation index.

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ENGINEERING GRAPHICS (CT-212)

SEM-II (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	-	3	60	40	25	25	150	4	--	1.5	5.5

A. OBJECTIVES OF THE COURSE

- The course is aimed at developing basic graphic skills in preparation of basic drawings
- Developing skills in reading and Interpretation of engineering drawings to efficiently communicate ideas graphically
- To understand dimension and annotation two-dimensional engineering drawings
- To understand objects in two-dimensional views to improve visualization skills
- Comprehend general projection theory, with an emphasis on the use of orthographic projection to represent three-dimensional

B. DETAILED SYLLABUS

1 ENGNEERING CURVES: Introduction to different curves & their applications, constructions of curves used in engineering such as Conics (Ellipse, Parabola, Hyperbola), Cycloidal curves (Cycloid, Epi-Cycloid, Hypo-Cycloid), Involutes, Archemedian spirals with tangents & normals. 2 PROJECTIONS OF POINTS AND STRAIGHT LINES: Introduction to principal planes, Projections of points, Projections of Lines, construction for H.T. & V.T. Simple applications of projection of points and lines

3 PROJECTIONS OF PLANES: Introduction to different types of planes, Projections of regular planes such as square, rectangle, triangle, circle, pentagon, hexagon, rhombus etc

4 PROJECTIONS OF SOLIDS: Introduction to different types of solids, Projections of Right & Regular Solids (Prisms, Pyramids, Cylinder and Cone)
5 ORTHOGRAPHIC PROJECTIONS: First angle projection method and third angle projection method.Dimensioning techniques and methods, Conversion of pictorial views into Orthographic Projections with dimensions, Sectional orthographic projection, Orthographic vies with full and half section, special sections.
6 ISOMETRIC PROJECITIONS: Introduction to Isometric planes, Isometric scale, Conversion of Orthographic views into Isometric Projections and views
7 DEVELOPLMENT OF SURFACES: Introduction, methods of development, Development of lateral surfaces of right regular solids (Prism, Cylinder, Pyramid and Cone)

C. RECOMMENDED TEXTBOOKS

1. Engineering Drawing, N. D. Bhatt, Charotar Publication
2. Engineering Drawing Vol.1 & Vol. 2., P. J. Shah

D. REFERENCE BOOKS

1. Fundamentals of Engineering Drawing, Luzadder
2. A Text Book of Geometrical Drawing, P. S. Gill, S. K. Kataria Publication
3. A Text Book of Machine Drawing, P. S. Gill, S. K. Kataria Publication

E. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD

The term work contents shall be based on the above syllabus.

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ENVIRONMENT SCIENCE (ES-210)

SEM-II (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
3	-	-	60	-	40	-	100	3	--	--	3

Objective: The objective for this course is to bring awareness about sustainable development is a key to the future of mankind. Continuing problems of pollution, solid waste disposal, degradation of environment, issues like economic productivity and national security, global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues. Managing environmental hazards have become very important. It is now even more critical than ever before for mankind as a whole to have a clear understanding of environmental concerns and to follow sustainable development practices.

Learning Outcomes:
After completion of this course students will be able to understand:

1. The meaning of environment, ecology, ecosystems, biotic & abiotic components, food chains & webs
2. Natural resources, biodiversity, hotspots, threats to biodiversity
3. Factors causing environmental pollution, prevention of pollution, role of an individual in pollution control & abatement and disaster management
4. Social issues related to environmental science, water conservation, rain water harvesting, environmental ethics, climate change, wasteland reclamation, consumerism and waste products, environment protection act and public awareness
5. Issues of population growth, population explosion, human health and rights
6. Field work related to ecosystems, polluted sites, and species

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Detailed Syllabus:

Unit 1: The multidisciplinary nature of environmental studies **(2 lectures)**

Definition, scope and importance & Need for public awareness

Unit 2: Natural resources **(8 lectures)**

- **Renewable and non-renewable resource**: **Natural resources and associated problems**
- Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams, and their effects on forests and tribal people
- Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefit and problems
- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies
- Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies
- Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies
- Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification
- Role of an individual in conservation of natural resources. Equitable use of resources of sustainable lifestyles

Unit 3: Ecosystems **(8 lectures)**

- Concept of an ecosystem, Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem
- Ecological succession, Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 4: Biodiversity and its conservation **(8 lectures)**

- Introduction definition: Genetic, species and ecosystem diversity
- Bio-geographical classification of India

- Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local levels
- India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity, habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India
- Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity

Unit 5: Environmental Pollution **(8 lectures)**

- Definition, Causes, effects and control measures of:
- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards
- Solid waste management, causes, effects and control measures of urban and industrial wastes
- Role of an individual in prevention of pollution, Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides

Unit 6: Social issues and the environment **(8 lectures)**

- From unsustainable to sustainable development, Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people: its problems and concerns. Case studies
- Environmental ethics: Issues and possible solutions
- Climate change: Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.
- Case studies
- Wasteland reclamation, Consumerism and waste products
- Environment Protection Act: Air (Prevention and Control of Pollution) Act, Water (Prevention &Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness

Unit 7: Human Population and the Environment **(8 lectures)**

- Population growth, variation among nations, population explosion, Family Welfare Program, environment and human health, human rights, Value education
- HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environmental and human health
- Case studies

Unit 8: Field work

- Visit to a local area to document environmental assets (river/forest/grassland/hill/mountain)
- Visit to a local polluted site - Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds
- Study of simple ecosystems – pond, river, hill, slopes etc.

Termwork: **(40 marks)**

1. Students will be required submit assignment based on field work related to biodiversity of the ecosystems, waste management, environmental pollution, and social issues of environment.

Text Books:

- Erach Bharucha *Textbook of Environmental Studies*; Second Edition, Universities Press: Hyderabad, 2013.
- Poonia, M. P.; Sharma, S. C. *Environmental studies*; Khanna Publishing House: New Delhi, 2017.
- Rajagopalan, R. *Environmental Studies*; Oxford University Press: India, 2015.

Reference Books:

1. Varandani, N. S. *Basics of Environmental studies*; Lambert Academic Publishing: Germany, 2013.
2. Basak, A. *Environmental Studies*; Dorling Kindersley: India, 2009.
3. Dhameja, S. K. *Environmental studies*; S. K. Kataria and Sons: New Delhi, 2007.
4. Rao, C. S. *Environmental Pollution Control Engineering*; Wiley publishers: New Delhi, 2006.
5. Brunner, R. C. *Hazardous Waste Incineration*; McGraw Hill: Michigan, 1989.
6. Clark, R. S. *Marine Pollution*; Clanderson Press Oxford: Bath, 2001.
7. Trivedy, R. K. *Handbook of Environmental Laws, Acts, Guidelines, Compliances & standards*; B. S. publications: Hyderabad, 2005.

8. Jadhav, H.; Bhosale, V. M. *Environmental Protection and Laws*; Himalaya Pub. House: Delhi, 1995.
9. Agarwal, K. C. *Environmental Biology*; Nidi Publ.: Bikaner, 2001.
10. Bharucha, E. *The Biodiversity of India*; Mapin Publishing: Ahmedabad, India, 2002.
11. Cunningham, W.P.; Cooper; Gorhani, T. H. E.; Hepworth, M.T., *Environmental Encyclopedia;* Jaico Publ. House: Mumbai, 2001.
12. De, A. K. *Environmental Chemistry;* Wiley Eastern: New Delhi, 2006.
13. Gleick, H. P. Water in crisis, Pacific Institute for Studies in Dev., *Environment & Security*; Stockholm Env. Institute Oxford Univ. Press: New York, 1993.
14. Hawkins, R.E., *Encyclopedia of Indian Natural History*; Bombay Natural History Society: Bombay, 1987.
15. Heywood, V. H.; Waston, R. T. *Global Biodiversity Assessment;* Cambridge Univ. Press: Cambridge, 1995.
16. Mckinney, M.L.; School, R.M. *Environmental Science systems & Solutions*; Web enhanced edition: USA, 1996.
17. Miller, T.G. Jr.; Spoolman, S. E. *Environmental Science*; Cengage learning: Wadsworth, 2014.
18. Odum, E.P. *Fundamentals of Ecology*; W.B. Saunders: USA, 1971.
19. Rao, M. N.; Datta, A.K. *Waste Water treatment*; Oxford & IBH Publ.: New Delhi, 1987.
20. Sharma, B. K., *Environmental Chemistry*; Goel Publ. House: Meerut, 2001.
21. Townsend, C., Harper, J.; Michael, B. *Essentials of Ecology*; Blackwell: Oxford, 2008.
22. Trivedi, R. K., *Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards*, Vol I and II; B. S. Publications, Hyderabad, 2010.
23. Trivedi, R. K.; Goel, P. K. *Introduction to air pollution*; ABD Publishers: Jaipur, 2003.
24. Wanger, K. D., *Environmental Management;* W.B. Saunders Co. Philadelphia, USA, 1998.

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ADVANCED C PROGRAMMING (AX-223)

SEM-II (1st Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES

The purpose of this course is to

- Provide the deep knowledge of Advanced topics of C programming language
- Learn about advanced programming concepts like Pointers, File handling, Preprocessor, Macro, etc.
- Learn about advanced programming concepts like graphics and mouse programming.

B. DETAILED SYLLABUS

[1] STRUCTURES AND UNIONS

Introduction, Structure definition, Giving values to members, Structure initialization, Comparison of structure variables, Arrays of structures, Arrays within structures, Structures within structures, Structures and functions, Unions, Size of structures, Bit fields, Case studies on structures and unions.

[2] POINTERS

Introduction, Understanding pointers, Accessing the address of a variable, Declaring and initializing pointers, Accessing a variable through its pointer, Pointer expressions, Pointer increments and scale factor, Pointers and arrays, Pointers and character strings, Pointers and functions, Pointers and structures, Pointers on pointers, Case studies on pointers.

[3] FILE MANAGEMENT IN C

Introduction, Defining and opening a file, Closing a file, Input/ Output operations on Files, Error handling during I/O operations, Random access to files, Command line arguments, Case studies on file management.

[4] DYNAMIC MEMORY ALLOCATION AND LINKED LISTS

Introduction, Dynamic memory allocation, Concept of linked lists, Advantages of linked lists, Types of linked lists, Pointers revisited, Basic list operations, Application of linked lists, Case studies on Dynamic memory Allocation and linked lists.

[5] THE PREPROCESOR

Introduction, Macro Substitutions, File inclusion, Compiler control directives, ANSI Additions.

[6] C GRAPHICS AND MOUSE PROGRAMMING

Introduction to C Graphics and Mouse Programming.

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C. INTENDED LEARNING OUTCOMES:

At the completion of the course, students will be able to …

- Have deep knowledge of C language.
- Apply his programming knowledge to develop C programs on Pointers, File handling, Preprocessor, Macro, etc.
- Able to implement C Codes on graphics and mouse programming.

D. TEXT BOOK :

1. Programming in ANSI C Authors : Bala guruswamy Edition : 3rd Edition Publisher : Tata McGraw Hill

E. REF.BOOK:

1. Let Us C Authors : Yashvant Kanetkar Edition : 12th Edition Publisher : BPB Publication
2. Journey to C Authors : Punit Ganshani Edition : 1st Edition Publisher : Mahajan Publication House
3. The C Programming Language Authors : Brian W. Kernighan Edition : 2nd Edition Publisher : Prentice Hall of India

F. LIST OF EXPERIMENTS

1. Structure & Union
2. Introduction to Pointers
3. Pointers and Arrays
4. Advanced Features of Pointers
5. File Handling
6. Command Line Arguments
7. Dynamic Memory Allocation
8. Linked List
9. Macros as Preprocessor Directives
10. C Graphics
11. Mouse Programming

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MATHEMATICS-III (AF-301)

SEM-III (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	-	-	60	40	-	--	100	4	--	--	4

A. OBJECTIVES OF THE COURSE

- Ability to analyse and solve problems in both familiar and unfamiliar situations including those in real-life contexts with better accuracy.
- Able to apply knowledge of key theories, concepts, tools and techniques of Mathematics to solve structured and unstructured Engineering problems.
- Understand and be able to use the language, symbols and notation of mathematics
- Use different forms of mathematical representation (formulae, diagrams, tables, charts, graphs and models)
- Generate and/or analyze information, find relationships and patterns, describe these mathematically as general rules, and justify or prove them.

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B. DETAILED SYLLABUS
FOURIER SERIES :

Euler's Formulae, condition for a Fourier expansion, functions having points of discontinuity, change of interval, odd & even functions, Expansion of odd & even periodic functions, Half-range series.

MATRICES:

Fundamental concepts, operations, associated with matrices, matrix method of solution of simultaneous equations, Rank of Matrix, Linear dependence of vectors, consistency of a system of linear equations, characteristic equations, Eigen vectors and Eigen roots, Cayley Hamilton theorem.

ORDINARY DIFFERENTIAL EQUATIONS:

Linear differential equations of higher order with constant coefficients, equations reducible to linear equations with constant coefficients, Simultaneous linear equations with constant coefficients. Application to engineering problems.

PARTIAL DIFFERENTIAL EQUATIONS :

Introduction, formation, linear equation of first order, non-linear equations of first order-Charpit's method, homogenous linear equations with constant coefficient to find the complementary functions & the particular integral, non-homogenous linear equations with constant coefficients. Method of separation of variables - vibrating string problem, Heat flow equation etc.

LAPLACE TRANSFORMS :

Application to differential equation, simultaneous linear equation with constant coefficients.

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C. LEARNING OUTCOMES: At the end of the course students are able to

- Obtain Fourier series of a periodic function into the sum of a (possibly infinite) set of simple oscillating functions, namely sines and cosines.
- Able to apply the method of solving linear system of equations, linear transformation and Eigen value problem as they arise, for instance from electrical networks, framework in mechanics, curve fitting, other optimization problems and processes in statistics.
- Model physical processes using partial and ordinary differential equation and same can be solved analytically as well numerically.
- Solve basic initial value problems, directly without determining a general solution with the help of Laplace Transformation.
- Characterize the solutions of a differential equation with respect to initial values and analyze the behavior of solutions.
- Solve wave and heat equation.

D. RECOMMENDED TEXTBOOKS

1) Higher Engineering Mathematics, Dr. B.S.Grewal

E. REFERENCE BOOKS

1) A Text Book of Applied Mathematics, P.N. & J.N. Wartikar

2) Mathematics for Engineering, Chandrika Prasad

3) A Text Book of engineering Mathemetics, Dr. K.N.Srivastva & G.K.Dhawan

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FINANCIAL AND MANAGEMENT ACCOUNTING (AF-310)

SEM-III (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
3	-	-	60	--	40	--	100	3	--	--	3

Objective: The need to understanding concepts of accountancy is essential in daily life of individuals as well as company where engineering is applied. Thus for better decision making, principles of accounting are applied to produce financial statements which can be appealing to the prospective stakeholders. Traditional and modern approach provides learning to understand different perspectives of accountancy which have evolved over the years. Management accounting is for understanding the Cost-Volume-Profit analysis. Concepts such as ratio analysis along with breakeven analysis are important to compare different companies of the same industry, to do fundamental analysis of a company's financial statements.

Learning Outcomes:

After completion of this course students will be able to understand:

- Concepts and principles of accounting, double-entry bookkeeping, limitations and objectives of accounting.
- Process of accounting
- Balance sheet, profit & loss statement, cash flow statement, and contents of an annual report.
- Breakeven point, marginal cost and breakeven analysis
- Concepts of time value of money, present value, future value, annuity, growing annuity, and perpetuity.

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Unit 1- Financial Accounting – An Introduction: **(5 lectures)**

- Introduction
- Meaning of Accountancy
- Book-keeping and Accounting
- Accounting Process
- Objectives for accounting
- Differences between book-keeping and accounting
- Users of accounting information
- Limitations of Accounting
- Basic terminologies

Unit 2- Accounting Concepts, Principles, Bases and Policies: **(4 lectures)**

Introduction
Accounting Concepts
Principles
Policies and Standards
Types of accounting concepts

- Business Separate entity concept
- Going concern concept
- Money measurement concept
- Periodicity concept
- Accrual concept
- Accounting Principles

- Principle of Income recognition
- Principle of expense
- Principle of matching cost and revenue
- Principle of Historical costs
- Principle of full disclosure
- Double aspect principle
- Modifying Principle
- Principle of materiality
- Principle of consistency
- Principle of conservatism or prudence
- Accounting Policies
- Changes in Accounting Policies
- Disclosure in case of changes in Accounting Policies
- Accounting Standards
- Scope and functions of Accounting Standards Board
- International Financial Reporting System

Unit 3- Double Entry Accounting: **(5 lectures)**

- Introduction
- Meaning of double entry accounting
- Classification of accounts under Traditional approach
- Classification of accounts under Accounting Equation approach
- Comparison of traditional approach with Modern approach equal approach
- Accounting Trail

- Transactions and events
- Meaning and roles of debit and credit
- Accounting equation

Unit 4- Secondary Books: **(3 lectures)**

- Introduction
- Secondary books
- Purchases Book/Purchases Day book
- Cash discount, Trade discount
- Difference between cash discount and trade discount, Sales Book or Sales Day book
- Purchase Returns Book
- Sales Returns Book
- Bills receivable book
- Bills payable book
- Cash book
- Posting to Ledger accounts

Unit 5-Trial Balance: **(4 lectures)**

- Introduction
- Meaning
- Objectives of preparing a trial balance
- Methods of preparing a trial balance
- Preparation of Trial balance

- Adjusting Entries
- Errors and their rectification
- Errors disclosed by Trial Balance
- Errors not disclosed by Trial Balance
- Steps to locate the errors

Unit 6- Final Accounts: **(3 lectures)**

- Introduction
- Adjustments before preparing final accounts
- Depreciation
- Bad Debts and accounting treatment of bad debts
- Provision for doubtful debts
- Reserves for Discount on Debtors
- Reserve for Discount on Creditors
- Closing Stock
- Trading Account
- Profit and Loss Account
- Balance Sheet

Unit 7- Introduction to Management Accounting: **(3 lectures)**

- Introduction
- Meaning of Management accounting
- The Role of Management Accounting

- Management Accounting Framework
- Functions of Management Accounting
- Tools of Management Accounting
- The Balanced Scorecard
- Cost Management System
- Value Added Concept
- Merits of Management Accounting
- Demerits of Management Accounting
- Distinction between Management Accounting and Financial Accounting

Unit 8- Financial Statement Analysis: **(3 lectures)**

- Introduction
- Meaning of Ratio
- Steps in Ratio Analysis
- Classification of Ratios
- Du Pont Chart
- Solved Problems
- Advantages of Ratio Analysis
- Limitation of Ratio analysis

Unit 9- Cash Flow Analysis: **(4 lectures)**

- Introduction
- Meaning of Cash Flow Statement
- Purpose of Cash Flow Statement

- Preparation of Cash Flow Statement
- Format of Cash Flow Statement (AS3: Revised Method)
- Cash Flow from Operating Activities
- Cash Flow Statement under Direct Method
- Different between Cash Flow Analysis and Fund Flow Analysis
- Uses of Cash Flow Statement

Unit 10- Marginal Costing and Break Even Analysis: **(3 lectures)**

- Introduction
- Concept of Marginal Costing
- Characteristics of Marginal Costing
- Difference between Absorption Costing and Marginal Costing
- Marginal Cost
- Contribution
- Cost Volume Profit (CVP) Analysis
- Break Even Chart
- Break Even Point
- Profit Volume ratio or MCSR
- Target profit
- Margin of Safety
- Application of Marginal cost
- Limitations of Marginal cost
- Solved Problems

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Unit 11- Basics of Financial Management: **(3 lectures)**

- Introduction of Financial Management
- Objectives of financial management
- Role of finance manager
- Functions of financial management
- Concept of time value of money
- Present value
- Future value
- Annuity concept
- Solved problems

Term work: **(40 marks)**

1. Students will be required submit assignment based on the topics covered in the syllabus such as ratio analysis for a company, calculation of breakeven point for a product, time value of money

Text Books:

1. Bhattacharya, S. K.; Dearden, J. *Accounting for Management – Text book & cases*; Vikash Publishing House: New Delhi, 2009.
2. Kishore, R. M. *Advanced Management Accounting*; Taxman: New Delhi, 2018.

Reference Books:

1. Arora, M. N. *A Text Book of Cost Accountancy*; Vikas Publishing: Mumbai, 2010.
2. Horngren, C. T.; Foster, S. M.; Datar, G. *Cost Accounting – A Managerial Emphasis*; Prentice Hall: New Jersey, 1997.
3. Prasad, N. K.; A.K. Prasad *Cost Accounting*; Book Syndicate: Kolkata, 2016.
4. Edmonds, T. P.; Edmonds, C. D.; Tsay, B,-Y *Fundamental Managerial Accounting Concept*; Irwin McGraw Hill: Boston, 2013.
5. Bhattacharya, A. *Principles and Practice of Cost Accounting*; Sultan Chand: New Delhi, 2004.
6. Pillai, R. S. N.; Bhagavati, V. *Cost and Management Accounting*; Sultan Chand: New Delhi, 2010.
7. Banerjee, B. *Cost Accounting – Theory & Practices;* Sultan Chand: New Delhi, 2014.
8. Saxena V. K.; Vashist, C. D. *Advanced Cost & Management Accounting – Problems & Solutions*; Prentice Hall of India: New Delhi, 2015.
9. Maheshwari, S. N. *Studies in Cost Management*; Sultan Chand & Sons: New Delhi, 2013.
10. Rao, M. E. T. *Cost and Management Accounting*; New Age International: New Delhi 2004.
11. Rao, M. E. T. *Management Accounting*; New Age International: New Delhi 2003.

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LINEAR ELECTRONICS-I (CI 308)

SEM-III (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES OF THE COURSE

1. To understand the basic physical structure, principles of operation, electrical characteristics and circuit models of semiconductor devices like, various diodes, transistors and field effect transistors.
2. To understand and analyze the effect of temperature on operating point stability of BJT.
3. To introduce combination of devices in integrated-circuit form as basic system building blocks.

B. DETAILED SYLLABUS

[A] JUNCTION-DIODE CHARACTERISTIC:
The Temperature Dependence of the V/I Characteristics, Diode Resistance, Space- Charge, or Transition Capacitance CT, Charge controlled Description, Diffusion Capacitance, Junction-Diode Switching Times, Breakdown Diodes, Tunnel Diodes, Sampling gate.
[B] BIPOLAR TRANSISTOR CHARACTERISTICS: The Junction Transistor, Transistor Current Components, The Transistor as an Amplifier, Transistor Construction, The Common-Base (CB) Configuration, The Common-Emitter (CE) Configuration, The CE Cutoff Region, Currents, The CE Saturation Region, Typical Transistor-Junction Voltage Values, Common-Emitter Current Gain, Common Collector
Configuration, Inverted Mode of Operation, Transistor Ratings, Additional Transistor Characteristics, Transistor Switching Times.

[C] TRANSISTOR BIASING & THERMAL STABILIZATION:
The Operating Point of a BJT, Bias Stability, Self-Bias or Emitter Bias, Stabilization against variations in Ico, VBE and, β, Bias Compensation, Biasing Technique for Linear Integrated Circuits, Thermistor & Sensistor Compensation.

[D] FREQUENCY RESPONSE OF AMPLIFIERS:
Transistor Hybrid Model, The h Parameters, Conversion Formula For The Parameters of the Three Transistor Configurations, Analysis of Transistor Amplifier Circuit Using h Parameters, The Emitter Follower, Comparison of Transistor Amplifier Configurations, Miller's Theorem and its Dual, The Hybrid Pi Common Emitter Transistor Model at high Frequency, Hybrid Pi Conductance, Hybrid Pi Capacitances, Validity of Hybrid Pi Model, Variation of Hybrid Pi Parameters, The CE Shot Circuited Current Gain, Current Gain with Resistive Load, Single Stage CE Transistor Amplifier Response, The Gain Bandwidth Product, Emitter Follower At High Frequency, Step Response of an Amplifier, Band pass of Cascaded Stages.

[E] INTEGRATED-CIRCUITS: FABRICATION AND CHARACTERISTICS
Integrated Circuit (Microelectronic) Technology, Basic Monolithic Integrated Circuits, Epitaxial Growth, Masking and Etching, Diffusion of Impurities, Transistors for Monolithic Circuits, Monolithic Diodes, The Metal Semiconductor Contact, Integrated Resistors, Integrated Capacitors, Characteristics of Integrated Components.

[F] FIELD-EFFECT TRANSISTORS:
Construction & characteristics of JFETs, Transfer characteristics, Depletion type MOSFET, Enhancement-type MOSFET, MOSFET Handling, VMOS, CMOS, JFET biasing circuits, Depletion-type MOSFET biasing circuits, Enhancement-type MOSFET biasing circuits, FET Small signal model, AC analysis of different types of biased FET amplifiers.

C. LEARNING OUTCOMES

1. Students will be able to analyze and design circuits containing elements such as
2. diodes, transistors, and field effect transistors using the concepts of load lines,
3. Operating points and small signal low frequency and high frequency analysis.
4. Students will be able to design a biasing circuit for BJT for a specified stability.
5. Students will get basic idea of fabrication and characteristics of integrated circuits.

D. RECOMMENDED TEXTBOOKS

1. Integrated Electronics, 1st Edition By: Millman & Halkians Publisher: Tata McGraw Hill
2. Electronic Devices & Circuit Theory, 8th Edidtion By: Robert L. Boylestad & Louis Nashelsky Publication: Prentice Hall of India

E. REFERENCE BOOKS

1. Integrated Circuits, 9th Edition By: K. R. Botkar Publication: Khanna Publications

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

1. Characteristics of PN Junction Diode.
2. Characteristics of Zener Diode to obtain Dynamic Resistance.
3. Implementation of Zener Regulator circuit using Data Sheet.
4. Drain and Transfer Characteristics of FET.
5. Four Diode Bridge Sampling Gate Circuit.
6. Input and Output Characteristics of CE Configuration.
7. Input and Output Characteristics of CC Configuration.
8. Frequency Response of RC coupled CE Amplifier.
9. Gain Bandwidth product of Multistage Amplifier
10. Square Wave Response of CE Amplifier.

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ELECTRONIC MEASUREMENT (IC-301)

SEM-III (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES OF THE COURSE

- To familiarize with the technology and practices in the area of Electrical & Electronic Measurement & Instrumentation.
- To develop different type of skills leading to the achievement of following competency, Operation & maintenance of various Electronic,
- Test and Measuring Instrument Measurement of different electrical parameters using variety of instruments

B. DETAILED SYLLABUS

[A] MEASUREMENT AND ERROR: Definitions, Accuracy and Precision, Significant Figures Types of Error, Statistical Analysis, Probability of Errors Limiting Errors.

[B] SYSTEM OF UNITS OF MEASUREMENT: Fundamental and Derived Units, Systems of Units, Electric and magnetic Units, International System of Units, Other Systems of Units, Conversion of Units.

[C] STANDARDS OF MEASUREMENT : Classification of Standards, Standards for Mass Length, and Volume, Time and Frequency Standards, Electrical Standards, Standards of temperature and Luminous Intensity, IEEE Standards.

[D] DIRECT-CURRENT INDICATING INSTRUMENTS : Suspension Galvanometer, Torque and Deflection of the Galvanometer, Permanent-Magnet Moving-Coil Mechanism, DC Ammeters, DC Voltmeters, Voltmeter Sensitivity, voltmeter, Ammeter Method of Measuring Resistance, Series-Type Ohmmeter Shunt-Type ohmmeter, Multimeter or VOM, Calibration of DC Instruments, Alternating-Current indicating instruments Thermo instruments, Electrodynamometers in Power Measurements Watt-hour Meter, Power- Factor Meter, Instrument Transformers.

[E] BRIDGES AND THEIR APPLICATION: Introduction, Wheatstone Bridge, Kelvin Bridge,
Guarded Wheatstone Bridge, AC Bridges and Their Application, Comparison Bridges, Maxwell Bridge, Hay Bridge, Schering Bridge, Unbalance Conditions, Wien Bridge, Wagner Ground Connection, Potentiometer.

[F] ELECTRONIC INSTRUMENTS FOR MEASURING BASIC PARAMETERS : Amplified DC Meter, AC Voltmeter Using Rectifiers, True RMS- Responding Voltmeter, Electronic Multimeter, Considerations in Choosing an Analog Voltmeter, Differential Voltmeters, Digital Voltmeters, Component Measuring Instruments, Q Meter, Vector Impedance Meter, Vector Voltmeter, RF Power and Voltage Measurement.

[G] OSCILLOSCOPES: Introduction, Oscilloscope Block Diagram, Cathode Ray Tube CRT Circuits, Vertical Deflection System, Delay Line, Multiple Trace, Horizontal Deflection System, Oscilloscope Probes and Transducers, Oscilloscope Techniques, Special Oscilloscopes.

C. LEARNING OUTCOMES

At the completion of the course, the students will be able to....

- Understand concept, system of units and standards of measurement.
- Measure various electrical parameters with accuracy, precision and resolution, in any electrical/electronic system.
- Use AC and DC Bridge for relevant parameter measurement.
- Use CRO, DSO, Multimeter and LCR meter for appropriate measurement
- Test and troubleshoot electronic circuit using various measuring instruments.

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RECOMMENDED TEXTBOOKS

1. Electronic Instrumentation and Measurement Technique, 5th Edition By: Wlliam D. Cooper & Albert D. Helfrick Publisher: Prentice Hall of India

REFERENCE BOOKS

1. Electrical & Electronic Measurement & Measuring Instruments, 17th Edition By: A.K. Sawhney Publisher: Dhanpat rai & Co.
2. Electronics Measurement & Instrumentation,1st Edition By: R.K.Rajput Publication: S. Chand & Company Ltd

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

1. To determine the resolution and internal resistance of Multimeter by measuring different electrical quantities in various ranges.
2. To study the operation and applications of CRO and DSO.
3. To determine the deflection sensitivity of CRT.
4. To study operation of LCR meter and to measure unknown value of component using LCR meter.
5. To measure unknown value of resistance using Wheatstone bridge.
6. To extend the range of an Ammeter.
7. To extend the range of a Voltmeter.
8. To Calibrate the D'Arsonval movement as a series type ohmmeter.
9. To determine frequency and phase using Lissajous Pattern on CRO/DSO.
10. To find modulation index of a modulated wave on CRO/DSO.
11. To measure high resistance using loss of charge method.
12. Design series type ohmmeter for a given half scale position resistance

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NETWORK ANALYSIS (EL-304)

SEM-III (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES OF THE COURSE

To offer profound understanding about analysis of electrical networks in time domain and using Laplace transforms. The course also aims at describing various theorems and methods for solution of the networks in theory and through hands on.

B. DETAILED SYLLABUS

[A]DEVELOPMENT OF THE CIRCUIT CONCEPT:

Introduction, Charge and Energy, The Relationship of Field and Circuit Concepts, The Capacitance Parameter, The Inductance Parameter, The Resistance Parameter, Units and scaling, Approximation of a Physical System as a circuit.

[B] CONVENTIONS FOR DESCRIBING NETWORKS:

Reference Directions for Current and Voltage, Active Element Conventions, the Dot Convention for Coupled Circuits, Topological Description of Networks.

[C] NETWORK EQUATIONS

Kirchhoff's Laws, The Number of Network Equations, Source Transformations, Examples of the Formulation of Network Equations Loop Variable Analysis, Node Variable Analysis, Determinants: Minors and the Gauss Method, Duality, State Variable Analysis.

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[D] FIRST ORDER DIFFERENTIAL EQUATIONS:
General and particular solutions, Time constants, the integrating factor, More Complicated Networks
[E] INITIAL CONDITIONS IN NETWORKS:
Why Study Initial Conditions? , Initial Conditions in Elements, Geometrical Interpretation of Derivatives, A Procedure for Evaluating Initial Conditions, Initial State of a Network
[F] DIFFERENTIAL EQUATIONS (CONTINUED)
Second order equations ;Internal Excitation, Higher order equations ;Internal Excitation, Networks Excited by External Energy Sources, Response as related to the s-Plane Location of Roots, General Solutions in terms of S,Q and ωn
[G] THE LAPLACE TRNASFORMATION
Introduction, The Laplace Transformation, Some Basic Theorems for the Laplace Transformation, Examples of the solution of problems with the Laplace Transformation, Partial Fraction Expansion, Heaviside's Expansion Theorem, Examples of Solutions by the Laplace Transformation
[H] TRANSFORMS OF SPECIAL SIGNAL WAVEFORMS:
The Shifted Unit Step Function, The Ramp and impulse Functions, Waveform Synthesis, The Initial and Final Value of f (t) from F(s), The Convolution Integral, Convolution as Summation.
[I] IMPEDANCE FUNCTIONS AND NETWORK THEOREMS: The concept of Complex Frequency, Transform Impedance and Transform Circuits, Series and Parallel Combinations of Elements, Superposition and Reciprocity, Thevenin's Theorem and Norton's Theorem.

[J] NETWORK FUNCTIONS: POLES AND ZEROS

Terminal Pairs or Ports, Network Functions for One Port and Two port. The Calculation of Network Function (1)Ladder Networks (2) General Networks, Poles and Zeros of Network Functions, Restrictions on Pole and Zero Locations for Driving-Point Functions, Restrictions on Pole and Zero locations for Transfer Functions, Time-domain Behavior from the Pole & zero plot
[K] TWO PORT NETWORKS
Relationship of two port variables, short circuit admittance parameters, the open circuit impedance parameters, transmission parameters, the hybrid parameters, relationship between parameter sets, parallel connection of two port networks.

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C. LEARNING OUTCOMES

At the completion of the course, students will be able to …

1. Understand behaviour of basic circuit elements- R, L, C.
2. Apply Kirchhoff's Laws to find currents, voltages and power in typical DC electric circuits using a variety of analytical methods.
3. Simplify complicated circuits into the Thevenin's and Norton's equivalent circuits.
4. Represent and analyse networks by differential equations and Laplace transforms.
5. Evaluate the time response of basic circuits with one energy storage element to the sudden application of DC voltage or current as well as to the sudden change in the circuit configuration.
6. Define basic parameters describing a sine wave and evaluate the steady state time response of R, L and C elements supplied by sinusoidal voltage or current sources.
7. Determine two port network parameters and their relationships
8. Develop the concept of Transform Impedance, Transform Admittance and Transfer Functions.

D. RECOMMENDED TEXTBOOKS

1. Network Analysis, 3rd Edition By: M.E. Van Valkenburg Publisher: Prentice Hall of India Private Limited

E. REFERENCE BOOKS

1. Network Analysis and Synthesis, 3rd Edition By: U. A. Patel Publisher: Mahajan Publication House
2. Circuit Theory- Analysis & Synthesis, 1st Edition By: A. Chakrabarti Publication: Dhanpat Rai & Company

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD

1. To verify the Kirchhoff's voltage law (KVL) and Kirchhoff's current law (KCL).
2. Transient and steady state behaviour of R-C circuit.
3. To verify the Thevenin's Theorem.
4. To verify the Norton's Theorem.
5. To verify the Superposition Theorem.

6. To verify the Reciprocity Theorem.
7. To verify the Maximum Power Transfer Theorem.
8. To find the Open circuit impedance (Z) Parameters for two port networks.
9. To find the short circuit admittance (Y) parameters for two port networks.
10. To find the hybrid (h) parameters for two port networks.
11. To find the Transmission (ABCD) parameters for two port networks.
12. To study Network Functions: Poles and Zeros.

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DIGITAL ELECTRONICS (IC-302)

SEM-III (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES OF THE COURSE

B. DETAILED SYLLABUS

[A] BINARY SYSTEMS: Introduction to digital computers and Digital systems, Binary numbers, Number Base Conversion, Octal and Hexadecimal Numbers, Compliments, Binary Codes, Binary Storages and Register, Binary Logic, Integrated Circuits.
[B] BOOLEAN ALGEBRA AND LOGIC GATE: Basic Definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Property of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Other Logic Operations and Digital Logic Gates, IC Digital Logic Families.
[C] SIMPLIFICATIONS OF BOOLEAN FUNCTIONS: The Map Method, Two and Three Variable Maps, Four Variable Map, Five and Six Variable Maps, Product of Sum Simplifications, NAND and NOR Implementations, Don't-Care Conditions, The Tabulation Method, Determinations of Prime–Implicates, Selection of PrimeImplicates, Concluding Remarks.
[D] COMBINATIONATIONAL LOGIC: Introduction, Design Procedure, Address, Subtractor, Code conversion, Analysis Procedure, Multilevel NAND Circuits, Multilevel NOR Circuits, Exclusive OR and Equivalence Functions.

[E] COMBINATIONAL LOGIC WITH MSI AND LSI: Introduction, Binary Parallel Adder, Decimal Adder, Magnitude Comparator, Decoders, multiplexers, Read Only Memory (ROM), Programmable Logic Array(PLA), Concluding Remarks
[F] SEQUENTIAL LOGIC: Introduction, Flip-Flops, Triggering of Flip-flops, Analysis of Clocked Sequential Circuits, State Reduction and Assignments, Flip-Flop Excitation tables, Design Procedure, Design of Counters, Design of State Equations.
[G] REGISTERS, COUNTERA AND THE MEMORY UNIT Introduction, Registers, Shift Registers, Ripple Counters, Synchronous Counter, Timing Sequence, The Memory Unit, Examples of Random Access Memories.
[H] DIGITAL INTEGRATED CIRCUITS: Introduction, Bipolar Transistor characteristics, RTL and DTL Circuits Integrated-Injection Logic, Transistor-Transistor Logic, Emitter-Couple Logic, Metal Oxide Semiconductor, complimentary MOS.

C. INTENDED LEARNING OUTCOMES: After completion of the course students should be able to:

- Study and understand binary systems
- Understand basics of Boolean algebra and logic gates
- Study and understand combinational logic
- Study and understand sequential logic
- Study and understand basics of sequential logics
- Study and understand basics of registers, counters and memory units
- Study and understand basics digital integrated circuits

D. TEXT BOOK : (1) Digital Logic and Computer Design By M.Morris Mano

E. REF.BOOK: (1) Microelectronics By Jacob Millman & Arvin Grabel McGraw-Hill International Edition

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Department of Instrumentation and Control Engineering

MATHEMATICS-IV (AF-401)

SEM-IV (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	-	-	60	40	-	--	100	4	--	--	4

A. OBJECTIVES OF THE COURSE

- Ability to analyse and solve problems in both familiar and unfamiliar situations including those in real-life contexts with better accuracy.
- Able to apply knowledge of key theories, concepts, tools and techniques of Mathematics to solve structured and unstructured Engineering problems.
- Understand and be able to use the language, symbols and notation of mathematics
- Use different forms of mathematical representation (formulae, diagrams, tables, charts, graphs and models)
- Generate and/or analyze information, find relationships and patterns, describe these mathematically as general rules, and justify or prove them.

B. DETAILED SYLLABUS

FUNCTIONS OF COMPLEX VARIABLE :

Analytic functions, Cauchy -Rieman equations, Harmonic functions, orthogonal system, complex potential function, Determination of conjugate function, conformal transformation, some standard transformations, bilinear transformation,line integral, properties of complex integration, Cauchy's theorem and Cauchy's integral formula.

NUMERICAL METHOD :
Solution of algebraic and transcendental equations, by Newton - Raphson method, Direct iteration method, false position method, Solution of linear simultaneous equation :(1) Gauss - elimination (2) Gauss - jordan (3) Gauss - siedal method , Numerical methods to solve first order and first degree ordinary differential equations by Picard's method &Taylor's series method, Modified Euler's Method, Milne's Method, Runge's method, Runge kutta method.

FINITE DIFFERENCES & DIFFERENCE EQUATIONS :
Finite difference, Interpolation, Newton's forward and backward and central differences and Lagrange's formula, Strling & bessel's formula, Numerical differentation & Integration, Trapezoidal rule, Simpson's (both) rules, Difference equations with constant coefficient.

VECTOR CALCULUS :
Vector function of a single scalar variable, Differentiation of vectors, simple applications to plane, motion, scalar and vector point functions, Del applied to scalar point function (gradient) Divergence of a vector point function, curl of a vector, second order expressions, line integrals, surface integrals, Gauss theorem and stoke's theorem.

STATISTICAL METHODS :
Binomial distribution, poission distribution, normal distribution, calculation of errors, probable errors, standard error, coefficient of correlation, lines of regression.

C. LEARNING OUTCOMES:

- Proficient to apply the theory and concepts of vector differential calculus and vector integral calculus in problems related to fluid flow, heat flow, electro static and so on.

- Understanding concept of Complex numbers and Complex functions and able to check the analyticity based on Cauchy-Riemann equations.
- Able to evaluate the complex integration and real integrals of practical interest.
- Able to interpolate and extrapolate the data with the help of numerical methods.
- Use numerical methods to find an approximate solution of algebraic and transcendental equations using appropriate method.
- Able to handle data numerically or graphically, in order to see what properties data have and what kind of information we can extract and if data influenced by chance student may apply the concepts and rules of probability theory.

D. RECOMMENDED TEXTBOOKS

1) Higher Engineering Mathematics, Dr. B.S.Grewal

E. REFERENCE BOOKS

1) A Text Book of Applied Mathematics, P.N. & J.N. Wartikar & Chandrika Prasad.

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

Not applicable

Dharmsinh Desai University

Faculty of Technology

Department of Instrumentation and Control Engineering

CONTROL THEORY (IC-407)

SEM-IV (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES OF THE COURSE

To prepare students to have knowledge of various types of control systems with characteristics, Transfer function of any control system with different techniques and mathematical model for physical systems, various stability criteria, define system specifications in time and frequency domain, identify stable/unstable systems and relative/ marginally stable various time and frequency domain stability analysis techniques, time-frequency domain concepts, calculate system specifications and solve control problems.

B. DETAILED SYLLABUS

[A] INTRODUCTION: Open-loop and closed loop control system, Servomechanism, Historical development of control system, sampled data & digital control system, Multivariable control system, Application in non-engineering field.

[B] MATHEMATICAL MODELS OF PHYSICAL SYSTEMS: Introduction, Differential equation of physical systems, Transfer functions, Block diagram algebra, signal flow graph. (Note: Problems on electrical, mechanical & electromechanical systems only.)

[C] FEEDBACK CHARACTERISTICS OF CONTROL SYSTEMS: Feedback and non feedback systems, reduction of parameter variations by use of feedback, control over system dynamics by use of feedback, effects of disturbance signals by use of feedback, linearizing effect of feedback, regenerative feedback, Basics of Feed forward Control System with example.

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[D] TIME RESPONSE ALALYSIS, DESIGN SPECIFICATION AND PERFORMANCE INDICES CONCEPTS OF STABILITY AND ALGEBRAIC CRITERIA: Introduction, standard test signals, time response of first order system, time response of second order system, steady state errors and error constants, effects of adding zero to a system, design specifications and constructions for second and higher order systems, performance indices, examples, concepts and conditions for stability, Huwitz's and Routh's stability criteria, relative stability criteria.

[E] THE ROOT LOCUS TECHNIQUE: Introduction, Rules of construction of root loci, sketching of root locus and applications

[F] FREQUENCY DOMAIN ANALYSIS & STABILITY: Frequency domain specifications, correlation between time and frequency domain specifications, Bode plot, Polar plot. Concept of stability, R-H criterion, Nyquist stability.

C. LEARNING OUTCOMES

1. The students shall be able to judge the best stable system by implementing the various techniques.
2. The students shall understand and analysis LTI Systems using various stability analysis techniques.
3. The students shall be able to solve control problems based on system specifications calculations.

D. RECOMMENDED TEXTBOOKS

a) Control System Engineering: By - Nagrath & Gopal

E. REFERENCE BOOKS

1. Control systems Engineering: By – U. A. Patel, Mahajan Publishing House
2. Problems and Solutions of Control Systems With Essential Theory: by Jairath, CBS Publisher
3. Modern Control Engineering: By - K. Ogata , Prentice Hall
4. A course in control engineering: By - A. Subbarao and Parag R. Desai. Dhanpat Rai Publications Ltd.
5. Automatic Control System: By - S.N.Verma , Khanna Publications
6. Feedback Control Systems: By - Di Staffeno

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F. LIST OF EXPERIMENTS

1. To Generate & Study Standard Test Signals using Function generate & DSO
2. Design, Determine & Plot Transient response of First Order System using Scilab & RC Circuit. Required Plat Form: Scilab for Simulation and Function Generator, DSO, Resistors, capacitors, DMM & Probes
3. Design, Determine & Plot Transient response of Second Order System using Scilab & RC Circuit. Required Plat Form: Scilab for Simulation and Function Generator, DSO, Resistors ,capacitors, DMM & Probes
4. Design, Determine, compare & Plot transient response of Type-0, Type-1 & Type-2 system using Scilab & RC Networks. Required Plat Form: Scilab for Simulation and Function Generator, DSO, Resistors , capacitors, DMM & Probes
5. Design, Simulate & Plot Frequency response (Bode Plot) of First Order System. Compare Scilab Results with Practical Results. Required Plat Form: Scilab for Simulation and Function Generator, DSO, Resistors , capacitors, DMM & Probes
6. Design, Simulate & Plot Frequency response (Bode Plot) of Second Order System. Compare Scilab Results with Practical Results. Required Plat Form: Scilab for Simulation and Function Generator, DSO, Resistors, capacitors, DMM & Probes
7. Design & Plot Frequency response of Second Order system for damping factor – 0.1, 0.5 & 1 for second order RC filter using OPAMP.
8. Draw transient response of Under Damp, Over Damp system with respect to Step Input.
9. Design & Sketch Polar Plot for First Order & Second Order System. Required Plat Form: Scilab for Simulation and Function Generator, DSO, Resistors, capacitors, DMM & Probes
10. Simulate Root Locus for first Order & Second Order System for different value of K;0 also observe the effect of K on Position of Poles.

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Department of Instrumentation and Control Engineering

LINEAR ELECTRONICS – II (CI-418)

SEM-IV (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES OF THE COURSE
To offer a profound understanding of the design, analysis, and applications for analog electronics circuits.

B. DETAILED SYLLABUS

[A] P0WER CIRCUITS AND SYSTEMS:
Amplifier Classification, Distortion in Amplifiers, Large-Signal Amplifiers, Harmonic Distortion, , Efficiency of a Class A Amplifier, Push-Pull Amplifiers, Class B amplifiers, Class AB Operation, Regulated Power Supplies, Series Voltage Regulator.

[B] FEEBACK AMPLIFIER CHARACTERISTIC:
Classification of amplifiers, the feedback concept, The Transfer Gain with Feedback, General Characteristics of negative-feedback amplifiers, Input Resistance, Output Resistance, Method Analysis of a feedback amplifier, Voltage-series feedback, Current-series feedback, Current-Shunt feedback, Voltage-shunt feedback.

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[C] OSCILLATORS USING TRANSISTOR:
Sinusoidal Oscillators, The phase-shift Oscillators, Resonant-circuit Oscillators, A general form of Oscillator circuits, Colpitt's Oscillator, Hartley's Oscillator, Clapp's Oscillator, Crystal Oscillators.

[D] OPERATIONAL AMPLIFIER CHARACTERISTICS:
Differential amplifier, DC and AC analysis of bipolar differential Amplifier, The ideal operational amplifier, Inverting and Non-inverting Amplifiers, Op-Amp Parameters, Measurement of Op-Amp Parameters, General description of various stages of Op-Amp, Open-loop and Closed-loop Frequency response, Op-Amp Stability, Frequency Compensation.

[E] LINEAR APPLICATIONS OF OP-AMP:
Summing and Difference amplifiers, Integrator and Differentiator, Current-to-voltage converters, Voltage-to-current converters, Current Amplifiers, Voltmeters and Current meters, Instrumentation Amplifiers, Transducer Bridge Amplifiers, Ideal and realistic frequency response of various filters, Basic first-order low-pass and high-pass filters, first order wideband band pass filters(phase-shifter), Second-order low-pass filters, Secondorder high-pass filters, Second-order Band-pass filters, Second-order Band-reject filters.

[F] NON-LINEAR APPLICATIONS OF OP-AMP: Precision half-wave rectifiers, Precision full wave rectifiers, Log amplifiers, Antilog amplifiers, Zero crossing detector, level detectors, Voltage magnitude comparator and window detector, Basic peak detectors using Op-Amps and comparators, Basic Sample and Hold circuits, Digital-to-Analog (D/A) Converters, Analog-to- Digital (A/D) Converters.

[G] WAVESHAPING & WAVEFORM GENERATORS: The Op-Amp as Voltage comparator, Some Applications of a comparator using Op-
Amp, Schmitt trigger circuit, Basic Triangular wave generator, Astable and Monostable multivibrator using Op-Amp, Introduction to 555 Timer, Timer 555 used in Astable and Monostable mode.

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C. LEARNING OUTCOMES

At the completion of the course, students will be able to

1. Understand the fundamentals and datasheet parameters of Op – Amp.
2. Design and analyze linear, non-linear, and waveform generating applications using Op – Amp.
3. Design various amplifier and oscillator circuits using feedback concepts.
4. Design and develop various applications using 555 timer in astable and monostable modes.
5. Design voltage regulator and different class of power amplifier circuits.

D. RECOMMENDED TEXTBOOKS

1. Integrated Electronics, 1st Edition By: Millman & Halkians Publisher: Tata McGraw Hill
2. Op- Amp and Linear Integrated Circuits, 4th Edition By: Ramakant A. Gayakwad. Publication: Pearson Education

E. REFERENCE BOOKS

1. Integrated Circuits, 9th Edition By: K. R. Botkar Publication: Khanna Publications

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

1. Inverting - Non Inverting Amplifier
2. Op-amp as a Summer Circuit and a Differential Amplifier
3. Feedback Amplifiers
4. Frequency Response Parameters
5. Integrator and Differentiator
6. Comparator Applications and Schmitt Trigger
7. RC Phase-Shift Oscillator
8. Square wave and Triangular wave Generator
9. Frequency Response of Low-pass Butterworth Filter
10. Monostable and Astable Multivibrator
11. Regulated Power Supply

Dharmsinh Desai University
Faculty of Technology
Department of Instrumentation and Control Engineering

POWER ELECTRONICS (IC-406)

SEM-IV (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES OF THE COURSE

To prepare the students to gain knowledge about the construction, operation & characteristics of Power Semiconductor Devices,
To analyze behavior of different power electronics switches for selection of components for design applications.

B. DETAILED SYLLABUS

[A] POWER SEMICONDUCTOR DEVICES:

Power Electronics Applications, Introduction, Power Semiconductor Converters, Thyristor Applications, Types of Power Diode, Series & Parallel operation of Diodes, Power MOSFET, Hybrid devices, IGBT, GTO, DIAC, TRIAC, and LASCR & Shockley Diode.

[B] THYRISTOR PRINCIPAL AND CHARACTERESTICS:

Introduction, Principal of Operation of SCR, Static Characteristics, Two Transistor Model of SCR, Construction, Gate Characteristics, Gate Circuit Parameter, Dynamic Characteristic, Measurement of Thyristor parameter, Series & Parallel Operation of Thyristor, Thyristor Rating.

THYRISTOR PROTECTION:

Introduction, Over Voltage and Current Protection, dv/dt & di/dt Protection, Gate Protection, Thermal Protection.

[C] RECTIFYING CIRCUITS, CONTROLLED RECTIFIER AND FILTERS:
Review of Half wave, Full wave & Bridge rectifiers with filter circuits, Introduction to Single Phase Controlled Rectifier, Control Techniques, Single Phase Half Wave Controlled Rectifier, Single Phase Full Wave Controlled Rectifier, and Single Phase Half Controlled Bridge Rectifier.

[D] REGULATORS & POWER SUPPLIES: Introduction, Voltage Regulation & Ripple Voltage, Voltage Multiplier Circuits, Discrete
Voltage Regulators, Zener Voltage Regulators, Basic Operation of Switching Regulators Transistorized Regulators, Current Regulator, IC Voltage Regulators.
[E] GATE TRIGGERING DEVICES & CIRCUITS: Introduction, Firing of Thyristor, Pulse Transformers, Optical Isolators, Gate Triggering Circuits (R & RC triggering) , UJT & PUT (Basic Operation, Mathematical Analysis & Firing Circuits), Phase Control using Pedestal & Ramp Triggering, Microprocessor Interface to Power Thyristor**.**

[F] THYRISTOR COMMUTATION CIRCUITS: Introduction, Turn of Mechanism, Turn-off Methods (Class-A Circuit with Mathematical Analysis, Class-B Circuit, Class-C Circuit, Class-D Circuit, Class-E Circuit, Class-F Circuit, Jones Turn-off Circuits & Design Examples)

C. LEARNING OUTCOMES
At the completion of the course, students will be able to

1. Understand construction operation & behaviour of different power semiconductor devices and design various power converter circuits with protection
2. Design triggering circuits & commutation circuits
3. Design power supply using Linear & Switching Regulators

D. RECOMMENDED TEXTBOOKS

[1] Power Electronics: Devices, Circuits, Systems & Applications By: H.C.Rai , Galgotia Publication Pvt. Ltd.
[2] Power Electronics By: M.D. Singh, K.B. Khandchandani Tata McGraw-Hill

E. REFERENCE BOOKS

[1] Power Electronics By: P. C. Sen, Tata McGraw-Hill Education
[2] Thyristor: Theory and Applications By: R. K. Sugandhi & K. K. Sugandhi , New Age International (P) Limited
[3] Introduction to Thyristors & their Applications By: Ramamurthy , East West Books (Madras) Pvt Ltd
[4] Thyristor Engineering By: M.S.Berde , Khanna Publishers

F. LIST OF EXPERIMENTS

1. DSO &lab station
2. Characteristic of SCR
3. Characteristic of DIAC
4. Characteristic of TRIAC
5. Characteristics of MOSFET
6. Measurement of latching and holding current
7. UJT as oscillator
8. PUT as oscillator
9. R & RC Triggering Circuits
10. Class A type of commutation
11. Class B type of commutation
12. Class C type of commutation
13. Class D type of commutation
14. Linear & Switching regulator devices

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Faculty of Technology
Department of Instrumentation and Control Engineering

ELECTRICAL MACHINES & POWER (CI-416)

SEM-IV (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES OF THE COURSE

To offer a profound understanding of different electrical machines .Also to learn concepts of electrical power generation, transmission and distribution.

B. DETAILED SYLLABUS

PART-I: ELECTRICAL MACHINES

[A] DC MACHINES:

DC Generator

Types of Generator, Iron Losses in Armature, Total Losses in Generator, Stray Losses, Constant Losses, power stages, condition for maximum efficiency and power, No load saturation characteristics, loadsaturation curve, internal, external characteristics of separately excited generator, critical speed & resistance. All ofthese characteristics without mathematical treatment.

DC motor

Principle and basic theory

[B] AC MACHINES:

Transformer

(1 phase Transformer) Working principle, construction, elementary theory of ideal transformer,E.M.F.equation, transformer on no load and load, transformer with winding resistance but no magnetic leakage, equivalent resistance, magnetic leakage, transformer with leakage reactance and resistance, exact volt drop,equivalent circuit, O.C. & S.C. tests, efficiency & regulation, why transformer are rated in kVA?, losses, conditionfor maximum efficiency, all day efficiency, concepts of auto transformer, define Buchholz relay, basic of 3-phasetransformer & their types of connections

Three Phase Motors

Classification, merits & demerits, construction, why does rotor rotate, slip, frequency of rotorcurrent, Relation between torque & rotor p.f., starting torque of squirrel cage & slip ring motors, condition formaximum starting torque, effect of change in supply voltage on starting torque, torque slip characters, effect of voltage on torque & speed, Induction motor as a generator, power stages, torque, mechanical power & rotoroutput, analogy with mechanical clutch &DC motor, Linear induction motor.

AC Starter

DOL Starter, primary res. Starter, Auto transformer, Star delta (only theory).

Single Phase Motors

Types, Double Field Revolving Theory, Making motor self-starting, AC Series, Universal motors.

Alternators

Basic principle, difference with DC generator, construction, damper winding, factors affectingalternator size, Alternator on load, synchronous reactance, vector diagram of a loaded Alternator, determination ofvoltage regulation by EMF method, Parallel operation of alternators.

PART–II: ELECTRICAL POWER

[A] GENERATING STATIONS

Schematic arrangement of Power plants- thermal, hydro, nuclear, diesel and gas turbine.

[B] VARIABLE LOAD ON POWER STATIONS Structure of electric power system, load curves, important terms and factors, unit generated per annum, loadduration curves, types of loads, typical demand and diversity factors.

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[C] POWER FACTOR IMPROVEMENT
Power factor, Power triangle, Disadvantage of low p.f., causes, (Significance of low and high power factor), (KVAR)calculations, power factor improving equipment, importance of p.f. improvement, Most economical power factor.
[D] MECHANICAL DESIGN OF OVER HEADING LINES
Main components, conductor materials, line supports, types of insulators, string Efficiency and its improvement.

[E] PERFORMANCE OF TRANSMISSION LINE
Classification of overload transmission line, important terms, Performance of short transmission line.
[F] UNDER GROUND CABLES
Construction of cables, insulating materials, classification.
[G] INTRODUCTION TO SWITCH GEAR
Switchgear, essential features of switchgear, switchgear equipments, bus bar arrangement, short-circuits currents, faults in power system.
[H] CURCUIT BREAKER
Arc phenomenon, principle and methods of arc quenching, important terms
[I] FUSES
Fuses, desirable characteristics of fuse element, Fuse element material, important terms, and types of fuse.
[J] RELAY
Protective relays, Fundamental requirements of protective relaying, relay timing, important terms, Time/P.S.M.curve, and calculation of relay operating time.
[K] PROTECTION OF ALTERNATORS & TRANSFORMERS
Differential protection of alternators, Protection of transformer, earth-fault protection

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C. LEARNING OUTCOMES

Compare the various types of power stations for generation of power and comparative Merit/Demerits. Analyze the performance of various units involved in the power plants.

1. Design power system components for a specified system and applications.
2. Calculate electrical power and plot the power /Energy demand in the form of graph.
3. Understand working of electrical machines and their applications.
4. Differentiate electrical machines
5. Understand different types of circuit breakers, fuses and protective relaysfor protecting power system equipments.

D. RECOMMENDED TEXTBOOKS

1. Electrical Technology (Vol: II), Authors : B. L. Theraja&A.K.Theraja Edition : 23rdEdition Publisher : S. Chand & Company Ltd
2. Principles of Power System Authors : V. K. Mehta&Rohit Mehta Edition :4th Edition, Publisher: S. Chand & Company Ltd

E. REFERENCE BOOKS

1. Theory and Performance of ElectricalMachine Authors : V.B. Gupta Edition : 13th Edition Publication: Laxmi
2. Electrical Engineering Authors : R.K. Rajput Edition : 1st Edition Publication: Laxmi
3. Course in Power System Authors : J. B. Gupta Edition : 10th Edition Publication: S. K. Kataria& Sons
4. Switchgear and Protection Authors : J. B. Gupta Edition : 2nd Edition Publisher: S. K. Kataria& Sons

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD

1. Study of DC Generator
2. Transformer Open Circuit Test and Short Circuit Test
3. Load Test on Single Phase Transformer
4. Transformer Sumpner's Test
5. DC Shunt Generator Characteristics
6. DC Series Generator Characteristics
7. DC Compound Generator Characteristics

8. DC and AC starter
9. No-load and Block rotor test on 3-Phase Squirrel Cage Induction Motor
10. Load Test on 3-Phase Squirrel Cage Induction Motor
11. To find out the Regulation of Alternator by Synchronous Impedance Method.
(OC & SC Test and Load Test of 3-Phase Alternator)

Dharmsinh Desai University

Faculty of Technology

Department of Instrumentation and Control Engineering

CONTROL TECHNOLOGY: COMPONENTS & SYSTEMS (IC-408)

SEM-IV (2nd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	--	1	5

A. OBJECTIVES OF THE COURSE

To prepare the students to gain knowledge about construction & operation of Control Systems Components and to determine basic structure of Control System Problem.

B. DETAILED SYLLABUS

[A] INTRODUCTION TO CONTROL PROBLEM

Control systems: Terminology and basic structure, the genesis and essence of feedback control theory, Feedback control structure, and Multivariable control systems.

[B] MECHANICAL COMPONENTS:

CAMS AND FOLLOWERS:

Introduction, Components of Cam, Types of Cam, Types of Followers, Classifications, Cam Motions, Cam Terminology, Cam Profile , Cam as a Mechanical Function Generator

GEARS, CLUTCHES, BREAKS:

Brief introduction of Integrators, Gears, Clutches, Break etc.

[C] OPTO-ELECTRONIC DEVICES:
Classification, Photoconductive, Photo Voltaic & Photo-emissive sensors with applications. Liquid Crystal Display device.

[D] ELECTRO-MECHANICAL COMPONENTS:
POTENTIOMETER:
Introduction, Type of Potentiometers, Applications, Selection of Potentiometers
TACHOMETERS:
Introduction, Characteristics requirement, DC Tachogenerator, AC Tachogenerators,
Tachometer Applications, characteristics of Tachogenerator
SERVO MOTOR:
Introduction, DC Servomotors, AC Servomotors
RELAYS:
Introduction, Classification of Relays, Relay Circuits, Construction of Relay, Logic Relay, Optoelectronic Relay, Relay Problems & Remedies, Relay Race, Actuation & Release Time, Characteristics of Electromechanical Relay, Dynamic Characteristics of Reed Relay, Merits & Design Features of Reed Relay
STEPPER MOTORS:
Introduction, PM type Stepper Motor, VR type Stepper Motor, Hybrid Stepper Motor, Disc Magnet Stepper Motor, Applications of Stepper Motors, Drive Circuits for Stepper Motor
SOLENOIDS:
Construction, Selection & Different types of Solenoid.
UNIVERSAL MOTOR:
Construction, Operation, Speed control
SWITCHES:
Single pole, double pole, elect mechanical, thumbwheel etc.

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[E] HYDRAULIC SYSTEMS & VALVES:
Introduction, Advantages & Disadvantages of Hydraulic Systems, Components of Hydraulic System, Classification of Hydraulic Systems, Control with Pump-Controlled Hydraulic System, Pump Controlled Hydraulic Motor, Hydraulic Transmission Lines , Hydraulic Power Supply, Different types of Hydraulic Valve

C. LEARNING OUTCOMES
At the completion of the course, students will be able to
1. Explain construction, operation & behaviour of different control system components
2. Identify different control problem

D. RECOMMENDED TEXTBOOKS
[1] Control systems principle and design By: M.Gopal, Tata McGraw-Hill Education publication
[2] Electronic Devices & Circuits – An Introduction By: Mottershed, Prentice hall publication
[3] Modern control Technology: Components and systems By: Kilian, Cengage Learning publication
[4] Control systems components By: M.D. Desai, PHI publication

E. REFERENCE BOOKS
[1] Electro-Mechanical System Components By: Edward S. Charkey, John Wiley & Sons Canada Limited publication
[2] Control System Components By: Gibson & Tuteur, Ernest otto doebelin Publication
[3] Handbook of Gear design By: Gitin M. Maitra, Tata Mcgrow Hill Publication
[4] Servomechanism Practice By: Ahrendt & Savant, McGraw-Hill
[5] Mechanical & Industrial Measurements By: R. K. Jain, Khanna Publishers
[6] Electro-Mechanical Components for Servo Mechanism By: Davis & Ledgerwood, McGraw-Hill publication

F. LIST OF EXPERIMENTS
1. Operation &Construction of Stepper Motor
2. Characteristic of a Relay
3. Hysteresis of DC Relay

4. Cams & Followers
5. Speed Measurement using Photoelectric type sensor
6. Speed Measurement using Magnetic type Sensor
7. Potentiometer as an Error Detector
8. Opto Transmitter &Receiver Devices
9. Gears, Breaks & Clutches

Dharmsinh Desai University

Faculty of Technology

Department of Instrumentation and Control Engineering

MICROPROCESSOR & MICROCONTROLLER (IC-514)

SEM-V (3rd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To prepare the students to gain application level knowledge about microprocessor & microcontroller

B. DETAILED SYLLABUS

[A] INTRODUCTION TO MICROPROCESSOR & MICROCONTROLLER

Introduction to Microprocessors, Basic information about Instruction Set & Assemble Language, Introduction to CISC & RISC Architecture, Difference between Microprocessor & Microcontroller and Example Application Discussion

[B] MICROPROCESSOR 8085 ARCHITECTURE, MEMORY & I/O DEVICES INTERFACING

Microprocessor Architecture & Its Operation, Memory Devices, I/O Devices, Logic Devices for Interfacing, Memory Interfacing, I/O Interfacing, Timing diagram & Applications

[C] AVR Architecture & Assembly Language Programming

Architecture, Memory Map & Registers of AVR, Assembly Programming, Data Move Instructions and I/O Port Programming, Branch & Call Operations, Arithmetic Instructions and Programs

[D] AVR Timer, Interrupt

Programming Timers 0, 1 and 2, Counter Programming, Timer Programming in C, AVR Interrupts, Programming of Timer & External Hardware Interrupts, Interrupt Priority, Interrupt Programming in C, Serial Port Connection of ATMEGA & Programming in C and Assembly Language

[E] Serial Port, SPI & I2C Bus

Serial Port of ATMEGA32 & Programming using Assembly & C SPI Bus Protocol and Programming I2C Bus Protocol and Programming

C. LEARNING OUTCOMES

At the completion of the course, students will be able to

- Explain basic operation and architectural difference between of microprocessor & microcontroller

- Integrate memory devices & Input output devices with 8085

- Explain timing diagram of various instructions of 8085

- Do basic programming of 8085 in Assembly language

- Utilize various features of AVR microcontroller for building up various applications

- Do basic & application level of programming of AVR Controller in Assembly & C Language

- Develop basics application using AVR microcontroller

D. RECOMMENDED TEXTBOOKS

1. Microprocessor Architecture, Programming and Applications with the 8085, by R. S. Gaonkar, Penaram International Publishing (India) Private Limited

2. The AVR Microcontroller & Embedded Systems, by Mahuammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Pearson Publication

3. Embedded Systems, by B. Kanta Ra, PHI

E. REFERENCE BOOKS AND STUDY MATERIAL

1. Microprocessor Application in Control & Instrumentation by Bibbero

2. Programming and Customizing the AVR Microcontroller by Dhananjay Gadre

F. LIST OF EXPERIMENTS

1. Importance of Microprocessor & Microcontroller

2. Architecture of 8085 & Interfacing of Memory Devices, Input Devices & Logic Devices with 8085

3. Interrupts & Timing Diagram of 8085

4. Basic 8085 Assembly Programming

5. AVR Architecture

6. Getting Started with AVR Studio (Free Version) for programming of AVR Controller

7. Simulation of Data Move Instructions and I/O Port Programming, Branch & Call Operations, Arithmetic Instructions using AVR Studio in Assembly & C

8. AVR Timer Programming & Simulation using AVR Studio

9. AVR Interrupt Programming & Simulation using AVR Studio

10. AVR Serial Port Programming & Simulation using AVR Studio

11. Mini Project Part-1 using AVR Microcontroller (Shall be demonstrated in practical exam)

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Department of Instrumentation and Control Engineering

SIMULATION TOOLS (IC-515)

SEM-V (3rd Year)

Program Elective-I

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To develop the ability in students for use of simulation tools in order to apply for better theoretical understanding.
- To apply use of such tools to experiments, projects etc. for implementation and detailed analysis of the same.

B. DETAILED SYLLABUS

Computing with Scilab

[A] Introduction to Scilab
Basics of Scilab, Numbers, Constants, Syntax

[B] Matrices
Entering Matrices, Subscripts, The Colon Operator, Concatenation, Special Matrices, Size of a Matrix

[C] Matrix Algebra
Transpose, Adding and Subtracting Matrices, Multiplication and Powers of Matrices, The Dot Operator, Mathematical Functions

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[D] Programming in Scilab

FOR loops, Functions, Returning Multiple Values, Local and Global Variables, Comparison and Logical Operators, WHILE Loops, IF Statements, Graphs, Simple Graphs, Styles, Multiple Curves, Multiple Plots, Other Features, 3D Curves, Histograms

[E] Working with Files in Scilab

Function Files, Script Files, Exporting Data, Importing Data

Virtual Instrumentation using LabVIEW

[F] Introduction to Virtual Instrumentation

What is VI?, How to use Computer in VI?, LABVIEW & Virtual Instrumentation
Conventional & Graphical Programming
Components of LABVIEW, Tools & other Pallets, Color coding Code debugging,
Creating sub – VIs

[G] For and While Loop

The FOR & WHILE loop, Loop Behavior & Inter loop communication, Local & Global

[H] The Structures

Sequence structures, Case structures, Formula Nodes

[I] Arrays and Clusters

Arrays, Clusters, Inter conversions of Arrays & Clusters

[J] Charts and Graphs

Wave form charts, Resetting plots, Use of cursors, X-Y graphs

[K] State machines

What is a state machine, A simple state machine, Event structures, Full state machine

[L] File input output

File formats, File I/O functions, Path functions, File WRITE and READ

[M] String handling

String functions, LABVIEW string formats, Parsing of strings, Examples

[N] Basics of data acquisition

Classification of signals, Real world signals, Analog interfacing, Connecting the signal to the board, Bridge signal source

[O] Data acquisition with LabVIEW, DAQ and Vis

Measurement & Automation Explorer, The wave form data type, Use of simple VIs & DAQmx, Intermediate Vis, Express VI's-DAQ assistant, Analysis, Instrumentation

[P] Interfacing instruments GPIB and RS 232

RS 232 vs. GPIB – Handshaking, GPIB Interfacing, RS232c/RS485 Interfacing VISA

[Q] Advanced topics in labVIEW

Inter process communication,
Front panel activity, Data socket, programmatically controlling VI's

C. LEARNING OUTCOMES

At the completion of the course, students will be able to:

- perform computational and numerical calculations using simulation tools
- acquire, analyze and present data
- programmatically log data
- perform file level operations

D. RECOMMENDED TEXTBOOKS

[1] Virtual Instrumentation using LabVIEW, Jovitha Jerome, Prentice Hall India

[2] Programming in Scilab 4.1 By- Vinu V.Das, Newage publication

E. REFERENCE BOOKS & NOTES

[1] Notes on Scilab, Gary Bunting

[2] Introduction to Scilab, Michael Baudin, Scilab Consortium

[3] Virtual Instrumentation using LabVIEW, Sanjay Gupta & Joseph John, Tata McGraw Hill

F. LIST OF EXPERIMENTS

1) Introduction to LabVIEW
2) Using loops in LabVIEW
3) Arrays and Clusters in LabVIEW
4) Decision Making using Case Structures in LabVIEW
5) File Handling in LabVIEW
6) Introduction to Scilab
7) Matrix Algebra in Scilab
8) Using loops, logical operators in Scilab
9) Graphical data presentation in Scilab
10) File Handling in Scilab

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INDUSTRIAL ELECTRONICS & DRIVES (IC-519)

SEM-V (3rd Year)

Program Elective-I

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To teach the students different types of thyristor Applications
- To make the students aware about core concepts of Power converters and their applications at industries
- To teach fundamental concepts of how to select suitable values and ratings of power devices for designing power converters like 3 phase rectifiers, All types of inverters, choppers etc.
- To make the students aware about fundamental concepts of DC drives ,their industrial Applications and speed control techniques of DC drives
- To make the students aware about fundamental concepts of AC drives ,their industrial Applications and speed control techniques of AC Drives

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B. DETAILED SYLLABUS

[A]POLYPHASE RECTIFIERS: Three phase controlled converters, Three pulse Converters(M3 Connection), Six Pulse Converters, Three Phase fully Controlled Bridge Converters, Three phase half Controlled Bridge Converter, Selection of Converter Circuits

[B] CONVERTERS & INVERTERS: Chopper Classification & Operation, Chopper Control Strategies, Chopper Configuration, Thyristor based Chopper Circuits, AC Choppers, Classifications of Inverters, Single phase Voltage source inverters, Performance Parameters of Inverters, PWM Inverter, 3 Phase Inverter, Thyristor based Inverters, Series Inverter, Self Commutated Inverter, Parallel Inverter, Current Source Inverter

[C] AC & DC DRIVES: Introduction, Speed Control of Induction Motors, Stator Voltage Control, Variable Frequency Control, Schemes for DC motor Speed Control, PLL Control of DC Drives, DC Chopper Drives

[D] INDUSTRIAL APPLICATIONS: Introduction, Introduction Heating, Dielectric Heating, Welding, HVDC Transmission, Smart UPS, Hybrid and Electrical Vehicles

[E] CYCLOCONVERTER & DUAL CONVERTER: Introduction, Basic Principle of Cycloconverters and Dual Converters, Single phase to single phase cycloconverter, Dual converter with and without circulating current Operation, Dual mode dual Converter

C. LEARNING OUTCOMES

After successful completion of this course, student shall be able to:

- Understand the application of Induction heating& Dielectric Heating
- Understand the concepts of different types of resistive welding

- Develop designing skill of different types of choppers , invertersand polyphase rectifiers
- Understand the circuit operation and application of Cycloconverter&Dual converter
- Aware about industrial applications of DC & AC Drives

D. RECOMMENDED TEXTBOOKS

1. A Text book on Power Electronics – Devices, Circuits, Systems and Applications, 2 nd Edition, by Dr. H. C. Rai
2. Industrial Electronics and Control, PHI Publication, Biswanath Paul
3. Power Electronics By: M.D. Singh, K.B. Khandchandani Tata Mcgrawhill, 2nd Edition

E. REFERENCE BOOKS

1. Industrial Electronics, 11th Edition, by G. K. Mithal
2. Calculations in Industrial Electronics and Instrumentation, by V. K. M. John
3. Engineering Electronics, by John D. Ryder
4. Thyristor Engineering, by M. S. Berde
5. Power Electronics, by P. C. Sen
6. Electric Motor Drives - Modeling, Analysis, And Control, by R. Krishnan

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F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

List of laboratory experiments:

1. To perform the operation of forced commutation Class A, Class- B and Class –C
2. To perform the operation of forced commutation Class Dand Class -E
3. To perform the operation of DC motor Speed Control
4. To perform the operation of Jone's Chopper
5. To perform the operation of Morgan's Chopper
6. To study single Phase full wave Controlled bridge Rectifier with R Load
7. To study single Phase full wave Controlled bridge Rectifier with RL Load
8. To perform the operation of Series Inverter
9. To perform the operation of Parallel Inverter
10. To perform the operation of Cycloconverter

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MEASUREMENT TECHNIQUES (IC-516)

SEM-V (3rd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To make the students aware about importance of measurement in control system design-development along with classification and terminologies of measurement Techniques
- To teach the students about specifications, selection criteria and characteristics of instrumentation measurement systems
- To teach the students about analytical parameter measurement methods and applications of relevant sensing-transduction instruments
- To teach the students about physical and industrial process parameter measurement methods and applications of relevant sensing-transduction instruments

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B. DETAILED SYLLABUS

[A] Fundamentals of Instrumentation

Basic concepts of measurement , Fundamental elements of measurement system, Applications of instrumentation systems, Classification of Instruments, Standards & calibration, Errors & Uncertainties in performance parameters, Static performance parameters, Impedance loading & matching, Selection of the instrument, Formulation of system equations, Dynamic response.

[B] Industrial Measurements

Displacement Measurement:

Introduction, Principles of transduction (variable resistance, inductance, reluctance and capacitance type transducers), digital transducers, measurement of Acceleration

Speed Measurement:

Introduction, Mechanical tachometers: Revolution counter, Centrifugal force tachometer, Resonance tachometers, Electric tachometers: Eddy current type tachometers, Electric Generator type tachometers, Contactless type tachometers, Frequency type tachometers, Ignition type tachometers, Stroboscopic tachometers, Pneumatic type speed transmitting elements, Measurement of Speed, Frequency and Short Time Intervals by direct application of frequency standards by comparative methods.

[C] Process Parameters measurement: Measurement of Humidity, Specific gravity and Viscosity, Measurement of pH & conductivity.

[D] Strain Measurement

Introduction, Factors affecting strain measurements, Types of strain gauges, Theory of operation of resistance strain gauges, Types of electrical strain gauges, Materials for strain gauges, Gauging techniques and other factors, Strain gauge circuits, Temperature compensation, Applications

[E] Vibration Measurement

Introduction, Characteristics of vibration, Analysis of vibration sensing devices, Vibration sensing devices, Signal conditioners, Shock measurements, System characteristics, Vibration exciters, Calibration

[F] Basics of Analytical Instruments

Basic elements of analytical instruments, Basic Introduction mass Spectrometers, IR Spectrophotometers and UV Spectrophotometers, Introduction of chromatography – Gas Chromatography

C. LEARNING OUTCOMES

After successful completion of this course, student shall be able to:

- develop awareness about needs of measurement systems along with their design-development, classification and associated technical terminologies
- learn specifications and salient characteristics based choice making of instrumentation measurement systems
- learn methods and applications in the field of analytical instrumentation
- learn measurement methods and applications of physical and industrial parameter

D. RECOMMENDED TEXTBOOKS

- Instrumentation Devices & Systems by Rangan, Sharma & Mani, 2nd edition-2005
- Mechanical & Industrial Measurement by: R.K. JAIN, 11h Edition- 2004
- Handbook of Analytical Instruments by: RS Khandpur, 16th reprint -2005
- Instrumentation Measurement & Analysis by: B.C. NAKRA & K. K. CHAUDHRY,3rd edition-2013

E. REFERENCE BOOKS

- Practical Instrumentation Transducers by: OLIVER
- Mechanical & Industrial Measurement by: R.K. JAIN, 11th Edition-2004
- Handbook of Analytical Instruments by: R. S. KHANDPUR
- Instrumentation devices & systems by RANGAN, SHARMA & MANI
- Industrial Instrumentation Fundamentals by: A.E.FRIBANCE

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

List of laboratory experiments:

1. To study the characteristics of Linear Variable Displacement Transformer
2. To study the characteristics of Light Dependent Resistor
3. To study the characteristics of Strain Gauge
4. To study the characteristics of Inductive Pick-up
5. To study the characteristics of Capacitive Pick-up
6. To study the characteristics of Piezoelectric Pick-up
7. To study the characteristics of Proximity Switch
8. To study the pH measurement & to measure the pH of different solutions
9. To study the digital conductivity meter
10. To study the Gas Chromatography

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COMMUNICATION SYSTEMS (IC-518)

SEM-V (3rd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

To prepare students to acquire knowledge about Analog & Digital Communication Systems, basic of Fiber Optic Communication and fundamental concept of Data Communication and Networking

B. DETAILED SYLLABUS

[A] INTRODUCTION TO COMMUNICATION SYSTEMS

Introduction to Communication, Elements of Communication System, Need for Modulation, Electromagnetic Spectrum & Typical Applications, Basic Terminologies in Communication Systems, Signal Representation & Analysis

[B] AMPLITUDE MODULATION

Principles of Amplitude Modulation (AM), AM modulating circuits, AM Modulator & Demodulator Circuits, Basics of AM Transmitters & Receivers.

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[C] ANGLE MODULATION

Introduction, Principal of FM, Sinusoidal FM & Analysis, Non-Sinusoidal Modulation : Deviation Ratio, Phase Modulation, Comparison between PM & FM, Sinusoidal PM, Digital PM, Angle Modulators & Demodulators, FM Transmitters & Receivers

[D] DIGITAL COMMUNICATION

Introduction, Information Capacity, Bits, Bit Rate, Baud, and *M*-ary Encoding, Amplitude-Shift Keying, Frequency-Shift Keying, Phase-Shift Keying, Quadrature-Amplitude Modulation, Bandwidth Efficiency, Carrier Recovery, Clock Recovery, Differential Phase-Shift Keying, Probability of Error and Bit Error Rate. Error Performance

[E] PULSE MODULATION

Introduction, Pulse Amplitude Modulation, Pulse Code Modulation, Differential PCM, Delta Modulation, Pulse Frequency Modulation, Pulse Time Modulation, Pulse Position Modulation, Pulse Width Modulation

[F] FIBER OPTICS

Introduction , History of Optical Fiber Communications, Optical Fibers versus Metallic, Electromagnetic Spectrum, Block Diagram of an Optical Fiber Communications System, Optical Fiber Types, Light Propagation, Optical Fiber Configurations ,Optical Fiber Classifications, Cable Facilities, Losses in Optical Fiber Cables, Light SourcesOptical Sources, Light Detectors, Lasers

[H]INTRODUCTION TO DATA COMMUNICATIONS AND NETWORKING

Introduction & History, Data Communications Network Architecture, Protocols and Standards, Standard Organization for Data Communication, Layered Network Architecture, Data Communication Circuits, Serial & Parallel Data Transmission, Data Communication Circuit Arrangement, Data Communication networks

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[I]FUNDAMENTAL CONCEPTS OF DATA COMMUNICATIONS

Introduction, Data Communications Codes, Bar Codes, Error Control, Error Detection, Error Correction, Character Synchronization, Data Communications Hardware, Data Communications Circuits, Line Control Unit, Serial Interfaces (RS232 & RS485), Data Communications Modems

C. LEARNING OUTCOMES

At the completion of the course, students will be able to

- Explain Amplitude Modulation –Demodulation Techniques , Frequency Modulation-Demodulation Techniques and applications
- Explore & Analyze various parameters for digital modulation techniques like Frequency Shift Keying, Amplitude Shift Keying, Phase Shift Keying, Differential Phase-Shift Keying, Pulse Amplitude Modulation, Pulse Code Modulation, Differential PCM, Delta Modulation, Pulse Frequency Modulation, Pulse Time Modulation, Pulse Position Modulation, Pulse Width Modulation
- Explain fundamental concept of Data Communications & Networking

D. RECOMMENDED TEXTBOOKS

1. Electronic Communication Systems By: George Kennedy, Tata McGraw-Hill Education Pvt. Ltd.
2. Advanced Electronic Communications Systems By: Wayne Tomasi, Pearson Education Limited.
3. Electronics Communication By: Roddy & Coolen, Pearson Prentice Hall, Inc.

E. REFERENCE BOOKS

1. Modern digital ananlog communication system By: B.P.Lathi
2. Electronic Communication Systems By: William Schweber, PHI Publication.

3. Communication systems By: Simon Haykins, John Wiley Publication.

F. LIST OF EXPERIMENTS

1. construct a triangular wave using Fourier series trainer
2. construct a Square wave using Fourier series trainer
3. Analysis of Harmonics on DSO
4. Audio Input / Output Amplifier
5. To perform Amplitude Modulation
6. To perform the Frequency Modulation
7. To perform Pulse Code Modulation
8. To perform FSK & ASK
9. ADC & DAC
10. To perform PAM, PPM and PWM
11. Serial Communication using RS232 & RS485
12. Introduction to Wireless Communication

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PROCESS MEASUREMENT (IC-517)

SEM-V (3rd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

To prepare the students to gain knowledge about the standards, principle, working and applications of process sensors and transducers

B. DETAILED SYLLABUS

[A] PRESSURE MEASUREMENT:
Manometers, Elastic type – Bourdon tube, diaphragm, bellows elements, Bell gauges, Solid State, Piezo- elastic and vibrating element type pressure transducer, Vacuum gauges Mechanical and electric types, differential pressure transmitter.

[B] FLOW MEASUREMENT:
Theory of flow system, Reynold's number, Variable pressure (Head) type meters-orifice, Orifice calculations and installation, Venturi tube, Pilot tube, Flow nozzle. Variable Area meters-rotameter, Open channel meters, Mass flow meters, Velocity meters, Quantity meters, Electomagnetic flow meter, turbine flow meters, Ultrasonic flow meters, Vortex flow, Anemometers, Flow markers, Laser anemometers, Flow measurement for solid materials.

[C] LEVEL MEASUREMENT:
Theory of level measurement, Float gauges, Differential pressure type level measurement technique, Level measurement by weighing, bubbler technique, thermal effect type, Capacitance type, Ultrasonic and radiation type level measurement techniques, level

measurement in open vessels and pressure vessels, Measurement of interface levels, Measurement of level of dry material.

[D] TEMPERATURE MEASUREMENT:

Liquid Gas and Vapour filled thermometers, Bimetal thermometers, Resistance Thermometers RTD, Thermisters, Thermo electric temperature measurement technique Thermocouples and thermopiles Radiation thermometers optical and electrical pyrometers Accuracy and response characteristic of different devices, Differential Temperature measurement.

C. Text Books:

1. Industrial Instrumentation By: D.P. Eckman. , CBS Publishers and Distributers
2. Principles of industrial instrumentation By: D Patranabis, Tata Mc Graw Hill
3. Instrumentation Devices and system By: Rangan, Sharma, Mani, McGraw Hill Education

D. Reference Books:

1. Instrumentation, Measurement and Analysis By: B.C. Nakra & K. K. Chaudhary , McGraw Hill
2. Mechanical And Industrial Measurements By: R. K. Jain, Khanna Publishers
3. Industrial Instrumentation Fundamentals By: Austin Fribance, Tata McGraw Hill publication
4. Industrial Flow Measurement, 3rd Edition, By: David W. Spitzer, ISA
5. Flow measurement methods and applications By: Jim E.Hardy, Jim O. Hylton, Tim E. McKnight, Carl J. Remenyik, Francis R. Ruppel, Wiley-Blackwell,
6. Temperature Measurement, 2nd Edition By: L Michalski, K Eckersdrof, J Kucharski, J McGhee, Wiley
7. Modern Sensors Handbook, By: Pavel Ripka, Wiley
8. Industrial Instrumentation- Principles & Design By: Tattamangalam R.Padmanabham, Springer
9. Instrumentation and Process Measurement By:W.Bolten, Universities Press
10. Instrumentation Measurement and Control By A.K. Ghosh, PHI

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E. LEARNING OUTCOMES:

After completing this course students should be able to:

- Describe standards for process measurements
- Explain various sensors used for measurement of Temperature for industrial applications
- Explain various sensors used for measurement of Pressure for industrial applications
- Explain various sensors used for measurement of Flow for industrial applications
- Explain various sensors used for measurement of Level for industrial applications

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

List of laboratory experiments:

1. To find out time response of first and second order system
2. To find out input output characteristic of RTD
3. To find out time constant of given RTD
4. To find out input output characteristic of Thermocouple
5. To find out time constant of given Thermocouple
6. To find out characteristic of Thermistor
7. To measure temperature of an object using non contact thermometer
8. To find out characteristics of given strain gauge pressure transducer
9. To find out characteristics of given piezoelectric pressure transducer
10. To measure flow using orifice plate
11. To measure flow using Venturi tube
12. To measure level in a tank using hydrostatic level sensor

13 To measure level in a tank using Ultrasonic level sensor

14 To determine ON-OFF control characteristic using Thermistor

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PROFESSIONAL COMMUNICATION-I (AF-501)

SEM-V (3rd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
1	0	2	50	-	-	50	100	1	0	1	2

Objectives:

- To develop confidence in the students for communicating at workplace.
- Develop their Listening, Speaking, Reading, and Writing Skills.
- To give exposure of communicating with public.
- How to develop fluency in English Language.
- To prepare students for placement.
- To teach how to be effective at the job.

Learning Outcomes:

After completion of this course students will be able to understand:

- Communication Process and framework
- Obstacles in Communication

- Possible remedies to barriers of communication
- Effective Listening, Reading, Writing and speaking skills
- Implementation of Non-Verbal features in the presentation
- Ways and manners Presentations, Speech, Group talk and Interview
- Competence in writing and reading

Unit 1- Introduction to Professional Communication:

- Importance
- Methods and Manners
- Need of Professional Communication
- Objectives of Professional Communication
- Skills required for Professional Communication
- Employers' Expectations

Unit 2- Communication and Barriers:

- Introduction
- Process
- Principles
- Components
- Types of Communication
- Main problems of Communication
- Verbal Communication
- Oral Communication

- Written Communication
- Advantages of Verbal Communication
- Limitations of Verbal Communication
- Non-Verbal Communication
- Importance of Non-Verbal
- Kinesics
- Proxemics
- Chronemics
- Haptics
- Oculesics
- Paralanguage

- Barriers of Communication

- Intrapersonal
- Inter-Personal
- Organisational
- Noises in Channel
- Physical
- Semantic
- Psychological
- Physiological

Unit 3- Language Proficiency:

- Introduction
- Basic Grammar Rule

- Vocabulary Building
- Language Games

Unit 4- Four Skills:

- Introduction
- Listening
  - -Process
  - -Types of Listening
  - -Six Stages of Listening
  - -Listening Criticism
  - -Characteristics of effective listening
- Speaking
  - -Elements of speaking skills
  - -Pronunciation
  - -Speech art
- Reading
- Skimming
- Scanning
- Intensive Reading
- Levels of Comprehension (Literal and Inferential)
- Techniques of Good Comprehension
- Improving Comprehension Skills
- Writing
  - -Developing Writing skills

-Letter and E-mail writing

Text Books:

1. Meenakshi Raman, Sangeeta Sharma. Technical Communication: Principles and Practice; Oxford University press: New Delhi, 2004.
2. Meenakshi Raman, Prakash Singh. Business Communication: Second edition; Oxford University Press: New Delhi, 2012.
3. Steve Hart, Arvind R. Nair, Veena Bhambhani. Embark: English for Undergraduates; Cambridge University Press: Delhi, 2016.

Reference Books:

1. T M Farhathullah. *Communication Skills for Technical Students;* Orient Longman Private Ltd.: Chennai, 2002.

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MICROCONTROLLER APPLICATIONS (IC-610)

SEM-VI (3rd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To prepare the students to design & develop microcontroller based applications using 8-bit AVR controllers

B. DETAILED SYLLABUS

[A] AN AVR MICROCONTROLLER DESIGN

A microcontroller Design, Testing the Design, Timing Subroutine, Lookup Tables Concept & Serial Data Communication

[B] BASIC APPLICATIONS & PROGRAMMING

Different types of Keyboard Interfacing & programming, Seven Segment Display interfacing & programming, LCD Interfacing & Programming, ADC Programming Keyboard, Internal ADC Programming & Sensor Interface, External Serial ADC & DAC, Relay, Optoisolator & Stepper Motor Interfacing & Programming, Input Capture & Wave Generation in AVR, PWM Programming & DC Motor Speed Control, MAX7221 Display Interface using SPI, DS1307 RTC Interface using I2C, RS232 & RS485 Bus Communication applications using UART

[H] INDUSTRIAL APPLICATICATIONS

MEASUREMENT OF ELECTRICAL QUANTITIES & PROTECTION:

Frequency, AC voltage, AC current, DC Voltage, DC Current, phase angle, power factor, AC Power, Over Current Relay

MEASUREMENT & CONTROL OF PROCESS PARAMETER:

Temperature, Pressure, Level & Flow

APPLICATION CASE STUDIES:

Traffic Control, Firing angle control of SCR, Process Controller, Machine Tool Control, Distributed Computer Control System, Industrial Control Boards

C. **LEARNING OUTCOMES**

At the completion of the course, students will be able to

- integrate & test Microcontroller based system
- write different application programs using Lookup table, Timing subroutine & Serial data subroutine
- interface & build applications using key board, LED Display, LCD Display, ADC, DAC , RTC with AVR Controllers
- use Serial Communications applications for networking applications
- build Industrial Applications using AVR Controller

D. RECOMMENDED TEXTBOOKS

1. The AVR Microcontroller & Embedded Systems, by Mahuammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Pearson Publication
2. Embedded Systems, by B. Kanta Ra, PHI
3. Fundamentals of Microprocessors & Microcomputers,by B. Ram, Dhanpat Rai Publications

E. REFERENCE BOOKS AND STUDY MATERIAL

1. Microprocessor Application in Control & Instrumentation by Bibbero
2. Programming and Customizing the AVR Microcontroller by Dhananjay Gadre

F. LIST OF EXPERIMENTS

1. Study of AVR Studio & Getting started with Embedded C Programming
2. Time Delay Subroutine
3. Measurement & Generation of Frequency
4. Internal ADC Programming
5. Interfacing of External DAC & Waveform generation
6. Different type of Keyboard Interfacing & Programming
7. Seven Segment Display Interfacing & Programming
8. LCD Interfacing & Programming
9. Serial Port UART Programming
10. RTD Interfacing & Programming
11. Mini Project Part-2 using AVR Microcontroller (Shall be demonstrated in practical exam)

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PROCESS INSTRUMENTATION AND CONTROL (IC-613)

SEM-VI (3rd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To make students acquire knowledge about the concept of controller principles, algorithms and tuning methods, different types of pneumatic control valve construction, applications, selection and valve sizing

- To prepare students to analyze and design discrete and continuous controllers

B. DETAILED SYLLABUS

[A] P/I AND P/I CONVERTERS: Manometric transducers, Torque balance design, Oscillator type, electro pneumatic transducers, Transducer positioners, magnetic converters, differential transformer converters

[B] CONTROLLER PRINCIPLES : Introduction, process characteristics, control system parameters, discontinuous controller modes, continuous controller modes, composite control modes

[C] CONTROL LOOP CHARACTERISTICS: Introduction, control system configuration, Single and multivariable control systems, Control system quality, Stability, Process loop tuning

[D] PNEUMATIC CONTROL VALVE AND ACTUATORS: Introduction, operating mechanism of control valves, direction control valves, construction and working of control valves, Pneumatic Actuators, Selection of control valves and actuators

[E] CONTROL VALVE CHARACTERISTICS: Characteristics of control valves, rangeability, control valve selection, Sizing of control valves

C. Text Books :

1. Process Control Instrumentation Technology, By: C. D. Johnson, Pearson Education Ltd

2. Industrial Instrumentation Fundamentals By: Austin Fribance, Tata McGraw Hill publication

3. Applied Instrumentation in Process Industries, Vol. II, By: W.G. Andrews/H.B.Williams, Gulf Publication Company

4. Control system components By: M.D.Desai, Pearson Prentice Hall, Inc

D. Reference Books :

1. Measurement systems : Applications & Design By: Ernest Doeblin, McGraw Hill

2. Instrumentation measurement & analysis By: B.C. Nakra & K. K. Chaudhary , McGraw Hill

3. Mechanical & Industrial Measurement, By: R. K. Jain, Khanna Publishers

4. Transducers & Instrumentation, By: D. V. S. Moorty, PHI Learning Pvt.Ltd

5. Instrumentation - Devices & Systems, By Rangan, Sharma & Mani, Tata McGraw Hill publication

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E. LEARNING OUTCOMES:

- After completing this course students will be able to:
- Explain different P/I and I/P converters
- Design and analyze P, PI, PD, PID Controllers
- Select and size appropriate pneumatic control valve based upon various selection parameters

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT

List of laboratory experiments:

1 Response of P Controller

2 Response of PI Controller

3 Response of PD Controller

4 Response of PID Controller

5 Study of control calve cut sections

6 To study pneumatic system components

7 To find out characteristics of I/P converter

8 To find out characteristics of P/I converter

9 Study of control valve characteristics

10 Instrumentation Amplifier characteristics

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Department of Instrumentation and Control Engineering

INSTRUMENTATION SYSTEMS (IC-611)

SEM-VI (B.Tech, 3rd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To prepare the students to gain application level knowledge about microprocessor &

B. DETAILED SYLLABUS

[A] INTRODUCTION & SYMBOLS:

Introduction to instrumentation system, Standard instrumentation system symbols, Symbols for Distributed Control Systems, Standard P & I diagrams for typical instrumentation systems.

[B] CONTROL ROOM SUPPLY:

Uninterrupted Power Supply, Area classifications & safety standards, intrinsic safety.

[C] DISTRIBUTED DIGITAL CONTROL SYSTEMS:

Introduction, History, Architecture of DCS, Architecture of DCS components – like Process Control Units, Single Loop & Multi Loop Controllers, Man-Machine Interface, Key-board units, Engineering unit etc., Typical graphics display used in DCS, Architecture of

three popular DCS – Honeywell, Yokogawa and Foxboro. Computer networking fundamentals and standards, Communication protocols, Concept of open architecture, Introduction to OLE and OPC

[D] INSTALLATION PRACTICE:

Installation practice for commissioning, maintenance & renovation of a plant. Documents required for installation of instrumentation systems. Testing of different instruments. Industry Standards & Recommended Practices for the installation & maintenance of various Instruments.

[E] SAFETY DEVICES:

Pressure relief valves, Rupturing disc, Flame-arrester, and Pressure switch.

[F] INDUSTRIAL NETWORKING:

An introduction to networking in process automation, Serial Communication, communication formats, error checking, encoding, communication modes, Serial interface standards, RS-232, RS-422, RS-485, USB, IEEE1394, HART network, Fieldbuses , MODBUS, PROFIBUS, FOUNDATION FIELDBUS.

C. LEARNING OUTCOMES

After successful completion of this course, student shall be able to:

- study and learn fundamental and latest concepts of industrial automation systems, with special focus on Distributed Control System (DCS) design and implementation in real life industrial process plants
- learn hierarchical advancements in industrial process plant automation systems
- study, interpret and prepare the instrumentation system documents and drawings
- understand the role for safety in industry

- learn industrial grade automation and communication technologies for industrial applications along with different industrial communication protocols and standards

D. RECOMMENDED TEXTBOOKS

1. Applied Instrumentation in Process Industries, Vol. I, by Andrews & Williams
2. Instrument Engineer's Handbook (Process Control), by B. G. Liptak
3. Mechanical & Industrial Measurements, 8th Edition, by R. K. Jain
4. Process Instrumentation Handbook, P. R. Srinivasan
5. Applied Instrumentation in Process Industries, Vol. II, by Andrews & Williams
6. Computer based industrial control, by Krishnakant, 1997 edition
7. Field Bus Technology: Industrial network standards for real time distributed control by Nitaigour Premchand Mahalik, Springer (2008)

E. REFERENCE BOOKS

1. Applied Instrumentation in Process Industries, Vol. III, by Andrews & Williams
2. Instrumentation, by Kirk & Rimboi
3. Industrial Instrumentation Fundamentals, by A. E. Fribance
4. Foundation field bus overview, National Instruments (May 2003)
5. Foundation field bus system engineering guidelines (Foundation field bus)

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F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

2. Instrumentation symbols, coding, diagrams and graphics and their interpretation
3. Instrument Air Supply System
4. Compressor
5. Pressure Switch
6. Air Filter Regulator
7. Strip chart recorder
8. Interfacing of strip chart recorder with RTD
9. Current-to-Pressure Transducer (I/P Convertor)
10. Pressure-to-Current Transducer (P/I Convertor)
11. HART Protocol and Smart Transmitter
12. Interfacing of Smart DP Transmitter with Digital Flow Indicating Totalizer
13. Single Loop Programmable Controller (SLPC)
14. Supervisory Control And Data Acquisition (SCADA)
15. Distributed Control System (DCS)

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AUTOMATION SYSTEM INTEGRATION (IC-616)

SEM-VI (3rd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To make the students aware about the concept of Automation, parts of automation system and their applications for developing automation application using PLC and SCADA

B. DETAILED SYLLABUS

[A] Programmable Logic Controller

- The PLC: A Over all look :-Introduction, Manufacturing and assembly process , PLC advantages and Disadvantages, Overall PLC system , CPU and Programmers , PLC Input/Output modules, Solid state memory
- General PLC programming Procedures
- Devices connected with PLC I/O modules :-Input/output on/off switching devices , Input/output Analog devices
- Programming on/off inputs to produce on/off outputs
- Relation to digital gate logic to contact/coil logic

- Creating ladder diagrams from process control descriptions
- PLC Basic functions :-PLC timer, counter, arithmetic functions
- PLC Intermediate functions :-PLC Number comparison functions , Numbering systems and PLC number conversion functions
- Data Handling Functions :-PLC skip and master control relay functions, JUMP functions, PLC data moves.
- PLC functions working with bits:- Digital bits, Sequential, controlling a robot with PLC, Matrix functions
- Advanced PLC functions :- Analog PLC operations, PID control of continuous process, networking of PLCs
- PLC Installation, Trouble shooting and maintenance
- PLC Auxiliary Commands and Functions Monitor Mode function, Force mode function, functions for different programming formats, print functions, Selection of PLC, Industrial control and rise of PLC, PLC versus PC, factors to consider in selecting a PLC
- PLC Installation Practices Installation Practices, Consideration of the operating environment, receiving check, testing and assembly, electrical connections, grounding and suppression considerations, circuit protection and wiring, troubleshooting PLC malfunctions, PLC maintenance

[B] Principles of Data Acquisition

Introduction of Data Acquisition system, sampling concept, digital to analog converters, analog to digital converters, Block diagram, Protections in DAS, Isolation in DAS, Data Acquisition Configuration

[C] System Integrity Level in Automation Systems :

Conceptual design stage, ISA conceptual design stage, IEC 615108 on conceptual design, skills and resources, basic SIS configuration, shared functions, technology choices, pneumatics relays, safety relay, solid state systems

[D] Safety PLC:

Programmable systems for the logic solver, upgrading of PLCs for safety applications, characteristics of safety PLCs, hardware characteristics of safety PLC, software characteristics of safety PLC, design of safety PLC, Triple Modular Redundant (TMR) systems, safety PLC with 1oo3 architecture, communication features of safety controllers, classification and certification , SIS architecture conventions

[E] Introduction and basics of SCADA and SCADA Configuration

Advance configuration of WONDERWARE SCADA, Detail study of SCADA configuration building blocks

C. LEARNING OUTCOMES

After completing this course students should be able to:

- Describe the features of Automation system
- Develop program for PLC and SCADA Systems and make small automation applications

D. Text Books:

1. Programming Logic Controllers- Principles and applications, By John W. Webb & Ronald Reis, PHI, fifth Edition (2006)

2. PC based Instrumentation – Concepts and practice By N.Mathivanan, PHI, 2007 Edition

3. Practical Industrial safety, Risk Assessment and Shutdown Systems By- Dave Macdonald, Elsevier science technology,

E. Reference Books:

1. User manual for Wonderware InTouch SCADA development software

2. Programming Logic Controllers- Programming methods and applications By John R. Hackworth & Frederick D. Hackworth Jr. , Pearson Education, Low Price Edition

3. Programming Logic Controllers and Industrial Automation – An Introduction, By Madhu chhanda, Samarjit sen Gupta, Tata Mc Graw Hill

4. Process Control Instrumentation By C. D. Johnson, Pearson Education Ltd

5. Digital measurement techniques, by- T. S. Rathore, Narosa, New Delhi, CRC Press

6. Instrument Engineers Handbook, third edition, volume-III, Process Software and Digital Networks, by- Bela G.Liptake, CRC Press,

7. Field bus Technology : Industrial network standards for real time distributed control By Nitaigour Premchand Mahalik ,Springer (2008)

8. Modicon MODBUS protocol reference guide, Modicon

9. Statement list Allen Bradley Micro logix 1000 & 1200 – Ref Manual-pdf

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F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT

List of laboratory experiments:

1 Introduction to Wonderware InTouch SCADA

2 Study of basic features of SCADA

3 Study of Advanced features of SCADA

4 Programming in SCADA using scripts

5 Study RSLogix 500 software.

6 Development of ladder program using bit instructions

7 Development of ladder program using Timer Functions

8 Development of ladder program using counter and compare Functions

9 Development of ladder program using Advance (Arithmetic) Functions

10 Development of ladder program using Advance (Analog) Functions

11 Development of ladder program using Advance (Program control and Sequencer) Functions

12 Project Development

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SMART INSTRUMENTS (IC-619)

SEM-VI (3rd Year)

Program Elective-II

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To make students aware about classification, fabrication and recent trends in sensor technologies as well as some special types of sensors
- To make students aware about sensor networking solutions and relevant design concepts of instrumentation transducers
- To teach students regarding wired-wireless networking techniques along with relevant terminologies and technical specifications
- To teach students wireless sensor networks along with relevant standards, protocols and technologies
- To teach students IEEE 1451 family of standards with each sub-standard information and their application for development of smart transducers

- To teach students concepts of intelligent instrumentation specifically aimed at data acquisition and monitoring

B. DETAILED SYLLABUS

[A] SMART SENSORS:

Sensors and their classification, Sensor fabrication techniques, Sensors fabrication process details and latest trends in sensor fabrication, some special types of sensors: Fiber optic sensors, Chemical sensors, Bio-sensors

Characterization of sensors

[B] SENSOR NETWORKS:

Basic concepts, Sensor networking, industrial networking, sensor networking solutions, ISO/OSI model of 7-layers, Smart Sensors, Smart Sensor manufacturing technologies, Smart transducers and smart valve actuators

[C] LAN: TECHNOLOGIES, PROTOCOLS AND TOPOLOGIES:

Wired and wireless networking, Various topologies, Wired network protocols, wireless network protocols

[D] WSNS AND THEIR APPLICATIONS:

Basic concepts, purposes, usage, Factors and considerations for applications, Practical implementation issues, WSN standard IEEE 802.15.4, WSN applications in emerging areas

[E] IEEE 1451 FAMILY OF STANDARDS:

Brief discussions on IEEE 1451.0 standard, IEEE 1451.1 standard, IEEE 1451.2 standard, IEEE 1451.3 standard, IEEE 1451.4 standard, IEEE 1451.5 standard, IEEE 1451.6 standard and IEEE 1451.7 standard

[F] INTELLIGENT INSTRUMENTATION:

Basic concepts, Modes of operation, Architectures of various Intelligent Instrumentation Systems, Microprocessor application techniques, Types and techniques of data transfer, Data acquisition and data delivery methods, Brief on IEEE 488 GPIB standard

C. LEARNING OUTCOMES

After successful completion of this course, student shall be able to:

- develop awareness regarding selection, production and modern updates in sensor technologies along with some special types of sensors
- develop awareness about basics of sensor networking and instrumentation transducers
- learn wired-wireless networking techniques along with relevant terminologies and technical specifications
- learn wireless sensor networks along with relevant standards, protocols and technologies
- study IEEE 1451 family of standards with each sub-standard information and their application for smart transducers development
- learn concepts of intelligent instrumentation for data acquisition and monitoring

D. RECOMMENDED TEXTBOOKS

1. Understanding Smart Sensors by R. Frank, 2000, Artech House
2. Smart Material Systems and MEMS: Design and Development Methodologies: Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan , John Wiley & Sons Ltd.
3. Data and computer communication by William Stallings, 8th Edition, 2004, Pearson
4. Wireless Sensor Networks – Architecture and Protocols, by Edger H. Callaway, 2004, CRC Press
5. Measurement and Instrumentation: Theory and Application, by AS Morris, R Langari and Butterworth-Heinemannm, 2nd Edition, Elsevier
6. Intelligent Instrumentation, by G. Barney, 1985, PHI
7. Chemical Sensors and Bio-Sensors, by Brayan Eggins, 2003, John Wiley & Sons.
8. Fiber Optic Sensors, by Eric Udd, 1991, Wiley
9. Smart Sensors, by Chapman P., 1995, ISA Publications

E. REFERENCE BOOKS

1. John G. Webster, Editor-in-chief, “Measurement, Instrumentation, and Sensors Handbook”, CRC Press (1999).
2. Jacob Fraden, “Handbook of modern Sensors”, AIP Press, Woodbury (1997).
3. Sabrie Soloman, “Sensors Handbook”, McGraw-Hill , 1999
4. Sensors and Transducers by D. Patranabis, Prentice Hall of India (PHI), 2003.

5. Deshpande P.B and Ash R.H, Elements of Process Control Applications, ISA Press, New York, 1995.
6. Sensors and Signal Conditioning by John Wiley, (2001).
7. Electronic Instruments and Instrumentation Technology by MMS Anand, 2004, Prentice Hall of India (PHI).
8. Microprocessors and Interfacing: Programming and Hardware by DV Hall, 1992, Tata McGraw Hill
9. Microprocessors: Architecture, Programming and Applications by Ramesh S. Gaonkar, 2003, Wiley Eastern.

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

List of laboratory experiments:

1. Introduction to Smart Instrumentation, Smart Sensors and Smart Networks
2. Study of Smart Sensors Manufacturing Processes
3. Study of special types of sensors
4. Sensor Networking: Concepts, Design and Implementation of ISO/OSI Model
5. Smart Transducers and Smart Actuators
6. Wired Networking Technologies: Concepts and Design Criteria
7. Wireless Networking Technologies: Concepts and Design Criteria
8. IEEE 1451 Family of Standards and Design of Smart Transducers
9. Intelligent Instruments and Microprocessor based data acquisition design
10. IEEE 488 GPIB standard and GPIB data acquisition system design

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ANALYTICAL INSTRUMENTATION (IC-620)

SEM-VI (3rd Year)

Program Elective-II

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To make the students aware about importance of different instruments in Analysis & Testing field which are used for the measurement of different parameters along with classification and terminologies of techniques.
- To teach the students about specifications, selection criteria and characteristics of different analytical instruments for Analysis & Testing.
- To teach the students about various analytical instruments with their principle, working, types & its applications in various fields.

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B. DETAILED SYLLABUS

[A] Spectrophotometers: UV - VIS – IR

Electromagnetic radiation, beer-Lambert law, Absorption Instruments, Colorimeters, Spectrophotometers, Sources of error in Spectrophotometric Measurement, Calibration.

[B] Spectrophotometers: IR, Raman & Photo acoustic and photo thermal

Infrared Spectroscopy, Basic Components of Infrared Spectrophotometer, Sample Handling Technique Fourier Transform Infrared Spectroscopy, Calibration, Attenuated Total Reflection Technique, Raman Spectrometers, Photo acoustic and photo thermal Spectrometers.

[C] Gas Chromatograph, Liquid Chromatograph & Mass Spectrometers:

Chromatography, Basic Parts of a Gas Chromatograph, Methods of Measurements of Peak Areas, Liquid chromatography, types of LC, Amino Acid Analysers. Basic Mass Spectrometers, Types of Mass Spectrometry, Components of Mass Spectrometers, Resolution, Application of Mass Spectrometry.

[D] Flame Photometers & X-Ray Spectrometers:

Principle, Constructional Details of Flame Photometers, Clinical Flame Photometers, Accessories for Flame Photometers, Interferences in Flame Photometry, Procedure for Determination. X-ray Spectrum, X-Ray Spectrometry, X-Ray Diffractometer, Electron probe micro analyzer.

[E] Electron and Ion Spectroscopy:

Surface Spectroscopic Techniques, Electron Spectroscopy, Instrumentation for Electron Spectroscopy, Ion Spectroscopy, Instrumentation for Ion Spectroscopy, Radiochemical Instruments, Automated Biomedical Analysis Systems.

[F] Blood Gas Analyzer & Industrial Gas Analyzers

Blood pH measurement, pCO2 & pO2 Analyzer, gas analyzers, paramagnetic O2 analyzer, magnetic wind analyzer, IR gas analyzer.

C. LEARNING OUTCOMES

After successful completion of this course, student shall be able to:

- develop awareness about needs of different Analytical instruments for measuring different parameters for analysis and testing of the products, classification and associated technical terminologies.
- learn specifications and salient characteristics based choice making of analytical instruments.
- learn methods and applications in the field of Analytical instrumentation.
- develop awareness of measuring different strategies with analytical instruments and acquired the knowledge about its importance for the analysis and testing of any product/material with the help of different analytical instruments.

D. RECOMMENDED TEXTBOOKS

[1] Handbook of Analytical Instruments by: R. S. KHANDPUR

[2] Instrumentation methods by B. K. Sharma

E. REFERENCE BOOKS

[1] Analytical Instrumentation by Bela G. Liptak
[2] Laboratory Instrumentation by Mary C. Haven (Author), Gregory A. Tetrault (Author), Jerald R. Schenken (Author)

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

List of laboratory experiments:

1. To study & perform the Gas Chromatograph.
2. To study & perform the UV Spectrometer.
3. To study & perform the Visible Spectrometer.
4. To study & perform the Liquid Chromatograph.
5. To study & perform the IR Spectrometer.
6. To study & perform the X-Ray Spectrometer.
7. To study & perform the Atomic Force Microscope.
8. To study & perform the Scanning Electron Microscope.
9. To study & perform the Transmission Electron Microscope.
10. To study & perform the Ion Chromatograph.

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POWER PLANT AUTOMATION (IC-612)

SEM-VI (3rd Year)

Program Elective-II

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To prepare students to acquire knowledge various types of power plants.
- To prepare students to acquire knowledge different control techniques for boiler and turbine.
- To prepare students to acquire knowledge about various interlocks and safety standards for turbine and generator.

B. DETAILED SYLLABUS

[A] Introduction to Power Plant:
Plant overview, Role of Control and instrumentation in power plant, Classification of power plants: thermal, hydro, combined cycle and nuclear.

[B] Boiler & Turbine Supervisory Control:
Introduction, Operation, Drum level control, Combustion control , Turbovisory system, Measurement and analysis of gas, Super-heated steam temperature, Level, Pressure and Flow. Coordinated controls of boiler and turbine.

[C] Power Plant Process:
Boiler process, Turbine process, Fuel Handling Plant, Air Compressor, etc.

[D] Power Plant Subsystem Automation:
Control of mill throughput, Mill temperature control, Forced draught control, Feed pump control, Boiler-following-turbine load control, Advanced Gas Cooled Reactors (AGRs) .

[E] Electrical Instruments and Metering:
Recorders and Industrial Displays, Electrical Instruments and Metering Working of meters, Meter calibration.

[F] **Plant Optimization:**
Performance optimization of power plant with integrated Controls, Plant Optimization Performance measurement of power plant.

[G]System Interlocks and Safety:
Turbine Interlock and Protections, Interlock and Protections for Generator.

C. LEARNING OUTCOMES

After completion of the course students should be able to:

- Classify various power plants and understand the role of control and Instrumentation in power plant.
- To apply supervisory control techniques for boiler and turbine.
- Learn different power plant processes, viz. Turbine process, boiler process, etc.
- Describe various recorders, Industrial Displays, working of meters and Meter calibration.
- Measure plant optimization performance parameters
- Describe turbine interlock and protections for generators.

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D. RECOMMENDED TEXTBOOKS

1. Modern Power Station Practice: Incorporating Modern Power System Practice: Vol - F Control and Instrumentation. / by British Electricity International.
2. Instrumentation Engg's Handbook on Process Control - Bela G. Liptak.
3. Power plant Engineering – P.K.Nag, Mc Graw Hill, 3rd edition

E. REFERENCE BOOKS & NOTES

1. Power plant instrumentation and control handbook – Swapan Basu and Ajaykumar Debnath, Academic Press, 1st edition
2. Standard Handbook of Powerplant Engineering – Thomas C. Elliot, Mc Graw Hill
3. Energy and Power Generation Handbook – K.R.Rao, ASME Press,

F. LIST OF EXPERIMENTS

1. Study of General layout of thermal power plant.
2. Study of Turbovisory system
3. Study of fuel handling system in coal based power plant.
4. Study of Control techniques for power plant process.
5. Study of drum level water control and swell and shrink phenomenon.
6. Study of air pollution by a thermal power plant.
7. Study of water pollution by a thermal power plant.
8. Study of various combustion process control.
9. Study of wireless monitoring of energy measurement.
10. Study of different Safety and Interlocking techniques for turbine and generator.

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PROFESSIONAL COMMUNICATION-II (AF-601)

SEM-VI (3rd Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
1	0	2	50	-	-	50	100	1	0	1	2

Objective:

- To develop confidence in the students for communicating at workplace.
- Develop their Listening, Speaking, Reading, and Writing Skills.
- To give exposure of communicating with public.
- How to develop fluency in English Language.
- To prepare students for placement.
- To teach how to be effective at the job.

Learning Outcomes:

After completion of this course students will be able to understand:

- Psychological aspects in communication
- Developing Positive Attitude and empathy

- Importance of team and how to work in a team
- Effective Listening, Reading, Writing and speaking skills
- Corporate Communication
- Writing Minutes, Notice, Proposal and Report
- Competence in writing and reading

Unit 1- Communication Skills:

- Intrapersonal Communication
- Interpersonal Communication
- Importance of Empathy in Communication
- Psychological Dealings in Communication
- Positive Attitude

Unit 2- Team Building:

- Introduction
- Meaning and importance of team
- Skills and qualities of a team member
- Techniques to be a good team member
- Working in Groups
- Leadership Qualities
- Negotiation Skills
- Adjustment level and Flexibility
- Understanding Team mates

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Unit 3- Effective Self Presentation through LSRW:

- Listening
  -active listening
- Speaking
  -Indianism
  Presentation
- Reading

- Speed Reading
- Reading Practice
- Levels of Comprehension (Evaluative and Applied)
- Comprehension practice

- Writing
  -Minutes
  - Notice
  - Proposal
  - Report Writing

Text Books:

1. Meenakshi Raman, Sangeeta Sharma. Technical Communication: Principles and Practice; Oxford University press: New Delhi, 2004.

2. Meenakshi Raman, Prakash Singh. Business Communication: Second edition; Oxford University Press: New Delhi, 2012.

3. Steve Hart, Arvind R. Nair, Veena Bhambhani. Embark: English for Undergraduates; Cambridge University Press: Delhi, 2016.

Reference Books:

1. T M Farhathullah. *Communication Skills for Technical Students;* Orient Longman Private Ltd.: Chennai, 2002.

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ADVANCED CONTROL THEORY AND SYSTEM DESIGN (IC-710)

SEM-VII (B.Tech, 4th Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	-	2	60	40	25	25	150	4	-	1	5

A. OBJECTIVES OF THE COURSE

- To introduce various state space models of control systems, nonlinear control systems and their analysis methods
- To apply different compensation designs to control systems in time and frequency domain
- To develop the ability in students to test positive real functions and synthesize one port passive networks (RLC).

B. DETAILED SYLLABUS

[A] State variable analysis

Introduction, State modes of linear continuous-time systems, Diagonalization, Solutions of state equations, Concept of controllability & Observability, Direct method of Liapunov's stability analysis.

[B] Non linear systems

Introduction to nonlinear systems, Common physical nonlinearities, The phase – plane methods, Singular points, Construction of phase – trajectories, The describing – function (D.F.) method, Derivation of DFS, Stability analysis by D.F. method, Jump resonance phenomena

[C] Optimal control systems

Introduction, Performance indices, Parameter optimization: Servomechanisms

[D] System compensation
Introduction to system compensation, Time domain compensation technique using root locus, Frequency domain compensation Techniques using Bode Plots, Minor-loop Design of Control System
[E] Network synthesis
Introduction, Positive Real Function, Synthesis of One Port LC, RC, RL and RLC passive networks

C. LEARNING OUTCOMES

After completion of the course students should be able to:

- Define State variables, build state model and learn state variable analysis techniques
- Solve Parameter optimization control problems
- Learn Nonlinear systems and their stability analysis
- Design and compensate a control system for given specifications using root locus technique and Bode plot.
- Synthesize a system network based on the driving point impedance functions.
- Describe positive real functions and their characteristics.

D. RECOMMENDED TEXTBOOKS

1. Control system engineering by I. J. Nagrath & M. Gopal
2. Modern Network Synthesis by Van Valkenburg
3. Control system principles and design by M. Gopal

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E. REFERENCE BOOKS & NOTES

1. State space analysis of control system by Ogata
2. Modern control theory by J. T. Tou
3. Modern control system theory by M. Gopal
4. Linear Control System (Analysis & Design conventional & Modern) by D'azzo & Houpis
5. Design of Feedback System by Thaler G. J.
6. Digital control and state variable methods by M. Gopal

F. LIST OF EXPERIMENTS

1. Introduction to state space models of control systems
2. State model Controllability and Observability
3. State model analysis
4. Introduction to Nonlinear systems and phase plan method
5. Describing function method
6. Introduction to Optimal control systems
7. Introduction to compensation in control systems
8. Compensation in Time domain
9. Compensation in Frequency domain
10. Testing driving point functions
11. Passive network synthesis

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Department of Instrumentation and Control Engineering

DIGITAL SIGNAL PROCESSING (IC-711)

SEM-VII (B.Tech, 4th Year)

Program Elective-III

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To make the students aware about core concepts of signal, its properties and importance of signal processing (especially in digital domain)
- To teach basic and fundamental concepts of classification, identification and characteristics of various types of systems based on time and frequency domains
- To teach the students various transforms as tools and their specific applications for signal processing in digital domain
- To teach the students classification, applications and design aspects of various types of digital filters
- To make the students aware about importance and fundamentals sampling concepts and associated different types of signal conversion/condition processes

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B. DETAILED SYLLABUS

[A] DISCRETE-TIME SIGNALS AND SYSTEMS

Introduction, Representation of Discrete-Time Signals, Basic Operations on Sequences, Classification of Discrete-time Signals, Classification of Discrete-Time Systems [A. Anand Kumar,Pg. 1 to 66]

[B] DISCRETE CONVOLUTION AND CORRELATION

Impulse Response and Convolution Sum, Analytical evaluation of Discrete Convolution, Convolution of finite sequences, Methods to compute the convolution sum of two sequences, Deconvolution using tabular method, Interconnection of LTI System, Discrete Correlation[A. Anand Kumar Pg. 90 to 102, 122 to 127]

[C] THE Z-TRANSFORMS:

Z-transforms by summation of left, right and two-sided sequences, Regions of convergence and z-transform properties, inverse z-transforms [Katsuhiko OGATA Pg. 41to 89]

[D] SYSTEM REALIZATION

Introduction, Realization of discrete time systems, Structure for realization of IIR systems, Structures for Realization of FIR Systems[A. Anand Kumar Pg. 277-357]

[E] DISCRETE –TIME FOURIER TRANFORM

Discrete – Time Fourier Transform(DTFT), Existence of DTFT, Relation between Z-Transform and Fourier Transform, Relation between Z- Transform and Fourier Transform, Inverse DTFT, Properties of DTFT[A.AnandKumar Pg. 358 to 375]

[F] DISCRETE FOURIER SERIES AND DISCRETE FOURIER TRANSFORM

Discrete Fourier Series, Properties of DFS, Relation between DFT and Z transform,Comparision between DTFT and DFT, IDFT, Properties of DFT[A.AnandKumar Pg. 412 to 428, 431 to 444]

[G] INTRODUCTION OF INFINITE DURATION IMPULSE RESPONSE (IIR) FILTERS AND FIR FILTERS

Introduction, Requirements for Transformation, Design of IIR Filters, Specification of the Low-pass Filter, Design of digital low –pass butterworth and chebyshev filters, Characteristics of FIR filters [A.AnandKumar Pg. 548 to 617, 651 to 656]

C. LEARNING OUTCOMES

After successful completion of this course, student shall be able to:

- develop awareness about signal and digital signal processing
- learn, study and classify systems based on time and frequency domains
- learn different transforms as tools and their specific applications for signal processing
- study, select and design application specific digital filters
- develop awareness about sampling and associated signal conversion techniques

D. RECOMMENDED TEXTBOOKS

1. Digital Signal Processing: A. Anand Kumar, PHI Publication
2. Discrete Time Control Systems: Katsuhiko Ogata

E. REFERENCE BOOKS

10. Digital Signal Processing: A Computer-Based Approach, S. K. Mitra, McGraw-Hill, Third edition, 2006.
11. Analog and Digital Signal Processing by Ashok Ambardar, THOMSON Books/Ole
12. Discrete-Time Signal Processing by A. V. Oppenheim and R. W. Shafer, PHI,2/E, 2000
13. Digital Signal Processing: Principles, Algorithms and Applications, J. Proakis, D. Manolakis, Prentice-Hall, 2006 (4-th edition)
14. Digital Filters – Analysis, Design & Applications by Andreas Antoniou, Tata McGrow Hill, 2nd Edition

F. **LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)**

List of laboratory experiments:

1. Introduction to signals, systems, signal and their classification
2. Z-transforms and their applications in digital signal processing
3. Design of first order hold circuit
4. Design of ADC and DAC
5. Filters: classification, design specifications and applications
6. Fourier Transforms, Fast Fourier Transforms and their applications in digital signal processing
7. Design of Butterworth filters and applications

8. Design of Chebyshev filters and applications
9. Design of All pass, Band pass and Band reject filters and applications
10. Design of Averaging filters and applications

Dharmsinh Desai University

Faculty of Technology

Department of Instrumentation and Control Engineering

MODELING, SIMULATION AND EVOLUTIONARY TECHNIQUES (IC-712)

SEM-VII (B.Tech, 4th Year)

Program Elective-III

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To make the students aware about importance and fundamental concepts, terminologies and applications of modeling, simulation and evolutionary techniques
- To teach the students about classification and modeling of system models as well as basics of Sets and Fractals along with their specific behavioral characteristics
- To teach the students about fuzzy logic concepts and design-development of fuzzy based controllers
- To teach the students fundamentals of simulation study and its step wise procedures associated to selected simulation modeling and study techniques
- To teach the students basic concepts of artificial neural networks, Genetic Algorithms and step wise procedures associated to selected controller optimization techniques

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B. DETAILED SYLLABUS

[A] INTRODUCTION:

Introduction, Objectives of the course, Overview of the course, Classification of Systems, Models, Purposes of Modeling, Classification of Models, Modeling Techniques, System Variables.

[B] SYSTEMS AND MODELING:

Fractals, Types of Fractals, The Sierpinski Triangle, Fractal and Scaling Similarity, Self-Similarity Dimension, Cantor Set, The Mandelbrot Set, Julia Set, Examples of The Mandelbrot Set, Julia Set and Fractals, The Chaos Theory, Basic Observations, Governing Rules of Chaos Theory, Chaotic Behavior of Logistic Equation, Example of Chaotic Behavior, Chaos and Fractals.

[C] FUZZY LOGIC:

Introduction, Fuzzification and Defuzzification of models, Fuzzy sets and set operations, Elementary Fuzzy Operators, Step-wise Procedure for Design of FLC using Matlab, Detailed Explanation of Matlab Fuzzy Logic Toolbox and its usage, Design of Fuzzy Controller, Design of Fuzzy Logic based PID Controller

[D] SIMULATION:

Explanations of System, Modeling and Simulation, Classification of System Models, Step-wise Procedure for Simulation Study, Advantages and Disadvantages of Simulation, Basic Flow Chart for Simulation Study

Monte-Carlo Simulation Technique, Step-wise Procedure for Monte-Carlo Simulation Technique, Verification and Validation of Simulation Models, Various techniques of model validation.

[E] ARTIFICIAL NEURAL NETWORKS (ANN):

Architecture Introduction to ANN, ADALIN, Learning method Delta Rule, MSE based Training to ADALIN, Adaptive Filtering, Tapped Delay Line, Adaptive Filter, Basic ANFIS, ANFIS Learning Algorithms, Step-wise Procedure to setup ANFIS using Matlab Takagi-Sugeno FIS, Mamdani FIS, Mamdani v/s Sugeno

[F] **EVOLUTIONARY TECHNIQUES:** Introduction to Genetic Algorithms (GA), Darwin's Observation, Darwin's Theory – Natural Selection, Terminology of GA, Applications of GA, PID controller optimization using GA, Kohonon's Self Organizing Map (SOM), Hopfield Neural Network

C. LEARNING OUTCOMES

After successful completion of this course, student shall be able to:

- develop conceptual awareness and applications of modeling, simulation and evolutionary techniques
- classify, characterize, select and model systems and learn behavior-specific characteristics of Sets and Fractals
- learn concepts of fuzzy logic and design-develop fuzzy based controllers
- learn fundamentals and development of simulation study along with modern simulation techniques
- learn and develop fundamental understandings of artificial neural networks, Genetic Algorithms and selected controller optimization techniques

D. RECOMMENDED TEXTBOOKS

1. Process Control–Principles and Applications by Surekha Bhanot, Publisher: Oxford University Press (2008), India.
2. Introduction to Artificial Neural Systems by Jacek M. Zurada, West Publishing Company, USA.
3. Advanced Control Engineering by Ronald S. Burns, Butterworth-Heinemann Publishers, USA.
4. Process Control and Optimization, Instrument Engineer's Handbook, Volume II by Bela G. Liptak, 2006 Edition, Taylor and Francis, CRC Press, USA.
5. Optimization of PID controller using Ant Colony and Genetic Algorithms by Unal, Tpuz and Erdal, 2013 edition, Springer
6. Design of Fuzzy Controllers by Jan Jantzen, Tutorial Paper, Department of Automation, Technical University of Denmark, Denmark.
7. Class Notes and Discussions in Theory and Laboratory Sessions

E. REFERENCE BOOKS

1. G. D. Sousa, B. K. Bose, "A Fuzzy Set Theory based Control of a Phase-controlled Convertor DC Machine Drive", IEEE Trans., Vol. IA – 30, no. I, pp. 34-44.
2. M. Godoy Simoes, Bimal K. Bose and Ronald J. Spiegel, "Fuzzy Logic based intelligent control of a variable speed cage machine wind generation system", IEEE Trans. on Power Electronics, Vol. 12, pp. 87-95, Jan. 1997.
3. Denn M. M., "Process Modeling", Longman, 1986.
4. Holland C. D., "Fundamentals and Modeling of Separation Processes", Prentice Hall., 1975.

5. Luyben W. L., "Process Modeling Simulation and Control for Chemical Engineers", 2nd Ed., McGraw Hill, 1990.
6. Najim K., "Process Modeling and Control in Chemical Engineering", CRC, 1990.
7. Aris R., "Mathematical Modeling, Vol. 1: A Chemical Engineering Perspective (Process System Engineering)", Academic Press, 1999.

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

List of laboratory experiments:

1. Introduction to Modeling and Simulation
2. Modeling of simple process control systems
3. Evolutionary techniques, classification and application criteria
4. Fuzzy Logic: Concepts, terminologies and application development
5. Fuzzy logic: Design and Implementation
6. Genetic Algorithms: Concepts, terminologies and application development
7. Genetic Algorithms: Design and Implementation
8. Artificial Intelligence and Neural Networks: Concepts, design and application development
9. Adaptive system design and tuning approaches
10. Comparative study of PID controller tuning using classical, Fuzzy logic, Genetic Algorithms and ANFIS

Dharmsinh Desai University

Faculty of Technology

Department of Instrumentation and Control Engineering

EMBEDDED SYSTEMS (IC-713)

SEM-VII (B.Tech, 4th Year)

Program Elective-III

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
3	1	2	60	40	25	25	150	3	1	1	5

A. OBJECTIVES OF THE COURSE

To prepare the students to design & develop Embedded Systems Applications using ARM Cortex M0/M0+ & Family

B. DETAILED SYLLABUS

[A] Introduction to Embedded Systems

Importance of ARM Cortex M0 Processor, Applications of Cortex M0 Processors, Background of ARM Processors, Cortex M0 Processor Specifications & Architecture,

[B] ARM Cortex-M0 Architecture

Overview, Programming Model, Memory System, Stack Memory Operations, Exceptions & Interrupts, Nested Vectored Interrupt Controller, System Control Block

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[C] Introduction to Cortex M0 programming

Introduction to Embedded System Programming, Designing Embedded Programs, Inputs and Outputs, Development Flow, C Programming & Assembly Programming, Program Image, Cortex Microcontroller Software Interface Standard

[D] Instruction Set, Basic Examples & Programming Using Embedded C

Assembly Basics, Exception related Instructions & basic assemble examples, Detail overview of Embedded C

[E] Memory Systems, Exceptions and Interrupts

Memory Map & Register Boundary Addresses, Program Memory, Boot Loader, and Memory Remapping, Introduction to Exceptions & Interrupts, Exception Types of Cortex M0 , Exception Priority Definition & Vector Table

[F] Interrupt & System Control

Overview of the NVIC and System Control Block Features,Interrupt Control,Exception Masking Register,Interrupt Inputs and Pending Behaviour, System Control Registers

[G] Introduction to Cortex M0 Peripherals

Power Control, Reset & Clock Control, System Configuration Controller, General Purpose Digital I/O, Watch Dog Timer, Basic Timer, General Purpose Timers, Advanced Control Timers, Real Time Clock, Analog to Digital Converter, PWM & DMA Controller

[H] Introduction to Cortex M0 Serial Peripherals

UART, SPI, I2C & USB

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[I] **Getting Started with Integrated Development Environment& Application Programming

** Only for Laboratory Purpose

C. LEARNING OUTCOMES

At the completion of the course, students will be able to

- To explain ARM Processor Architecture& various features of Cortex M0 Processor
- To do programming of Cortex M0 Processor using Embedded C
- To build various applications by exploring strong peripherals like Watch DogTimer,16/32 bits Timers, ADC, DMA Controller, SPI, I2C , UART & USB

D. RECOMMENDED TEXTBOOKS

[1] The Defective Guide to the ARM Cortex M0 By: Joseph Yiu, Elsevier

[2] STM32F030x4/x6/x8/xC and STM32F070x6/xB advanced ARM^{R}-based 32-bit MCUs By: Reference Manual by ST Semiconductor

E. REFERENCE BOOKS

[1] Mastering STM32 ,A step-by-step guide to the most complete ARM Cortex-M platform, using a free and powerful development environment based on Eclipse and GCC By: Carmine Noviello

[2] Embedded Systems By: B. Kanta Rao , PHI Learning Private Limited

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F. LIST OF EXPERIMENTS

1	Getting Started with Integrated Development Environment
2	System Clock &Configuration Programming
3	Digital I/O Programming
4	General Purpose Timer & Time Delay Applications in C
5	Advanced Timer Applications Programming in C
6	DMA Application Programming in C ADC Application Programming in C
7	UART Application Programming in C
8	SPI & I2C Programming in C
9	Temperature Monitoring & Control Application
10	System Monitoring & Control using IOT Library

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Department of Instrumentation and Control Engineering

PROCESS CONTROL (IC-714)

SEM-VII (B.Tech, 4th Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To teach the students fundamental concepts, terminology and evolution of process control along with control loop configuration
- To discuss the open and closed loop response of simple control systems and teach them the salient features and effects of P, PI, PD and PID control algorithms on the transient response of control systems
- To teach the students basics of complex control and level control explaining their importance
- To teach the students process details, identification of critical parameters, interaction among critical parameters as well as design of recommended control schemes for most widely utilized industrial process units using boiler, distillation column, steam turbine, compressor and heat exchanger as case study examples

- To make the students aware about limitations of basic PID control and necessities of control strategies for solving process control problems. To teach the students various control strategies such as Ratio, Cascade, Feed Forward, Split-range, Inverse derivative, Selector, etc. in problem-solution methodology
- To discuss higher level process complexities and teach the students the brief and introductory concepts of various advanced control strategies such as Adaptive control, Valve Position Control (VPC), Multi-variable control, Internal Model Control (IMC), Model Predictive Control (MPC), Artificial Intelligence (AI) and Fuzzy Logic Control (FLC)

B. DETAILED SYLLABUS

[A] INTRODUCTION TO PROCESS CONTROL AND FUNDAMENTAL CONCEPTS:

Introduction to process control, Evolution of process control, Laplace transforms in process control, open loop v/s closed loop systems, open loop response, feedback v/s feed forward control configuration

[B] STUDY OF OPEN LOOP RESPONSE OF SYSTEM AND ANALYSIS:

Open loop response of simple systems, Effects of P, PI, PD & PID controllers on the transient response of control systems, Complex control systems, Level control.

[C] STUDY OF TRANSIENT RESPONSE OF SYSTEM AND CONTROL DYNAMICS:

Transient response of control systems, Level control.

[D] CONTROL OF UNIT OPERATIONS:

Boiler controls, Distillation column controls, Compressor controls, Steam turbine controls, Heat exchanger controls

[E] CONTROL SCHEMES:

Ratio control, Cascade control, Feed-forward control, Selector control, Inverse-derivative control, Split range control, etc.

[F] ADVANCED PROCESS CONTROL:

Advance Control Systems – Adaptive Control, Valve Position Control (VPC), Multi-variable control, Introduction to Internal Model Control (IMC), Introduction to Model Predictive Control (MPC), Introduction to Artificial Intelligence (AI) and Fuzzy Logic Control (FLC).

C. LEARNING OUTCOMES

After successful completion of this course, student shall be able to:

- learn fundamental concepts of process control and basic loop configuration
- understand and interpret the open and closed loop response of simple control systems, as well as various control algorithms and their impacts
- learn basics of complex control and level control
- learn to study process and systematic stepwise design aspects of process control and apply them to design control schemes selected industrial process units as case study examples
- develop awareness regarding limitations and needs of basic PID control and various control strategies in problem-solution methodology
- develop understanding about higher level process complexities and basic brief concepts of various advanced control strategies

D. RECOMMENDED TEXTBOOKS

1. Process Control, by Peter Harriot
2. Applied Instrumentation in Process Industries, Vo. I & II, by Andrews & Williams
3. Process Control-Principles and Applications, by Surekha Bhanot

4. Principles of Process Control, by Patranabis
5. Automatic Control of Power & Process, by Manifold
6. Instrument Engineer's Handbook (Process Control), by BG Liptak (Vol. II)
7. Process Modeling, Simulation & Control for Chemical Engineers, by W. Luyben

E. REFERENCE BOOKS

1. Chemical Process Control, by Stephanopoulos
2. Process Control, by Pollard
3. Principal of Industrial Measurements, by Patranabis
4. Applied Instrumentation in Process Industries Vol. II, by Andrews & Williams
5. Chemical Process Control, by Shinskey
6. Chemical Process Control, by Coughnour & Copel

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

1. To study the response of Bare Thermometer
2. To study the response of Thermometer with thermowell
3. To study the open loop response of first order system
4. To study the open loop response of second order system
5. To study the response of Ratio Control Scheme

6. To study the response of Cascade Control Scheme
7. To study the response of Feed Forward Control Scheme
8. To study the response of First order Mixing Process
9. To study the response of Transportation Lag
10. To study the response of Single Tank and Two Tanks Systems

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Faculty of Technology

Department of Instrumentation and Control Engineering

BIOMEDICAL INSTRUMENTATION (IC-709)

SEM-VII (B.Tech, 4th Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To make the students aware about importance of different instruments in Medical field which are used for the measurement of different parameters of human body along with classification and terminologies of measurement Techniques
- To teach the students about specifications, selection criteria and characteristics of instrumentation measurement systems of different Biomedical signals in Medical field.
- To teach the students about various Imaging techniques for different applications in biomedical field.

B. DETAILED SYLLABUS

[A] Measurement, Recording and Monitoring:

Fundamentals of Medical Instrumentation:

Anatomy and Physiology, Physiological system of Body, Sources of Biomedical Signals, Basic Medical Instrumentation System, Performance requirement of Medical Instrument system, General Constraints of Medical Instrument system, Regulations of Medical Devices

Bioelectric signals and Electrodes:

Origin of Bioelectric signals, Recording Electrodes, Electrodes for ECG, EEG,EMG, Electrical conductivity of electrodes jellies and creams, Microelectrodes, Skin surface electrodes and needle electrodes

Recording systems :

Basic recording system,General considerations for signal conditioners, Preamplifiers, Sources of noise in low level measurement,Biomedical signal analysis techniques, Signal processing techniques, The main amplifier and driver stage,Different types of recorders, VCG,PCG,EEG,EMG,ECG

Patient monitoring Systems:

System concepts, Cardiac monitor,Bedside Patient Monitoring system,Central Monitors, Measurement of Heart Rate,Measurement of Blood Flow, Measurement of Pulse Rate, Blood Pressure Measurement, Measurement of Temperature, Measurement of Respiration rate ,Catherization lab instrumentation

[B] Modern Imaging Systems:

X-Ray Machines and Digital Radiography:

X-Rays, X-Rays Machine, X-Ray Computed Tomography,Nuclear Medical Imaging

Systems, Emission Computed Tomography (ECT),Single Photon Emission Computed Tomography (SPECT),Positron Emission Tomography (PET), Magnetic Resonance Imaging (MRI)

Ultrasonic Imaging Systems:

Diagnostic Ultrasound, Physics of Ultrasonic waves, Medical Ultrasound, Basic Pulse echo apparatus, A- scan, Echocardiograph, Real time Ultrasonic Imaging Systems, Biological effects of ultrasound

[C] Therapeutic Equipments:

Cardiac Pacemakers:

Need for Cardiac Pacemakers, External Pacemakers, Implantable Pacemakers, Recent Development in Pacemakers

Cardiac Difibrillators:

Need for Cardiac defibrillator, DC Defibrillator, Implantable Defibrillator, Pacer-Cardioverter-Defibrillator

Instruments for Surgery:

Surgical Diathermy, Surgical Diathermy Machine, Safety aspects in Surgical Diathermy machine, Surgical Diathermy Analyzers

LASER Application in Biomedical Engineering:

What is LASER ? ,Different types of LASER,Effects of Tissues and related issues, Selection of LASER for surgery, Application in different areas,Safety Aspects

Physiotherapy and Electrotherapy Equipments:

Shortwave Diathermy, Microwave Diathermy ,Ultrasonic Diathermy, Pain relief through Electrical Stimulation

Haemodialysis machine:

Function of Kidneys, Artificial Kidneys, Dialyzer, Haemodialysis machine

Electrical Safety of Medical Equipment:

Physiological effect of electrical current, Shock hazard form electric equipment, Methods of accident prevention

Latest Issues in BME:

Biomaterials, Telemedicine, Artificial heart

C. LEARNING OUTCOMES

After successful completion of this course, student shall be able to:

- develop awareness about needs of different biomedical instruments for measuring different bioelectric signals along with their design-development, classification and associated technical terminologies.
- learn specifications and salient characteristics based choice making of biomedical instrumentation measurement systems
- learn methods and applications in the field of Biomedical instrumentation.
- develop awareness of measuring different body parameters and acquired the knowledge about its importance for body with the help of different biomedical instruments.

D. RECOMMENDED TEXTBOOKS

[1] Hand book of Biomedical Instrumentation by R. S. Khandpur.

[2] Biomedical Instrumentation and measurement by Cromwell, Weibell & Preiffer.

E. REFERENCE BOOKS

[1] Introduction to Biomaterials- by Sujata Bhatt (Narosa Publishing House)

[2] Introduction to Biomedical Equipment Technology- Joseph Carr and John Brown (Pearson Education)

[3] Biomedical Digital signal Processors- Wills J. Tompkins (PHI)

[4] Medical Instrumentation- Application and Design- John G. Webster (Wiley Student edition)

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

List of laboratory experiments:

1. To study & perform the Blood Pressure Measurement Unit.
2. To study & perform the Blood Flow Measurement.
3. To study & perform the Respiration Rate Meter.
4. To study & perform the Phonocardiograph System.
5. To study & perform the D.C. Defibrillator.
6. To study & perform the Heart Rate Indicator.
7. To study & perform the Single channel ECG Machine.
8. To study & perform the Medical Telemetry Machine.
9. To study & perform the Multi-parameter Monitor.
10. To study & perform the Tread Mill Tester.
11. To study & perform the External Pacemaker.

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Department of Instrumentation and Control Engineering

ROBOTICS ENGINEERING (IC-715)

SEM-VII (B.Tech, 4th Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
4	0	2	60	40	25	25	150	4	0	1	5

A. OBJECTIVES OF THE COURSE

- To make the students aware about importance of Roboticsin every field along with classification and terminologies.
- To teach the students about specifications, selection criteria and characteristics of different robotic systems of different fields like as Industry, Space, Agriculture, Home sector, Automation etc.
- To teach the students about various applications of Robotics in various field.

B. DETAILED SYLLABUS

[A] Introduction

Evolution of Robot and Robotics, Laws of Robotics, Progressive advancement in Robot, Robot Anatomy, Human Arm characteristics.

[B] Co ordinate Frames ,Mapping & Transforms

Co ordinate frames, Description of objects in space, Transformation of vectors, Inverting of Homogeneous Transforms, Fundamental rotation Matrices.

[C] Modeling of robot –Direct kinematic model

Mechanical structure and notations, Description of links & joints, Kinematic modeling of the manipulator, Denavit- Hartenberg notation, Kinematic relationship between adjacent links Inverse Kinematics.

[D] Trajectory planning

Joint space techniques, Cartesian space techniques

[E] Robotic Actuators, sensor & vision

Sensors in robots , Actuators, Kinds of sensors used in Robotics, Robotic vision

[F] Robot Safety, Robot-Economy & installation

Introduction, plant survey, potential safety hazards ,Safety planning check list, safety guidelines

C. LEARNING OUTCOMES

After successful completion of this course, student shall be able to:

- Develop awareness about needs ofdifferent devices & instruments for developing any robot with their design-development, classification and associated technical terminologies.
- Learn specifications and salient characteristics based choice making of any robotic system.

- Learn methods and applications in the every field.

D. RECOMMENDED TEXTBOOKS

[1]Robotics and Control by I.K.Mittal & I.J.Nagrath ,Second reprint 2005 Tata Mc Grawhill

[2] Introduction to robotics by Saeed B.Niku ,first Indian reprint 2002, pearson education

E. REFERENCE BOOKS

[1]Robotics by K. S. Fu , R. C. Gonzalez & C.S. G. Lee.

[2] Robotics principles & practice by K.C.Jain & L.N.Aggarwal, khanna publishers 2003 edition

F. LIST OF EXPERIMENTS TO BE PERFORMED UNDER THIS SUBJECT HEAD (IF APPLICABLE)

List of laboratory experiments:

1. To study about Robotics, Mapping and Transforms.
2. To study about Kinematic Modelling-I.
3. To study about Kinematic Modelling-II.
4. To study about Inverse Kinematic Modelling.
5. To study about Trajectory Planning -I.
6. To study about Trajectory Planning -II.
7. To study about Robotic Sensors- I.
8. To study about Robotic Sensors-II.
9. To study about Robotic Applications-I.
10. To study about Robotic Applications- II

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Faculty of Technology

Department of Instrumentation and Control Engineering

INDUSTRIAL EXPOSURE AND PRACTICES (IC-716)

SEM-VII (B.Tech, 4th Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	**Tut**	**Prac**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
-	-	6	-	-	25	25	50	-	-	3	3

The students will undertake vocational training in industries after completion of 6th semester for the period of minimum 4 week and maximum 6 week. They should understand the instrumentation engineer's role in industries. They are supposed to prepared and submit a project report as a part of their term-work for the industrial training and give seminars on their training work.

*** 2 Credit for the Industrial Training (Vocational Training) (Part of the 6th Semester)**

1 Credit for Minor Project done during 7th semester.

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Faculty of Technology

Department of Instrumentation and Control Engineering

PROJECT/INDUSTRIAL TRAINING (IC-801)

SEM-VII (B.Tech, 4th Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
--	--	28	--	--	100	300	400	--	--	14	14

The students will undertake project work for the period of one semester. They should design/develop & fabricate the project. They are supposed to prepared and submit a project report as a part of their term-work for the project and give seminars on their project work. The students may be sent to the industry for their project and they are to timely report to the department regarding monitoring and necessary guidance. They should arrange for demonstration of the project work at the time of examination They are to be examined based on viva and/or demonstration.

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Faculty of Technology

Department of Instrumentation and Control Engineering

SEMINAR (IC-802)

SEM-VII (B.Tech, 4th Year)

Teaching Scheme (Hours)			Marks					Credit Structure			
Lect	Tut	Prac	Ext	Sess.	TW	Prac	Total	Lect	Tut	Prac	Total
--	--	8	-	-	100	--	100	--	--	4	4

Seminar

The students are required to present Seminar on Project/given topic at every week.

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Department of Instrumentation and Control Engineering

Detailed Syllabus Book

Detailed Syllabus for Post Graduate Course of

Instrumentation & Control Engineering

Faculty of Technology Dharmsinh Desai University, Nadiad

M.TECH. [IC]

Department of Instrumentation & Control Engineering
Faculty of Technology,
Dharmsinh Desai University, Nadiad – 387 001,
Gujarat state, India.
Website: ***http://www.ddu.ac.in***

Department of Instrumentation and Control Engineering

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Dharmsinh Desai University

Course structure and scheme of M.Tech (IC Engg.),

Teaching, Credit and Exam scheme of 1st to 4th Semester

SEMESTER- I [IC]												
SUBJECT CODE	**SUBJECT**	**TEACHING SCHEME**			**CREDIT STRUCTURE**		**TOTAL CREDIT**	**Exam Scheme (Marks)**				
		LECT	**TUT**	**PRA**	**L+T**	**P**		**Theory (3 hrs)**	**Sessional (1 hrs 15 min)**	**Practical**	**T/W**	**Total**
MI-111	Advanced Digital Signal Processing	3	1	2	4	1	5	60	40	25	25	**150**
MI-115	Advanced Microprocessor And Microcontroller	3	1	2	4	1	5	60	40	25	25	**150**
MI-117	Virtual Instrumentation **(Elective -I)**	3	1	2	4	1	5	60	40	25	25	**150**
MI-112	Modern Control Theory **(Elective -I)**	3	1	2	4	1	5	60	40	25	25	**150**
MI-114	Advance Power Electronics	3	1	2	4	1	5	60	40	25	25	**150**
MI-113	Process Sensors And Control	3	1	2	4	1	5	60	40	25	25	**150**
MI-116	Seminar-I	-	-	2	0	1	1	0	0	0	50	**50**
							26					**850**

SEMESTER- II [IC]												
SUBJECT CODE	**SUBJECT**	**TEACHING SCHEME**			**CREDIT STRUCTURE**		**TOTAL CREDIT**	**Exam Scheme (Marks)**				
		LECT	**TUT**	**PRA**	**L+T**	**P**		**Theory (3 hrs)**	**Sessional (1 hrs 15 min)**	**Practical**	**T/W**	**Total**
MI-212	Digital Control System	3	1	2	4	1	5	60	40	25	25	**150**
MI-213	Advance d Process Instrumentation	3	2	2	4	1	5	60	40	25	25	**150**
MI-214	Power Electronics System Design	2	1	2	4	1	5	60	40	25	25	**150**

MI-217	Biomedical Instrumentation **(Elective -II)**	3	1	2	4	1	5	60	40	25	25	**150**
MI-218	Orthopedic mechanics **(Elective -II)**	3	1	2	4	1	5	60	40	25	25	**150**
MI-219	Nanotechnology and Nano Sensors	3	1	2	4	1	5	60	40	25	25	**150**
MI-215	Neural Networks and Fuzzy Logic Controls	3	1	2	4	1	5	60	40	25	25	**150**
MI-216	Seminar-II	-	-	2	0	1	1	0	0	0	50	**50**
		-					**31**					**950**

SEMESTER- III [IC]												
SUBJECT CODE	**SUBJECT**	**TEACHING SCHEME**			**CREDIT STRUCTURE**		**TOTAL CREDIT**	**Exam Scheme (Marks)**				
		LECT	**TUT**	**PRA**	**L+T**	**P**		**Theory (3 hrs)**	**Sessional (1 hrs 15 min)**	**Practical**	**T/W**	**Total**
MI-311	Project (Phase-I)	-	-	16	0	8	8	-	-	225	125	**350**
MI-312	Seminar-III	-	-	4	0	2	2	-	-	-	50	**50**
							10					**400**

SEMESTER- IV [IC]												
SUBJECT CODE	**SUBJECT**	**TEACHING SCHEME**			**CREDIT STRUCTURE**		**TOTAL CREDIT**	**Exam Scheme (Marks)**				
		LECT	**TUT**	**PRA**	**L+T**	**P**		**Theory (3 hrs)**	**Sessional (1 hrs 15 min)**	**Practical**	**T/W**	**Total**
MI-411	Project (Phase-II)	-	-	20	0	10	10	-	-	300	150	**450**
MI-412	Seminar-IV	-	-	4	0	2	2	-	-	-	50	**50**
							12					**500**

Total Credit: 79

Dharmsinh Desai University

Faculty of Technology

Department of Instrumentation and Control Engineering

Detailed Syllabi Book

Detailed Syllabi for Post Graduate Course of

Instrumentation & Control Engineering

Faculty of Technology

Dharmsinh Desai University, Nadiad

Department of Instrumentation & Control Engineering

Faculty of Technology,

Dharmsinh Desai University, Nadiad – 387 001,

Gujarat state, India.

Website: *http://www.ddu.ac.in*

Dharmsinh Desai University
Faculty of Technology
Department of Instrumentation and Control Engineering

M. Tech. Sem. I
SYLLABUS & SCHEME FOR THE SUBJECT
ADVANCED DIGITAL SIGNAL PROCESSING

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr 15 min)	Practical	T/W	Total
3	1	2	60	40	25	25	150

Syllabus Details:

Introduction, Discrete Signals, Discrete Time Systems,
Discrete Convolution, Analog Filters, Discrete-Time,
Fourier Transform, The DFT & FFT,
The Z-Transform Applications of z Transform,
IIR Digital Filters, FIR Digital Filters

Text Books:

i. Analog & Digital Signal Processing [Second Edition] by Ashok Ambardar Books/Cole Publishing Co.

Reference Books:

i. Distance Signal Matlab By Vinay Hingday & John Prokis Prentice Hall of India, New Delhi.

ii. Matlab Programming for Engineers By Chapman (second edition)

Dharmsinh Desai University
Faculty of Technology
Department of Instrumentation and Control Engineering

M. Tech. Sem. I
Elective 1
SYLLABUS & SCHEME FOR THE SUBJECT
MODERN CONTROL THEORY

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

Introduction
Controller Modes & Control Actions, Digital Controllers, Control loop Characteristics,

Model Control
Controllable & Observable companion forms, Pole placement by state feedback, full order observers, Dead bit observers.

Optimal Control
Formation of Optimal Control Problem, Calculus of variations, minimum principle, Dynamic programming, Numerical solution of two point boundary value problem.

Optimal Feedback Control
Discrete time linear state regulator, time in-variant linear state regulators, Numerical solution of the Riccatie equation, Minimum time control of linear time in-variant system.

Stochastic Optimal Linear estimation & Control
Stochastic Processes and linear system, optimal estimation or linear discrete time system, Stochastic Optimal Linear regulator

Adaptive Control

Input adaptation, Model adaptive systems, Identifications requirement of an Ideal identification scheme, the functio n, decisi on functio n, Identificati on indic es tim e of performance, A stability of Adaptive control system, certain aspects of learning system.

Text Books:

i. Non linear Automatic Control by J.E. Gibson, McGraw Hill Publication.
ii. Modern Control System Theory by M. Gopal (2nd Edition), Wiley Eastern Publicaton.
iii. Process Control Instrumentation Technology by Curtis Johnson (4th Edition), PHI.

Reference books:

i. Modern Control System Theory By J.T. Tou, McGraw Hill Publication.
ii. Modern Control Engineering By Ogata (2nd Edition), Prentice-Hall India. **Note**: * indicate Lab Tutorial

M. Tech.
Sem.I
Elective 1

SYLLABUS & SCHEME FOR THE SUBJECT
VIRTUAL INSTRUMENTATION

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

- **Virtual Instrumentation**: Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems
- **VI programming techniques**: VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.
- **Data acquisition basics**: Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. ADC, DAC, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.
- **LabVIEW Hardware**: VI Chassis requirements Common Instrument Interfaces: Current loop, RS 232, GPIB.PCI card communication, NI DAQ MAX
- **LabVIEW Control Design Toolbox:**

  Creating continuous-time (s-)transfer functions
  Creating discrete-time (z-)transfer functions
  Creating continuous-time state-space models
  Creating discrete-time state-space models
  Standard transfer functions
  PID controllers
  Writing models to file. Reading models from file
  Getting information about a model
  Converting Control Design models to/from Simulation Module models

- Calculating transfer functions from state-space models
- Discretizing continuous-time models
- Simulation (time responses)
- Frequency response Analysis

TEXTBOOKS:

1. Virtual Instrumentation using LabVIEW by Sanjeev Gupta
2. Introduction to LabVIEW Control Design Toolkit 1.0 by Finn Haugen
3. LabVIEW Basic 1 & Basic 2 course guide by National Instruments

REFERENCES**:**

1. LabVIEW 8 : Authors and Organization:Robert Bishop, University of Texas, Austin Publisher: Prentice Hall ISBN-13: 9780138004606
2. LabVIEW 2009:Authors and Organization:Robert Bishop, University ofTexas at Austin Publisher: Prentice HallISBN-13: 9780132141291
WEB RESOURCES:www.ni.com

M. Tech. Sem. I
SYLLABUS & SCHEME FOR THE SUBJECT
PROCESS SENSORS & CONTROLLERS

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

Process Sensors
Sensors for Temperature, Pressure, Flow, Level, Stress, Strain, Phototubes, Photodiodes, Photovoltaic and photoconductive cells, Laser, Displacement transducers, Accelerometers, Smart Transmitter & SMART Sensors
Application of sensors: displacement, velocity, acceleration, force, stress, strain, pressure, temperature, flow, level and laser.

Process Controllers & Actuators
Multi-variable control systems, Pneumatic, Hydraulic & Electrical Actuators, Control Valves.

Process Control Networks
SCADA, DCS, Fieldbus, Foundation Fieldbus, wireless sensors

Text Books:

i. Process Control Instrumentation Technology by Curtis Johnson, 4th Edition, PHI.
ii. The Condensed Handbook of Measurement and Control by N. E. Battikha, 3rd Edition, ISA
iii. Fieldbuses for Process Control: Engineering, Operation and Maintenance, Jonas Berge, ISA
iv. Foundation field bus by Ian Verhappen and Augusto Pereira, 2nd Edition, ISA
v. SCADA: Supervisory Control and Data Acquisition, Stuart A. Boyer, 3rd Edition, ISA

Reference books:

i. Process Instrumentation and controls Handbook (3rd Edition) by Douglus M. Considine, McGraw Hill Book Company.
ii. Industrial Control Handbook Volume-I Transducers by E.A. Parre, Collins, London.
iii. A course in Mechanical measurement & Instrumentation by A.K. Sawhney, Dhanpat Rai & Sons, Delhi.
iv. Advanced PID Control, Karl J. Astrom and Tore Hagglund, ISA
v. Automation Network Selection by Dick Caro, 2nd Edition, ISA

M. Tech. Sem. I
SYLLABUS & SCHEME FOR THE SUBJECT
ADVANCED POWER ELECTRONICS

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

Characteristics of modern power semiconductor devices
Characteristics of Power Semiconductor Devices (PSDs) like Thyristors, GTOs, MOSFETs, IGBTS, MCS and their static & switching characteristics., Device protection & Design of snubber circuits.

Converters
Principle of Inversion & Analysis of different Inverter circuits with various load.
Principle of choppers & Analysis of different Chopper circuits with various load.
Pulse width modulated Inverters
Resonant pulse Inverters & analysis.

DC-DC Switch mode converters
Analysis of various regulator circuits.

DC Drive
Single phase Drives
Three phase Drives
Chopper phase Drives
Closed loop control of DC device

AC Drive
Induction motor drives
Synchronous motor drives

Text Books:

i. Power Electronics, Circuits, Devices & Applications by Muhammad H. Rashid (2nd Edition), PHI publication.
ii. Power Electronics, Devices & Circuits by C.M. Pauddar, Jain brothers, New Delhi.

Reference books:

i. Power Electronics by P.C. Sen, Wheeler Publication Company, New
ii. Delhi.

Power Electronics, Converters, Applications & Design by Mohan, Undeland & Robbins, Wiley Eastern Ltd., New York.

M. Tech. Sem. I
SYLLABUS & SCHEME FOR THE SUBJECT
ADVANCED MICROPROCESSORS & MICRO CONTROLLERS

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

Advanced Microprocessor & Micro controllers

Introduction to the microprocessor and computer. The microprocessor and its architecture.Addressing modes, Data movement Instructions. Arithmetic and logic Instructions. Program control Instructions, Programming the Microprocessor. 8086/8088 hardware specifications. Memory Interface. Basic I/O interface. Interrupts. Direct memory Access and DMA controlled I/O. The Arithmetic Co processor. Bus Interface. The 80186, 80188 and 80286 Microprocessors. the 80386 and 80486 Microprocessors. The Pentium and Pentium pro Microprocessors Introduction to PIC 16F84 microcontroller

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Text Books:

1. The Intel Microprocessors: 8086 / 8088, 80186 / 80188 , 80286 , 80386,80486, Pentium and Pentium Pro processor – Architecture , Programming , and Interfacing
   4th edition By: B. Brey.
2. Easy Micrcontrol'n (formerly Easy Pic'n) : By Davis Benson , From Square – 1, version 4.1.

Reference Books:

1. Fundamentals of Microprocessors and Micro Computers by B. Ram (4th Edition,1994) Dhanpatrai & Sons.
2. PIC Microcontrollers : by Di Jasio, Wilmshurst, Ibrahim, Morton, Bates, J. Smith, D.W. Smith, Hellebuyck, from Newnes

M. Tech. Sem. I
SYLLABUS & SCHEME FOR THE SUBJECT
SEMINAR-I

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
-	2	-	-	-	-	50	50

Seminar I

Each student will be required to submit one term paper about the trends in the subject chosen in consultation with faculty. He/She has to present a seminar intermittently regarding the progress of his/her studies.

M. Tech. Sem. II
Elective 1
SYLLABUS & SCHEME FOR THE SUBJECT
BIOMEDICAL SYSTEMS AND CONTROL

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

A. Introduction to Biomedical Instrumentation

1. Bio electric signals & their measurements
2. Pulmonary function analysers, Blood gas analysers & oximeters
3. Blood flow and Blood pressure measurement
4. Foetal monitoring instruments
5. Arrhythmia & ambulatory Monitoring instruments
6. Magnetic resonance imaging system
7. Cardiac pacemakers, Cardiac Defibrillators
8. Hemodialysis machine
9. Ultrasonic Imaging system
10. Surgical diathermy & various diathermy applications. LASER in bio medical

B. Biomedical systems and Control

1. Model and Analog study of Biological system
2. Resistive property, Compliance property,
3. System response, System stability
4. Feedback concept and control mathematics
5. Regulation of body temperature
6. Cardiovascular control system

Text and Ref books:

1. System approach to Biomedicine by W.B. Blessor, McGrawhill
2. Human Physiology by Vander, Shermon & Lucieno, Latest Eastern Edition
3. IEEE transcation on BME
4. Physiological control systems: Analysis, Simulation Estimation. By: Michael C.K.Khoo. Pub: Prentice Hall of India Pvt. Ltd. New Delhi.
5. Handbook of bio medical instrumentation by R.S. Khandpur, Tata McGraw Hill Book Publishing company, New Delhi
6. Biomedical Instrumentation & Measurements (2nd Edition) by leslie Cromwell, Fred J. Weibell & Erich A. Pfeiffer by PHI Editions, New Delhi

M. Tech. Sem. II
Elective 1
SYLLABUS & SCHEME FOR THE SUBJECT
ORTHOPAEDIC MECHANICS

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

A. Introduction to Biomedical Instrumentation 1. Bio electric signals & their measurements

2. Pulmonary function analysers, Blood gas analysers & oximeters
3. Blood flow and Blood pressure measurement
4. Foetal monitoring instruments
5. Arrhythmia & ambulatory Monitoring instruments
6. Magnetic resonance imaging system
7. Cardiac pacemakers, Cardiac Defibrillators
8. Haemodialysis machine
9. Ultrasonic Imaging system
10. Surgical diathermy & various diathermy applications. LASER in bio medical

B. Orthopaedic Mechanics

2. Structure and properties of bone, tendon, ligaments, cartilage as a composite material, forces at joints, redius, ulnar and elbow joint force, muscle force, ligament force, fatigue ness of bone
3. Spinal biomechanics, deformity, analysis, correction procedure, quantization, accident investigation, FEM analysis
4. Biomechanics of the knee joint, anatomy, forces at knee in standing, kinetics, prosthetic knee
5. Mechanics of the upper and lower limb, hand and foot anatomy, functions, estimation of grip forces, muscle involved, problems of foot, quantization , correction
6. Gait analysis- locomotion, math modelling, work done forces, energy studies, instrumentation for locomotion
7. Prosthesis- above knee prosthesis, below knee prosthesis, component materials, prosthesis, orthosis, , hip prosthesis design, EMG analysis, signal processing
8. Biomechanics of head & neck injuries, anatomy, modelling, , FEM Analysis,, restraint system, Protective system, injury index
9. Dental mechanics
10. Sports mechanics

Text and Ref books:

1. Biomechanics of medical devices- Ghista D.N.
2. Human body mechanics- Ghista
3. Introduction to biomechanics of joint & joint replacement – Dowcon & Wright
4. Clinical Biomechanics of spine by Punjabi and white
5. Biomechanics of the knee- Paul Macquet
6. Biomechanics of hand- E.Y.S. Chao
7. Prosthetics and Orthotics, 2nd Edition By: Donald G. Shurr et al.
8. Rehabilitation Engineering,1995, By Robinson C.J. Pub.: CRC Press
9. Basic Biomechanics 3rd Edition By: Susan J Hall .Pub:McGraw Hill
10. GAIT analysis – Normal and pathological function, Jacquelin Perry, Pub: Slack Inc, New Jersy
11. Handbook of bio medical instrumentation by R.S. Khandpur, Tata McGraw Hill Book Publishing company, New Delhi
12. Bio medical Instrumentation & measurements (2nd editio n) by Lesl ie cromwell, Fred J. Weibell & Erich A. Pfeiffer by PHI Publications, (2nd edition), New Delhi.

M. Tech. Sem. II
SYLLABUS & SCHEME FOR THE SUBJECT
DIGITAL CONTROL SYSTEMS

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

- Introduction to discrete Time control system
- The Z transform
- Z plane analysis of discrete Time control system
- Design of discrete Time control system by conventional Methods
- Polynomial Equations Approach to control System Design: Using MATLAB
- Principles of signal conversion
- Optimum control through digital compensation

Text Book:

Discrete – Time Control Systems, Second Edition.
Author: Katsuhiko ogata

Digital & Sampled Data Control Systems by J.T. Tou, McGraw Hill Book company, New York.

Reference books:

i. Analysis & Synthesis of sampled-data control system by B.C. Kuo, Printice-Hall, Englewood Cliffs, New Jersey.
ii. Control Engineers Handbook by J.G. Truxal, McGraw Hill Book Company Inc., New York.
iii. Theory of Sampled Data Control system by D.P. Lindorff, John Wiely, New York.
iv. Control Systems Engineering Third Edition by I.J.Nagrath & M.Gopal

M. Tech. Sem. II
SYLLABUS & SCHEME FOR THE SUBJECT
ADVANCED PROCESS INSTRUMENTAION

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

Process Instrumentation

Effects of Measurement lag, Process Disturbance, Magnitude of Process Load, cascade Control Loop, Batch Process Control, Continues Process Control, Optimizing or computing machine control.

Sinusoidal Analysis

Sinusoidal Disturbance and response, Operation with complex Numbers, Plotting Sinusoidal or frequency response, Sinusoidal response of dynamic elements, Dead time, Distributed Parameter and exothermic elements, Limiting, Dead zone and Hysteresis Elements, Testing sinusoidal response.

Stability Analysis

Transfer function, Transfer locus, Nyquiest stability criteria, Bode method of analysis.

Logic devices and PLC's

Computer and Distributed Control

Text Books:

i. Instrument Engineer's Handbook (Process Control) by Bela G. Liptak (Revised Edition) Clinton Book Company.
ii. Automatic Process Control, by Donald P. Eckman (7th Edition), Wiley Eastern Ltd.

Reference books:

i. Computer Based Industrial Control, by Krishnakant (1997 Edition), PHI, New Delhi.
ii. Control System Design, by Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado (2002 Edition), PHI, New Delhi.

M. Tech. Sem. II
Elective 2
SYLLABUS & SCHEME FOR THE SUBJECT
POWER ELECTRONICS SYSTEM DESIGN

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

Design of various inverters – like parallel capacitor commutated inverter, series inverter, Mc Murray Bedford Inverter, Design of class A,B,C,D and E choppers, Jone's Choppers & Morgan's Chopper, Design of Switch Mode Power Supply, Resonant Converter, Design of Device drivers circuits, Synchronized control circuits and free running control circuits, Dual converter analysis & Design. Design of various device protection circuits

Text Books:

i. Modern Power Electronics by P.C. Sen, Wheeler Publication Company, New Delhi.

ii. Power Electronics Devices & Circuits by C.M. Pauddar, Jain Brothers, New Delhi.

Reference books:

i. Power Electronics by Mohan, Undeland and Robbins, Wiley Publication, New York.

ii. Power Electronics by M.H. Rashid, PHI Publications, New Delhi

M. Tech. Sem. II
Elective 2
SYLLABUS & SCHEME FOR THE SUBJECT
NANOTECHNOLOGY AND NANO SENSORS

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

[A] Introduction to Nanotechnology
Essence of Nanotechnology, Nano in daily life, Brief account of nano applications, Properties of nano materials, Metal nano clusters, Semiconductor nano particles.

[B] Nano Materials
Nano composites, Nanofying electronics, Sensing the environment, Mechanising the micro world, Energy and cleaner environment with nano technology.

[C]Carbon Nano Structures:
Introduction, Carbon molecules, Carbon clusters, Carbon nano tubes, Applications of carbon nano tubes.

[D] Diagnosing Personal Health and Medical Applications:
Lab on a chip, Super X-ray vision, Mapping the genes, Understanding how pharmaceutical company develops drugs, Delivering a new drug the Nanotech way, Cooking cancer with nano cells, Biomimetics.

[E]Nano sensors & Nanodevices
Micro and nano-sensors, Fundamentals of sensors, biosensor, micro fluids, MEMS and NEMS,Packaging and characterization of sensors, Sensors for aerospace and defense: Accelerometer,Pressure Sensor, Night Vision System, , Integration of sensor with actuators and electroniccircuitry, Sensor for biomedical applications: Cardiology, Neurology and as diagnostic tool,Biosensors. Clinical Diagnostics, generation of biosensors, immobilization, characteristics,
applications, conducting Polymer based sensor, DNA Biosensors, optical sensors. Biochips. MetalInsulator Semiconductor devices, Transistors, MOSFET and Nano FET.

[F] Instruments for Nano particle properties measurements
Equilibrium surface tension, dynamic surface tension, contacts angle and Ultra violet- visible spectroscopy.

Textbooks

1. Nanotechnology by Richard Booker, Earl Boysen, Wiley Publishing Inc., 2006.
2. Introduction to Nanotechnology by Charles P. Poole Jr., Frank J. Owens, John Wiley & Sons
Publications, 2003.
3. MEMS & MOEMS Technology and Applications- P. Rai Choudhury
4.HANDBOOK OF APPLIED SURFACE AND COLLOID CHEMISTRY,Volume 2 Edited by Krister Holmberg Chalmers University of Technology, Goteborg, Sweden, Dinesh O. Shah, University of Florida, USA,Milan J. Schwuger, Forschungszentrum Jtilich GmbH,Germany, JOHN WILEY & SONS, LTD

Reference Books:

1. Nano Materials- A.K.Bandyopadhyay New Age Publishers. India.
2. Nano Essentials- T.Pradeep TMH, India.
3. Sensors: Micro & Nano sensors, Sensor Market trends (Part 1&2) by H. Meixner.
4. Between Technology & Science : Exploring an emerging field knowledge flows & networking
on the nanoscale by Martin S. Meyer.
5. Nano science & Technology: Novel structure and phenomena by Ping Sheng (Editor)
6. Nano Engineering in Science & Technology : An introduction to the world of nano design by
Michael Rieth.
7. Enabling Technology for MEMS and nano devices -Balles, Brand, Fedder, Hierold.
8 OptimalSynthesis Methods for MEMS- G. K. Ananthasuresh
From Atom to Transistor- Supriyo Datta

M. Tech. Sem. II
SYLLABUS & SCHEME FOR THE SUBJECT
NEURAL NETWORKS AND FUZZY LOGIC CONTROLS

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
3	1	2	60	40	25	25	150

Introduction, sets, Boolean logic and algebra. Fuzzy sets, Fuzzy logic algebra. Fuzzy control. Electronic neural networks. Fuzzy neural networks.

Artificial Neural systems: Preliminaries, Fundamental concepts and modes of artificial Neural systems, Single Layer perceptron classifiers, single layer feedback networks, applications of neural algorithms.

Text Books:

i. Introduction to applied fuzzy electronics, by Ahmad M. Ibrahim, PHI, New Delhi.

ii. Introduction to Artificial Neural systems by Jacek M. Zurada, Jaico Publishing House, (3rd Jaico Impression).

Reference books:

i. Fundamental of Artificial Neural Networks, by Mohamad H. Hassoun, PHI, New Delhi.

ii. Fuzzy-Neural Control: Principles, Algorithms & Applications by Nie & Libnkens, PHI, New Delhi.

Note: * Indicate Lab-Tutorial

M. Tech. Sem. II
SYLLABUS & SCHEME FOR THE SUBJECT
SEMINAR-II

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
-	2	-	-	-	-	50	50

Seminar II

Each student will be required to submit one term paper about the trends in the subject chosen in consultation with faculty. He/She has to present a seminar intermittently regarding the progress of his/her studies.

M. Tech. Sem. III
SYLLABUS & SCHEME FOR THE SUBJECT
PROJECT (Phase-I)

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
-	-	6	-	-	225	125	350

The student will undertake project work for the period of two semesters, out of which this is the first phase of the project. They should design/develop & fabricate the project.

They are supposed to prepared and submit a project report as a part of their term-work for Phase-I of the project and give seminars on their project work. The students may be sent to the industry for their project and they are to timely report to the department regarding monitoring and necessary guidance.

They should arrange for demonstration of the project work at the time of examination (which may be partly). They are to be examined based on viva and/or demonstration. The project is to be continued and to be completed in the forth semester.

M. Tech. Sem. III
SYLLABUS & SCHEME FOR THE SUBJECT
SEMINAR-III

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
-	-	2	-	-	-	50	50

Seminar III

The students are required to present Seminar on Project/given topic at every week.

M. Tech. Sem. IV
SYLLABUS & SCHEME FOR THE SUBJECT
PROJECT (Phase-II)

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
-	24	-	-	-	300	150	450

The student will undertake project work for the period of one semester and this is the second phase of the project. They should design/develop & fabricate the project for Phase-II.

They are supposed to prepared and submit a project report as a part of their term-work for Phase-II of the project and give seminars on their project work. The students may be sent to the industry for their project and they are to timely report to the department regarding monitoring and necessary guidance.

They should arrange for demonstration of the project work at the time of examination. They are to be examined based on viva and/or demonstration.

The students should complete the project and should be completed the moderation at the time of final examinations.

M. Tech. Sem. IV
SYLLABUS & SCHEME FOR THE SUBJECT
SEMINAR-IV

Teaching Scheme (H/W)			Exam Scheme (Marks)				
Lectures	Tutorial	Practical	Theory (3 hrs)	Sessional (1 hr)	Practical	T/W	Total
-	6	-	-	-	-	50	50

Seminar IV

The students are required to present Seminar on Project/given topic at every week.

SUBJECT : Communication Skills

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac
-	-	2	2	1	-	-	-	25

A. COURSE OVERVIEW

The course is intended to familiarize students with the basics of English language and help them to learn to identify language structures for correct English usage. To enable the students to adopt strategies for effective reading and writing skills. It helps students to carry out day to day communication at the work place by adequate understanding of various types of communication to facilitate efficient interpersonal communication.

B. COURSE CONTENT

NO	TOPIC	Practical	COs
[1]	Concord, Tenses, Impersonal Passive Voice, Conditional Sentences, Conjunctions and Prepositions, Idioms.	4	CO1
[2]	Nature and Scope, Communication Networks, Supervisor and Em-ployee Communication, Organizational Structure, Lack of Trust, Un- ethical Communication. Non-verbal Communication: Significance and Forms, Elements of Non-verbal Communication. Cross-cultural Communication: Concept, Different Communication Styles and Strategies. Technology-enabled Business Communication: Tools, Impact, Effec- tiveness. Case Study.	6	CO2 CO3
[3]	Business Messages: Importance, Types, Approaches, Stages. Business Letter Writing: Principles and Components, Kinds of Busi-ness Letters Instructions: Written Instructions, Format, Audience Analysis, Char- acteristics Business Reports: Kinds, Characteristics, Parts, Elements, Steps Proposals: Types, Components, Format, Proposal Layout and Design Resume: Format, Types, Video Resumes, Send Resumes, Online Re- cruitment: Process and Techniques.	8	CO3 CO5
[4]	Interviews: Principles, General Preparations, Follow up, Questions Group Discussion: Planning and Preparation, Steps.	6	CO4 CO5

C. TEXT BOOKS

1. Meenakshi Raman and Prakash Singh, *Business Communication;* Oxford University Press
2. Meenakshi Raman and Sangeeta Sharma, *Technical Communication;* Oxford University Press

D. REFERENCE BOOKS

1. Sangeeta Sharma & Vinod Mishra , *Communication Skills for Engineers and Scientists*; PHI
2. William Sanborn Pfeiffer and T. V. S. Padmaja, *Technical Communication*; Pearson

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply	Effective use of tenses and Conditional Sentences for academic writing
CO2	Analyze	Identify Various Means of Professional Communication
CO3	Apply	Practice Effective Business Writing and Correspondence
CO4	Apply	Exercise Interviews and Group Discussion Practices
CO5	Apply	Understanding Professional Environment and Being Competent

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	2	2	3	2	-	-	1	3	-	-	2
CO2	2	2	2	2	3	2	-	-	3	3	2	-	2
CO3	2	2	2	3	2	2	-	-	2	3	2	-	2
CO4	2	2	2	2	2	2	-	-	3	3	2	-	2
CO5	2	2	2	1	1	2	-	-	3	3	2	-	2
Avg	2	2	2	2	2.2	2	-	-	2.4	3	2	-	2

SUBJECT : SOFTWARE ENGINEERING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course describes software engineering approaches and principles. It imparts the knowledge of various software process models as well as phases of software development. The course includes agile development and testing approach used for software development. It gives understanding of various quality measures of software and development process .

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Software and Role of Software, Types (nature) of Software, Software Engineering-A Layered Technology, Software Process, Software Myths, Software Engineering Practices.	3	CO1
[2]	Process Models – A Generic Process Model, Process Assessment and Improvement, Overview of Prescriptive Process Models: Waterfall, Incremental, Evolutionary, Concurrent, Overview of Specialized Process Models: Component-Based, Formal Methods, Aspect-Oriented Software Development, Unified Process, Personal and Team Process Models.	8	CO1 CO2
[3]	Requirements Engineering, Establishing the Ground Work, Eliciting Requirements, Developing Use Cases, Building the Requirement Model, Negotiating Requirements, Validating Requirements.	5	CO1 CO3
[4]	Requirements Analysis: Domain Analysis, Analysis Rules of Thumb, Requirements Modelling Approaches: Scenario Based, Information Based, Flow Oriented Strategies.	5	CO1 CO3
[5]	Abstraction, Architecture, Aspects, Cohesion, Coupling, Data Design, Design Process, Functional Independence, Good Design, Information Hiding.	5	CO1 CO4
[6]	Software Architecture, Importance of Architecture, Architectural Descriptions and Decisions, Architectural Mapping Using Data Flow.	4	CO4
[7]	User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Web App Interface Design.	4	CO4
[8]	Agility and Cost of Change, Agile Process, Extreme Programming, Introduction to Agile Process Models: Adaptive Software Development, Dynamic Systems Development Method, Scrum, Crystal, Feature Driven Development, Lean Software Development, Agile Modeling, Agile Unified Process, Advantages and Disadvantages of Agile.	8	CO5
[9]	Agile Requirements Abstraction Model, Requirements Management in Agile Environment, Agile Requirements Prioritization, Agile Requirements Modeling and Generation, Collaborative User Story Creation.	7	CO5
[10]	Agile Testing – Principles, Methods & Advantages, Agile Testing Quadrants: the Purpose of Testing, Technology- Facing Tests that Supports the Team, Overview of Agile Testing Methods: Test Driven, Ac-	8	CO5

	ceptance Test Driven, and Behaviour Driven Development.		
[11]	Verification and Validation, Software Quality Assurance, Software Quality, Capability Maturity Model (SEI-CMM), International Standard Organization (ISO), Comparison of ISO-9000 Certification, SEI-CMM, Reliability Issues, Reliability Metrics.	3	CO6

C. TEXT BOOKS

1. Robert C. Martin, *Agile Software Development, Principles, Patterns and Practices* ; Prentice Hall
2. Lisa and Janet, *Agile Testing – A Practical Guide For Testers And Agile Teams*
3. Roger Pressman, *Software Engineering A practitioner's Approach*; 6th ed.; Mcgraw-Hill International Edition

D. REFERENCE BOOKS

1. Jim Highsmith, *Agile Software Development Ecosystems*; Addison Wesley
2. Rajib Mall, *Fundamentals of Software Engineering;* 3rd ed.; PHI
3. Ian Sommerville, *Software Engineering*; 5th ed.; Addision Wesley

E. COURSE OUTCOMES

CO1	Understand	Describe the importance of software engineering approaches, principles, models and processes.
CO2	Analyse	Identify an appropriate process model for effective planning for the given system.
CO3	Analyse	Perform requirements engineering for the given system.
CO4	Apply	Prepare robust software design for given system requirements individually and in team.
CO5	Apply	Demonstrate Agile software development and testing.
CO6	Understand	Understand significance of software reliability and quality measures for lifelong software practices

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	1	-	-	-	-	3	1	-	-	-	-	-
CO2	2	2	3	3	-	-	3	3	3	-	3	-	-
CO3	3	3	3	3	-	-	3	3	3	-	3	-	-
CO4	2	3	3	3	-	-	-	2	3	-	3	-	-
CO5	3	2	2	2	-	-	2	2	3	-	3	-	-
CO6	-	1	1	1	-	-	2	1	-	-	-	-	-
Avg	2	2	2	2	-	-	2.1	2	2	-	2	-	-

MCA SEMESTER – II
SUBJECT : SEMINAR PRESENTATION

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
-	-	2	2	1	-	-	-	25	25

A. COURSE OVERVIEW

The course aims to develop learners' communication, presentation and report writing skills lifelong. It enables the learner strengthen and practice discussion abilities, develop Internet research skills, increase vocabulary, improve reading and listening comprehension & build confidence for oral communicative purposes.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Independently explore and identify a suitable technological topic.
CO2	Understand	Find relevant literature for a given technological topic individually and in a team.
CO3	Analyse	Perform detailed literature review on the identified topic to pursue lifelong learning.
CO4	Evaluate	Summarise reviewed literature.
CO5	Create	Prepare a detailed informative report individually and in a team based on the reviewed literature.
CO6	Create	Prepare an effective presentation.
CO7	Apply	Deliver presentations to individuals and groups to practice lifelong in a professional environment.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	-	-	2	2	3	-	1	2	2	-	2
CO2	3	2	-	-	2	2	3	-	2	2	2	-	2
CO3	2	3	-	-	2	2	2	-	2	2	2	-	2
CO4	1	2	-	-	2	2	2	-	2	2	2	-	2
CO5	2	2	-	-	2	2	2	-	2	2	2	-	2
CO6	2	2	-	-	2	2	3	-	2	2	2	-	2
CO7	1	1	-	-	2	2	3	-	3	2	2	-	2
Avg	2	2	-	-	2	2	2.57	-	2	2	2	-	2

C. TEXT BOOKS

SUBJECT : SOFTWARE DESIGN AND TESTING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	25	-	125

A. COURSE OVERVIEW

This course provides a way of thinking about real world information system design problems and their solutions using various UML models. It covers various phases of software testing life cycle. The course will enable the learners to use various testing techniques and automated testing tools. It also introduces testing of web-based and object-oriented systems.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	The Importance of Modeling. Object-Oriented Modeling and Principles, An Overview and Conceptual Model of UML	6	CO1
[2]	Classes, Relationships and Other Common Mechanisms, Types of Diagrams, Class Diagrams, Interfaces: Types and Roles, Object Diagrams	9	CO1 CO2
[3]	Interactions, Use-cases, Use-Case Diagrams, Interaction Diagrams, Activity Diagrams, State-chart Diagrams.	9	CO2
[4]	Patterns and Frameworks, Component Diagrams, Deployment Diagrams, A Detailed Case Study on System Analysis and Design using Unified Approach.	6	CO2
[5]	Introduction and Evolution of s/w Testing, Definition and Goals of Testing, Effective and Exhaustive Testing, Software Testing Life Cycle (STLC), Testing Terminology and Methodology.	3	CO3
[6]	Verification, Verification of Requirements, High-level and Low-Level Design, How to Verify Code? Validation, Validation Activities: Unit Testing, Integration Testing, Function Testing, System Testing, Acceptance Testing, Overview of Regression Testing	6	CO3
[7]	Static Testing: Inspection, Structured Walkthroughs, Technical Reviews Dynamic Testing Black-Box Testing: Boundary Value Analysis, Equivalence-Class Testing, White-box Testing: Need of White-box Testing, Basis Path Testing, Graph and Loop Testing, Data Flow Testing.	8	CO3
[8]	Test Organization, Structure of Testing Group, Test Planning, Detailed Test Design and Test	3	CO4
[9]	Need for Automation, Categorization of Testing Tools, Selection of Testing Tools, Cost Incurred in Testing Tools, Guidelines for Automated Testing, Overview of some Commercial Testing Tools.	4	CO3
[10]	Object-Oriented Testing (OOT) Basics, Comparison: Conventional testing and OOT, Issues in OOT, Issues in testing Inheritance, Various OO Testing Techniques.	3	CO5
[11]	Overview of Web-Based Systems, Web Technology Evolution And Comparison with Traditional Software, Challenges in Testing Web-Based Systems, Web Engineering, Testing Web-Based Systems.	3	CO5

1. Grady Booch, James Rumbaugh, and Ivar Jacobson. *The Unified Modeling Language User Guide;* Low Price Edition, Pearson Education
2. Naresh Chauhan. *Software Testing Principles and Practices;* Oxford Publication

D. REFERENCE BOOKS

1. Joseph Schumuller. *Teach yourself UML in 24 Hours; 3rd ed.;* Sams Publication.
2. Rax Black, Eric Van Veenendaal and Dorothy Greham. *Foundations of Software Testing ISTQB Certification*; Cengage Learning.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe Object Oriented Methodology and Unified Modeling Language for software design and development
CO2	Apply	Prepare overall design using various UML models and diagrams.
CO3	Apply	Understand software testing life cycle and efficiently use modern testing techniques and tools to test software.
CO4	Evaluate	Write and execute test plan, test case and test specification
CO5	Understand	Discuss object-oriented and web-based testing techniques.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	-	1	1	-	1	1	2	1	-	-	-	-
CO2	3	3	3	3	-	3	3	2	3	-	-	-	-
CO3	2	3	3	2	-	3	2	2	2	-	-	-	-
CO4	3	3	3	3	-	3	3	2	3	-	-	-	-
CO5	1	1	-	1	-	1	1	2	1	-	-	-	-
Avg	2.2	2	2	2	-	2	2	2	2	-	-	-	-

C. TEXT BOOKS

SUBJECT : WEB DEVELOPMENT WITH PHP

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course provides the knowledge necessary to design and develop dynamic, object oriented, database-driven and MVC based web applications using PHP. It will enable learners to work with the server environment and database interaction using MySQL. The course also makes learners familiar with popular PHP development frameworks.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	A Brief Introduction to Apache, Mysql, PHP and Open Source, Configuring Apache, Mysql and PHP, PHP Structure and Syntax, Creating PHP Program, PHP Using HTML	9	CO1
[2]	PHP Files, Variables, Data Types, Strings, Arrays, Operators PHP in Web Applications: Getting Information from the User, Working with HTML Forms, Persisting Data with Cookies, Conditionals, Switch… Case, Loops, Function Declaration, Function Arguments, Return Statement, Type Hinting and Return Types, Reading and Writing Files, File System Functions.	14	CO1 CO2
[3]	Classes and Objects, Properties, Methods, Constructors, Magic Methods, Properties and Methods Visibility, Encapsulation, Namespaces, Autoloading Classes, Inheritance, Overriding Methods, Abstract Classes, Interfaces, Polymorphism, Traits, Handling Exceptions, Anonymous Functions.	10	CO3
[4]	Connecting to the Database using PHP Data Objects, Performing Queries, Prepared Statements MVC: The MVC Pattern, using Composer, Managing Dependencies, Autoloader with PSR-4, Adding Metadata, Working with Requests, The Request Object, Filtering Parameters from Requests, Mapping Routes to Controllers, The Router, Model, View, Controller, Implementation of MVC Application, Dependency Injection.	14	CO4
[5]	The Purpose of Frameworks, The Main Parts of a Framework, Other Features of Frameworks, Authentication and Roles, ORM, Complete and Robust Frameworks, Lightweight and Flexible Frameworks Popular Frameworks: Symfony 2, Zend Framework 2 Laravel Framework: Composer, Laravel Homestead, Virtual Box, and Vagrant, File Structure, Routing, A Static Method, Controller Class, View and Blade, Environment, Database Migration, Eloquent Model Class, Model, View, Controller Workflow, HTML Form Builder, A CRUD Application, Conditional Rules, Custom Validation, Form Validation.	13	CO5

1. Elizabeth Naramore, Jason Gerner, Yann Le Scouarnec, Jeremy Stolz and Michael K. Glass. *Beginning PHP6, Apache, and MySQL Web Development;* Wrox,
2. Antonio Lopez. *Learning PHP 7;* 2016 Packt Publishing
3. Sanjib Sinha. *Beginning Laravel;* Apress

D. REFERENCE BOOKS

1. Atkinson Leon. Suraski Zeev. *Core PHP Programming*; Pearson Publication
2. Robin Nixon. *Learning PHP, MySQL & JavaScript; 4th ed.;* O'Reilly Publication.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Explain the basics of open-source software and the building blocks of PHP
CO2	Apply	Experiment handling of HTML forms, files and cookies in PHP
CO3	Apply	Demonstrate robust object-oriented programs with PHP
CO4	Create	Develop MVC based and database centric web applications using PHP and MySQL
CO5	Apply	Summarize different PHP frameworks and develop basic CRUD applications using Laravel framework

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	1	1	1	-	-	1	-	1	-	-	-	2
CO2	2	3	2	3	2	-	2	-	2	-	2	-	2
CO3	2	1	3	2	2	-	2	-	2	-	2	-	2
CO4	3	3	3	3	3	-	3	-	3	-	3	-	2
CO5	2	2	2	1	3	-	2	-	2	-	3	-	2
Avg	2.2	2	2.2	2	2	-	2	-	2	-	2	-	2

C. TEXT BOOKS

SUBJECT: Mobile Application Development

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course is intended to make learners capable of developing applications for mobile devices. It will enable learners to develop data centric applications on android platform. The course also covers hybrid mobile application development.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	The Evolution of Mobile Application Development, Different Ecosystems: Apple, Google, Microsoft, Problems with Ecosystem-Based Applications, Web Sites and Web Views for Mobile Devices, Adding Javascript, Hybrid Mobile Applications, Front-End and Back-End Development, Introduction to Testing Mobile Applications, Native Vs. Hybrid Mobile Applications.	4	CO1
[2]	An Android Platform, Android SDK Features, Which Devices Android Runs on, Why Android For Mobile Development, Comparison of Android with other Platform, Android Development Framework, Understanding Android Software Stack, Android Application Architecture Installing and Updating Android SDK, Android Development Tools: AVD Manager, Android SDK Manager, Emulator, Dalvik Debug Monitor Service, Debug Bridge, Hierarchy View and Lint Tool, Monkey and Monkey Runner.	3	CO1
[3]	Building Blocks of Android Application, The Application Manifest File, Manifest Editor,Creating Resources, Using Resources, Android Application Lifecycle, Application's Priority and Its Process States, Extending and Using Android Application Class, Overriding the Application Lifecycle Events Android Activities: Creating Activities, Activity Lifecycle, Activity Stacks, Activity States, Monitoring State Changes, Understanding Activity Lifetimes, Android Activity Classes Introduction to an Intent, Starting Activities, Sub Activities and Services using Implicit and Explicit Intents.	4	CO1 CO2
[4]	Fundamental Android UI Design, Assigning UI To Activities, Layout Classes, Defining Layouts, Linear Layout, Relative Layout, Grid Layout, Optimizing Layouts Fragments, Creating New Fragment, Fragment LifeCycle, Fragment Manager, Fragment Specific LifeCycle Events, Fragment States, Adding Fragments to Activities, Using Fragment Transaction, Interfacing Between Fragments and Activities, Fragment Without User Interfaces, Android Fragment Classes.	7	CO2
[5]	Toolbox Controls, Creating and Modifying Views, Creating Compound Controls, Custom Views, Handling User Interaction Events, Custom Controls, Customizing Array Adapter and Simple Cursor Adapter.	10	CO2
[6]	Introduction to Sqlite Database, Content Values and Cursors, Working with Sqlite Databases: Opening and Creating Database without	8	CO4

	Sqlite Open Helper, Querying Database, Extracting Values from a Cursor, Adding, Updating and Removing Rows, Content Provider's URI Address, Content Provider Transaction, Adding, Deleting and Updating Content, Storing and Accessing Files from a Content Provider, Introduction to Native Android Content Providers.		
[7]	Broadcasting Events with Intents, Introduction to Intent Filters and Broadcast Receiver Saving Simple Application Data: Shared Preferences, Saved Application UI State, Files Creating, Saving and Retrieving Shared Preferences, Persisting the Application Instance State, Working with the File System	4	CO2
[8]	Introduction to Location Based Services, Emulator with Location Based Services, selecting a Location Provider, Finding your Current Location Hardware Support Phone States, Monitoring Changes in Phone State using the Phone Listener, Using Intent Receiver to Monitor Incoming Calls SMS and MMS, Sending SMS at for Telephony, Initiating Phone Calls, Replacing Native Dialer, Accessing Telephony Properties and MMS Using Intents, Sending SMS Using SMS Manager, Listening For Incoming SMS.	5	CO2
[9]	iOS Layer, Windows Phone Layer, Browser-Based Applications and Browser Runtime, How Hybrid Application Works Basics of HTML 5 and Useful APIS : Integrated and Associated APIS Data Formats: Using XML, JSON, JQuery Basics, JQuery Selectors, Server-Side Support SOA Architecture: Web Services, WCF Services, Rest Based Services, CSS, Bootstrap, Skeleton HMAD Development and Packaging Frameworks, Testing Mobile Applications.	5	CO3
[10]	HTML with JQuery, Event Handling in JQuery, Live Event Binding in JQuery Using On function, JQuery Plug-in-based Approach to Generating a UI, Miscellaneous Libraries and Plugins, Responsive UI, Frequently Used Style Classes.	4	CO3
[11]	Saving A File to Device Storage, Opening a Local File from Device Storage, Displaying the Contents of a Directory, Creating a Local Sqlite Database, Uploading a File to a Remote Server Via a Post Request, Caching Content using the Web Storage Local Storage API	6	CO4

C. TEXT BOOKS

1. Reto Meier. *Professional Android 4 Application Development;* Wrox (Willey) Publication
2. Mahesh Panhale. *Beginning Hybrid Mobile Application Development*; Apress
3. Matt Gifford. *PhoneGap Mobile Application Development Cookbook;* PACKT.

D. REFERENCE BOOKS

1. Lauren Dercey & Shane Conder. *Android Wireless Application Development Vol-I Android Essential; 3rd ed.;* Pearson
2. W.Frank Ableson, Robi Sen, Chris King, C. Enrique Ortiz. *Android in action; 3rd ed.;*, Dreamtech Press.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe mobile application environment, android development framework and android application structure.
CO2	Apply	Develop native mobile applications using android
CO3	Apply	Develop hybrid mobile applications using opensource platform
CO4	Apply	Design and develop dynamic mobile applications with sqlite database

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	1	-	-	-	-	2	-	1	-	-	-	-
CO2	3	3	3	3	3	-	2	-	2	-	3	-	-
CO3	2	2	2	2	3	-	2	-	2	-	2	-	-
CO4	3	3	3	3	3	-	2	-	3	-	3	-	-
Avg	2.75	2.2	2	2	2.25	-	2	-	2	-	2	-	-

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course makes learners understand virtualization concepts and ecosystem of cloud computing. The course covers key services of public cloud for deploying applications on the cloud platform. It includes containerization and DevOps concepts. Enables Learners set up applications in container as well as DevOps environment. The course contains fundamentals of openstack platform.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Defining Cloud Computing, Cloud Types, Characteristics of Cloud Computing, The Role of Open Standards, Benefits of Cloud Computing, Cloud Architecture, Cloud Computing Service Models (IaaS, SaaS, PaaS, IDaaS, CaaS).	9	CO1
[2]	Introduction to Virtualization Technologies, Advanced Load Balancing on Google Cloud, Understanding Hypervisors, Virtual Machine Types, Oracle VirtualBox, KVM.	5	CO3
[3]	Using Amazon Web Services, Understanding Amazon Web Services (AWS), AWS Components and Services, Working with Elastic Compute Cloud (EC2), Working with Amazon Storage Systems: Amazon Simple Storage Systems (S3), Amazon Elastic Block Storage (EBS), Understanding Amazon Database Services: Different Database Services of AWS, Amazon Relational Database Service (RDS), Steps for Creating RDS and Connect with EC2 Application Using Microsoft Cloud Services: Microsoft Cloud Services, Windows Azure Platform, Azure Service, Azure Content Delivery Network, Azure Virtual Machine, SQL Azure, Windows Live Services.	16	CO2
[4]	Introduction to Docker Container, Advantage of Container over Virtual Machine, Work with Docker Image and Container, Work with Data Docker, Publish Docker Image on Public Repository,Container Orchestration Docker Swarm: Docker Swarm Architecture, Steps for Creating Docker Swarm Kubernetes: Introduction to Kubernetes, Kubernetes Architecture Docker and DevOps: Continuous Integration, Continuous Delivery, Need for CI/CD, Running Jenkins Master within Docker Container,Setup Build Job,Test Job with Jenkins Master.	16	CO3
[5]	Introduction to OpenStack and its Components, Keystone - OpenStack Identity Service, Nova- OpenStack Compute, Swift- OpenStack Object Storage.	8	CO4
[6]	Security in Cloud: Securing the cloud, Securing Data, Establishing identity and Presence, Docker and Security.	6	CO5

C. TEXT BOOKS

1. Barrie Sosinsky, *Cloud Computing Bible;* Wiley Publishing Inc.
2. Kevin Jackson, Cody Bunch, Egle Sigler, *OpenStack Cloud Computing Cookbook;* 3rd ed.; Packt Publishing
3. Ian Miell, Aidan Hobson Sayers, *Docker in Practice;* 2nd ed.; Manning

D. REFERENCE BOOKS

1. https://docs.aws.amazon.com
2. https://docs.microsoft.com/en-us/azure/
3. https://docs.openstack.org
4. https://help.ubuntu.com/community/KVM
5. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, *Cloud Computing Concepts Technology and Architecture ;* Prentice Hall
6. Anthony Velte, Tony Velte, Robert Elsenpeter, *Cloud Computing A Practical Approach;* McGrawHill
7. Nigel Poulton, *Docker Deep Dives;* 4th ed.;

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe cloud computing ecosystem
CO2	Apply	Develop and deploy cloud based applications on public clouds
CO3	Apply	Work with virtualization and containerization
CO4	Understand	Describe openstack fundamentals
CO5	Understand	Understand importance of security measures on cloud environment

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	1	1	-	1	2	-	2	-	-	-	-
CO2	3	3	3	3	3	3	3	-	3	-	-	-	-
CO3	3	3	3	3	3	3	3	-	3	-	-	-	-
CO4	3	-	1	2	2	1	2	-	1	-	-	-	-
CO5	3	2	2	1	2	2	2	-	1	-	-	-	-
Avg	3	2	2	2	2	2	2.4	-	2	-	-	-	-

SUBJECT : APPLIED MACHINE LEARNING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course will introduce the field of Machine Learning, in particular focusing on the core concepts of supervised and unsupervised learning. It familiarizes the learners with the techniques on learning by a model, its evaluation and implementation of basic algorithms to construct a learning model using Python libraries. The course covers fundamentals of neural networks and regression.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Python: Introduction to Python, Basic Loop Structure of Python, Use of Pandas, NumPy, Sklearn, Matplotlib, Scipy, Scikit-learn library Data Preprocessing: Introduction to Outlier, Missing Data, Types of Data, NULL Values, Handle Categorical Data, Display Data Graphically.	9	CO1 CO6
[2]	Introduction to machine learning, Key Terminology, Types of Machine Learning, Key Tasks, Right Algorithm, Steps for Developing a Machine Learning Application, Python for Machine Learning.	5	CO1
[3]	Classification Naïve Bayes Method: Introduction to Bayesian Decision Theory, Naive Bayes Classification, Estimating Accuracy Decision Tree: Introduction, Building and Splitting Decision Tree, Decision Forest Introduction Logistic Regression: Logistic Regression Introduction, Sigmoid Function, Classification with Logistic Regression, Find Best Regression Coefficient K-Nearest Neighbor: Introduction, Distance Measurement, Classification with K-Nearest-Neighbor, Case Study.	14	CO2
[4]	Linear Regression: Introduction, Finding Best Fitting Line using Least - Square Method, Solving Regression with Gradient Decent Decision Tree Regression: Building tree with continuous and Discrete Features, Using CART for Regression Case Study.	7	CO3
[5]	Clustering Introduction to Cluster Analysis, K-Mean Clustering: Steps for K-Mean Clustering, Generates Clusters, Hierarchical Clustering: Introduction, Distance Measurement between Clusters, Agglomerative Method for Creating Clusters, Locating Regions of High Density using DBSCAN Association Rule Mining: Introduction, Terminology, Working of Apriori Algorithm, Working of Eclat Algorithm Case Study.	12	CO4
[6]	Introduction to Perceptron, Single-layer Neural Network, Introduction to Multilayer Neural Network Architecture, Activating Neural Network using Forward Propagation, Introduction to Back Propagation, Train Neural Network via Back Propagation.	8	CO5

[7]	Introduction to Principal Component Analysis, steps for PCA Algorithm, Features Transformation, PCA using Python.	5	CO5

C. TEXT BOOKS

1. Sebastian Raschka, *Python Machine Learning ;* Packt Publication
2. GK Gupta, *Introduction to Data Mining with Case Study*
3. Peter Harrington, *Machine Learning in Action;* Dreamtech Press

D. REFERENCE BOOKS

1. Stephen Marsland, *Machine Learning Algorithmic Perspective*
2. Shai Shalev-Sharwtzs, Shai Ben-David, *Understanding Machine Learning from Theory to Algorithm ;* Cambridge University Press
3. Tom M Mitchell, *Machine Learning;* McGraw Hill
4. I H Witten, Eibe Frank, Mark A Hall, *Data Mining: A Practical Machine Learning Tools and techniques;* 3rd ed.; Elsevier

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe the basic machine learning concept and perform data preprocessing operations
CO2	Understand	Distinguish between Supervised and Unsupervised learning techniques
CO3	Apply	Apply classification and regression techniques
CO4	Apply	Apply clustering and association rules techniques
CO5	Understand	Understand dimensionality reduction using principal component analysis and Neural Network fundamentals.
CO6	Evaluate	Demonstrate Python libraries for machine learning and implement basic machine learning algorithms using Python.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	1	-	-	2	-	2	-	2	3	2	-	2
CO2	2	2	3	3	-	-	2	-	2	3	2	-	2
CO3	2	3	3	3	3	-	3	-	3	2	3	-	2
CO4	3	3	3	3	3	-	3	-	2	2	2	-	2
CO5	2	2	1	-	1	-	-	-	-	1	-	-	2
CO6	3	1	3	3	3	-	2	-	3	1	3	-	2
Avg	2.33	2	2.16	2	2	-	2	-	2	2	2	-	2

SUBJECT : BIG DATA ANALYTICS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course gives an overview of technologies used for Big Data storage, retrieval and its processing. It covers working with Apache Hadoop, Map Reduce, programming tools PIG & HIVE in Hadoop ecosystem.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Big Data and Its Importance, Big Data Characteristics, Types of Big Data, Differentiate: Traditional and Big Data Approach, Traditional Data Warehouse Approach, Big Data Approach, Advantages of Big Data Analytics, Big Data Applications, Overview of Data Analytics Life Cycle.	5	CO1
[2]	Introduction to Hadoop, Core Hadoop Components: HDFS, Hadoop Common Package, MapReduce, YARN, Overview of Hadoop Ecosystem: Hbase, Hive, HCatalog, Pig, Sqoop, Oozie, Mahout, ZooKeeper, Physical Architecture, Comparing SQL Data Bases and Hadoop, Hadoop Limitations.	7	CO2
[3]	Distributed File Systems, Physical Organization of Compute Nodes, Large Scale File-System Organization, Grouping by Key, Coping with Node Failures Anatomy of Map Reduce Program: Hadoop Data Types, Mapper, Reducer, Partitioner- Redirecting Output from Mapper, Combiner - Local Reduce, Word Counting Example with Predefined Mapper and Reducer Class Map Reduce Patterns: Count, Min, Max, Average, Top N, Filter, Distinct, Sorting, Joins Algorithms Using Map Reduce:Matrix Multiplication, Relational Operators (Selection, Projection, Union, Intersection), Computing Natural Join, Grouping and Aggregation.	15	CO5
[4]	The Design of HDFS, HDFS Concepts: Blocks, Name Node, Data Node, Block Caching, Command Line Interface, Basic File System Operations, Hadoop File Systems, Interfaces, The Java Interface: Reading data, Writing Data, Directories, Querying the File System, Deleting Data, Data Flow: Anatomy of File Read, Anatomy of File Write, Coherency Model, Parallel Copying With distcp.	10	CO3 CO4
[5]	Apache Sqoop: Getting Sqoop, Sqoop Connectors, A Sample Import, Working With Imported Data, Imported Data and Hive, A Sample Export.	5	CO3 CO4
[6]	Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.	6	CO3 CO4
[7]	Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined	7	CO3 CO4

	Functions.		
[8]	Hbase : HBasics, Concepts, Clients, Example, Differentiate: Hbase and RDBMS.	5	CO3

C. TEXT BOOKS

1. Arshdeep Bahga & Madisetti, *Big Data Science and Analytics - A Hands On Approach;*
2. Tom White,,*Hadoop: The Definitive Guide;* 4th ed.; O'Reilly Media
3. Chuck Lam , Manning, *Hadoop in Action*
4. Radha Shankarmani, M Vijayalakshmi , *Big Data Analytics;* 2nd ed.; Wiley

D. REFERENCE BOOKS

1. Venkat Ankam, *Big Data Analytics;* Packt Publishing Ltd.,
2. Seema Acharya, Subhashini Chhellappan, *Big Data and Analytics;* Wiley
3. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, and Marcia Kaufman, *Big Data for Dummies*
4. EMC Education Services, *Data Science & Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data;* Wiley

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand the fundamentals of Big Data Analytics
CO2	Understand	Explain working of Hadoop ecosystem.
CO3	Understand	Differentiate various big data technologies like Hadoop, MapReduce, Sqoop, Pig, Hive, Hbase.
CO4	Apply	Develop Big Data solutions using Hadoop ecosystem
CO5	Apply	Apply Map Reduce programming model to access and process data on Distributed File System.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	1	2	2	-	-	2	-	2	-	1	-	3
CO2	2	1	2	2	1	-	2	-	2	-	1	-	3
CO3	2	2	-	2	3	-	2	-	2	-	2	-	2
CO4	2	3	3	2	3	-	2	-	2	-	3	-	1
CO5	2	3	3	2	3	-	2	-	2	-	3	-	1
Avg	2	2	2	2	2	-	2	-	2	-	2	-	2

SUBJECT : ADVANCED JAVA PROGRAMMING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course provides the knowledge necessary to understand J2EE architechture and develop dynamic web pages using java servlets and java server pages. It enables learners to develop data centric Web Application using Hibernate. Learners will understand how to develop RESTful web services using Java.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction to J2EE Platform, Challenges and Requirements for Enterprise Application Development, Introduction to Enterprise Architecture Styles, J2EE Container Architectures, J2EE Server and Containers, J2EE Architecture, Introduction to Web Containers and microservices.	10	CO1 CO2
[2]	Introduction to Java Servlet, Servlet Lifecycle, Servlet Implementations, Servlet Configuration, Servlet Exceptions, Requests & Responses, Servlet Session Tracking, Servlet Context & Collaboration, Introduction to Events and Event Handling [Context Level Events and Session Level Events] Introduction to Filter: Filter and Filter Chain, Filter API, Deployment Descriptor for Filter, Sample Filter in Web Application.	14	CO1 CO2 CO3
[3]	Introduction, JSP Directives, Scripting Elements, Introduction to Java Beans, Standard JSP Actions, JSP Implicit Objects, Scopes, Expression Language, JSP Tag Extensions: Tag Handlers, Library Descriptors, using with JSP Page, Deploying and Packing, Integrating JSPTL into JSP Pages, Introduction to XML and XML Usage, Developing MVC Application Using Servlets, JSP and POJO Beans.	12	CO1 CO2 CO3
[4]	Define REST, Restful Architecture, Restful Clients, Accessing Restful Services, Restful Web Service Design, Introduction to JAX-RS and Jersey, Annotations, Web Service Architecture, Implementation with JAX-RS – Jersey, Securing Web Service, Performance	12	CO2 CO5
[5]	Understanding Persistence and Paradigm Mismatch, Introduction to Object-Relational Mapping, Java Hibernate, Hibernate Architecture, Hibernate Object Life Cycle, Hibernate Configuration File and Mapping Files, Working with Hibernate Objects, Session Operations, Hibernate Strategies, Mapping of Relations, Introduction to Fetching Strategies, Querying Using HQL.	12	CO2 CO3 CO4

C. TEXT BOOKS

1. Subrahmanyan Allamaraju, Cedric Buest, Daniel O'Connor Et Al. *Professional Java Server Programming J2EE 1.3 Edition;* Apress Publications.
2. Jose Sandoval, *Restful Java Web Services;* Packt Publication.
3. Christian Bauer, Gavin King, Manning, *Hibernate in Action*.

D. REFERENCE BOOKS

1. *Java Server Programming Java EE 7 (J2EE 1.7) Black Book;* Dreamtech Press
2. Daniel O'Connor, Gordon Van Huizen, Jason Diamond Et Al, *Professional Java Server Programming J2EE Edition;* Wrox Publications.
3. Bryan Basham, Kathy Sierra, Bert Bates,*Head First Servlet and JSP;* O'Reilly Publication

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand Components of Advanced JAVA Technology: Servlet, JSP and Java Bean
CO2	Apply	Work with Web Containers
CO3	Create	Develop & Deploy Database Driven Multitier Enterprise Applications Using J2EE
CO4	Apply	Map classes and object association to relational database with hibernate
CO5	Apply	Demonstrate RESTful API using Java's JAX-RS framework.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	2	-	2	-	2	-	1	-	2	-	2
CO2	2	2	1	-	3	-	2	-	2	-	2	-	2
CO3	3	2	3	-	3	-	2	-	3	-	3	-	2
CO4	2	2	2	-	1	-	2	-	2	-	2	-	2
CO5	1	2	2	-	2	-	2	-	2	-	1	-	2
Avg	2	2	2	-	2.2	-	2	-	2	-	2	-	2

SYLLABI BOOK

BACHELOR OF TECHNOLOGY
MECHANICAL ENGINEERING

Department of Mechanical Engineering
Faculty of Technology
Dharmsinh Desai University
Nadiad – 387 001, Gujarat, India.

TEACHING SCHEME FOR THE COURSE
B. TECH., MECHANICAL ENGINEERING
(Admission Year_2021)

SEMESTER I

	Subject Title	Teaching Scheme & Credit			Examination Scheme					
		Lect	Tut	Prac	TH	Sess	Prac	TW	Total	Credit
1	MATHEMATICS -I	3	1	0	60	40	0	0	100	4.0
2	THERMODYNAMICS	3	0	2	60	40	50	0	150	4.0
3	BASIC ELECTRICAL ENGG.	3	0	2	60	40	50	0	150	4.0
4	MECHANICS	3	0	2	60	40	0	0	100	4.0
5	COMPUTER PROGRAMMING	2	0	3	40	0	0	50	90	3.5
6	ENVIRONMENTAL STUDIES	2	0	0	40	0	0	0	40	0.0
7	WORKSHOP PRACTICE - I	0	0	2	0	0	50	0	50	1.0
									680	20.5

SEMESTER II

	Subject Title	Teaching Scheme & Credit			Examination Scheme					
		Lect	Tut	Prac	TH	Sess	Prac	TW	Total	Credit
1	MATHEMATICS-II	3	1	0	60	40	0	0	100	4.0
2	ENGINEERING GRAPHICS	3	0	3	60	40	50	0	150	4.5
3	BASIC ELECTRONICS	3	0	2	60	40	50	0	150	4.0
4	MECHANICS OF SOLIDS	3	0	2	60	40	50	0	150	4.0
5	CHEMISTRY	3	0	0	60	0	0	0	60	3.0
6	WORKSHOP PRACTICE - II	0	0	3	0	0	0	50	50	1.5
									660	21

SEMESTER III

	Subject Title	Teaching Scheme & Credit			Examination Scheme					
		Lect	Tut	Prac	TH	Sess	Prac	TW	Total	Credit
1	NUMERICAL TECHNIQUES	3	0	2	60	40	25	25	150	4.0
2	ELECTRICAL MACHINES AND DRIVES	3	0	2	60	40	25	25	150	4.0
3	FLUID MECHANICS	3	0	2	60	40	25	25	150	4.0
4	MATERIAL SCIENCE AND METALLURGY	3	0	2	60	40	25	25	150	4.0
5	KINEMATICS OF MACHINES	3	1	2	60	40	25	25	150	5.0
6	ENGLISH	2	0	2	40	0	0	50	90	3.0
									840	24.0

SEMESTER IV

	Subject Title	Teaching Scheme & Credit			Examination Scheme					
		Lect	Tut	Prac	TH	Sess	Prac	TW	Total	Credit
1	APPLIED THERMODYNAMICS	3	0	2	60	40	25	25	150	4.0
2	ADVANCE SOLID MECHANICS	3	0	2	60	40	25	25	150	4.0
3	MANUFACTURING TECHNOLOGY - I	3	0	4	60	40	25	25	150	5.0
4	DYNAMICS OF MACHINES	3	1	2	60	40	25	25	150	5.0
5	MACHINE DRAWING & INDUSTRIAL DRAFTING	0	0	4	0	0	25	25	50	2.0
6	ARTIFICIAL INTELLIGENCE & MACHINE LEARNING	1	0	2	0	0	0	100	100	2.0
7	UNIVERSAL HUMAN VALUES	3	0	0	60	0	0	0	60	3.0
									810	25.0

SEMESTER V

	Subject Title	Teaching Scheme & Credit			Examination Scheme					
		Lect	Tut	Prac	TH	Sess	Prac	TW	Total	Credit
1	MEASUREMENT AND METROLOGY	3	0	2	60	40	25	25	150	4.0
2	HEAT AND MASS TRANSFER	3	0	2	60	40	25	25	150	4.0
3	MANUFACTURING TECHNOLOGY - II	3	0	4	60	40	25	25	150	5.0
4	MACHINE DESIGN - I	3	1	2	60	40	25	25	150	5.0
5	OPEN ELECTIVE - I	3	0	0	60	0	0	0	60	3.0
6	INDUSTRIAL MANAGEMENT & ECONOMICS	2	0	2	40	0	0	50	90	3.0
7	MENDATORY COURSE - 2 (CONSTITUTION OF INDIA OR ESSENCE OF INDIAN KNOWLEDGE TRADITION)	2	0	0	40	0	0	0	40	2.0
									790	26.0

SEMESTER VI

	Subject Title	Teaching Scheme & Credit			Examination Scheme					
		Lect	Tut	Prac	TH	Sess	Prac	TW	Total	Credit
1	MACHINE DESIGN - II	3	1	2	60	40	25	25	150	5.0
2	FLUID MACHINES	3	0	2	60	40	25	25	150	4.0
3	COMPUTER AIDED DESIGN & MANUFACTURING	3	0	2	60	40	25	25	150	4.0
4	PROFESSIONAL ELECTIVE - I	3	0	2	60	40	25	25	150	4.0
5	PROFESSIONAL ELECTIVE - II	3	0	2	60	40	25	25	150	4.0
6	OPEN ELECTIVE - II	3	0	0	60	0	0	0	60	3.0
									810	21

SEMESTER VII

	Subject Title	Teaching Scheme & Credit			Examination Scheme					
		Lect	Tut	Prac	TH	Sess	Prac	TW	Total	Credit
1	FINITE ELEMENT ANALYSIS	3	0	2	40	0	0	50	90	4.0
2	PROFESSIONAL ELECTIVE - III	3	0	2	60	40	25	25	150	4.0
3	PROFESSIONAL ELECTIVE - IV	3	0	2	60	40	25	25	150	4.0
4	OPEN ELECTIVE - III	3	0	0	60	0	0	0	60	3.0
5	OPERATION RESEARCH	3	0	2	60	40	25	25	150	4.0
6	EFFECTIVE TECHNICAL COMMUNICATION	3	0	0	60	0	0	0	60	3.0
7	SEMINAR	0	0	2	0	0	0	100	100	1.0
									760	23.0

SEMESTER VIII

	Subject Title	Teaching Scheme & Credit			Examination Scheme					
		Lect	Tut	Prac	TH	Sess	Prac	TW	Total	Credit
1	PROFESSIONAL ELECTIVE - V	2	0	3	40	0	25	25	90	3.5
2	PROFESSIONAL ELECTIVE - VI	2	0	3	40	0	25	25	90	3.5
3	PROFESSIONAL ELECTIVE - VII	2	0	3	40	0	25	25	90	3.5
4	PROJECT	0	0	4	0	0	0	100	100	2.0
5	INDUSTRIAL TRAINING (8 Weeks)	0	3	12	0	0	150	100	250	9.0
									620	21.5

B. TECH. SEMESTER – I (CH/CL/IC/MH)

SUBJECT: MATHEMATICS - I (BS102)

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	Tut	Prac	Total	Credits	Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	0	0	100

DETAILED SYLLABUS

1 CALCULUS: INTEGRAL CALCULUS

Evolutes and involutes, Applications of definite integrals to evaluate surface areas and volumes of revolutions.

2 LINEAR ALGEBRA: MATRICES, VECTORS, DETERMINANTS, LINEAR SYSTEMS:

Matrices, Vectors: Addition and Scalar Multiplication, Matrix Multiplication, Rank of a matrix, Solutions of Linear Systems: Existence, Uniqueness, Determinants, Cramer's Rule, Inverse of a matrix, Eigen values, Eigenvectors, Symmetric, Skew-symmetric, Linear Independence of vectors, Diagonalization.

3 SEQUENCES AND SERIES:

Convergence of sequence and series, Introduction to tests for convergence; Power series, Series for exponential, Trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

4 MULTIVARIABLE CALCULUS (DIFFERENTIATION)

Partial derivatives, Total derivative; Tangent plane and normal line; Taylor series expansion for function of two variables, Jacobians, Maxima, minima and saddle points; Method of Lagrange multipliers, Introduction to Vector Differential Calculus; Directional derivatives, Gradient, Curl and divergence.

LEARNING OUTCOMES:

The students will learn:

- To apply differential and integral calculus to notions of curvature and applications of definite integrals.
- Convergence, divergence, and analysis of sequences and infinite series.
- To develop functions as a Fourier series.
- The essential tools of matrices and linear algebra including linear transformations, eigen values, diagonalization.

TEXT/REFERENCE BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 40th Edition, 2007.

2. G. B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
8. V. Krishnamurthy, V.P. Mainra and J. L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

B. TECH. SEMESTER – I (CH/CL/IC/MH)
SUBJECT: THERMODYNAMICS (ES111)

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	50*	--	150

* TW marks include Viva based on TW

DETAILED SYLLABUS

1 INTRODUCTION:

Macroscopic versus microscopic view point, thermodynamic systems and control volume, thermodynamic properties, processes and cycles, homogeneous and heterogeneous systems, thermodynamic equilibrium, quasi-static process, pure substance, concept of continuum, temperature and zeroth law of thermodynamics, ideal gas and gas laws

2 ENERGY AND ENERGY TRANSFER:

Forms of energy, energy transfer by heat and work, mechanical forms of work, first law of thermodynamics, energy conversion efficiencies

3 PROPERTIES OF PURE SUBSTANCES:

Pure substance, phases and phase change process, thermodynamic properties, property diagrams, ideal gas equation of state, van der waal equation, virial equation of state

4 ENERGY ANALYSIS OF A CLOSED SYSTEM:

PdV work in various quasi-static processes, energy balance, specific heats, internal energy, enthalpy and specific heats of solids, liquids and ideal gases.

5 ENERGY ANALYSIS OF A OPEN SYSTEM:

Conservation of mass, flow work and energy of a flowing fluid, energy analysis of steady and unteady flow systems.

6 SECOND LAW OF THERMODYNAMICS:

Introduction to second law, thermal energy reservoir, heat engine, refrigerator and heat pump, Clausis and Kelvin-Plank statement, perpetual motion machines, reversible and irreversible processes, Carnot and reversed Carnot cycle, , entropy principle and isentropic process, Tds and Maxwell relation.

7 SEAM BOILERS:

Introduction, classification, mountings and accessories, classification and comparison of boiler draught systems.

8 APPLICATIONS OF THERMODYNAMICS:

Construction and working of pumps, compressors, IC engine- Otto and Diesel engines, vapour compression refrigeration system, vapour absorption refrigeration system.

TEXT/REFERENCE BOOKS:

1. Yunus A. Cengel, Michael A. Boles., "Thermodynamics- An engineering approach", Tata McGraw Hill publishing co. ltd.
2. Nag P.K., "Engineering Thermodynamics", Tata McGraw Hill publishing co. ltd.
3. Smith J.M., Van Ness H.C., Abbott M.M, "Introduction to chemical engineering thermodynamics", McGraw Hill publishing co. Ltd.
4. Sonntag. R.E., Borgnakke, C. and Van Wylen G.J.,"Fundamental of thermodynamics", John Wiley and Sons.
5. Moran M.J. and Shapiro H.N., "Fundamentals of engineering thermodynamics", John Wiley and Sons.

B. TECH. SEMESTER – I (CH/CL/IC/MH)

SUBJECT: ELEMENTS OF ELECTRICAL ENGINEERING (ES112)

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	50*	--	150

* TW marks include Viva based on TW

DETAILED SYLLABUS

1 D.C. CIRCUITS

Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

2 A.C. CIRCUITS

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

3 TRANSFORMERS

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

4 ELECTRICAL MACHINES

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

5 ELECTRICAL INSTALLATIONS

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthling. Elementary calculations for energy consumption, power factor improvement. DC-DC buck and boost converters. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

6 SEMICONDUCTORS, DIODES AND APPLICATIONS

Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener

Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) in brief.

TEXT/REFERENCE BOOKS:

1. R. Muthu Subramanian, S. Salivahanan, and K. A. Muraleedharan, Basic Electrical, Electronics and Computer Engineering, 2nd Edition, Tata McGraw Hill
2. V. K. Mehta & Rohit Mehta, Principles of Electronics, 11thEdition, S. Chand & Company
3. B. L. Theraja , A. K. Theraja, Electrical Technology (Vol: II), 23rdEdition, S. Chand & Company
4. D.P. Kothari and I. J. Nagrath, Basic Electrical Engineering, 3rd Edition, Tata McGraw Hill

B. TECH. SEMESTER – I (CH/CL/IC/MH)
SUBJECT: MECHANICS (BS103)

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	50*	--	150

* TW marks include Viva based on TW

DETAILED SYLLABUS

1 STATICS

Resultant force for 2D and 3D force system, concept of free body diagrams, equilibrium equations for particles and rigid body subjected to 2D and 3D force system, centroid and center of gravity, moment of inertia, Friction

2 DYNAMICS AND VIBRATIONS

Rotational Transformation of scalers and vectors, Newton's Laws for particle motion, Potential Energy function F= - Grad V, conservative and non-conservative forces, Conservation of momentum, angular momentum, collision, energy equation, free harmonic motion, damped harmonic motion, forced oscillation and resonance, kinematics in a coordinate system rotating and translating in a plane.

TEXT/REFERENCE BOOKS:

1. Engineering Mechanics, M. K. Harbola, 2nd Edition, Cengage Learning, 2013.
2. Mechanics – J P Den Hartog, Dover Publications, 2003.
3. Mechanical Vibrations - J P Den Hartog, Dover Publications, 1985.
4. Theory of Vibrations with Applications – W. T. Thomson, 5th Edition, Pearson Education, 2008.
5. Engineering Mechanics: Statics (V.1), Dynamics (V.2), J. L. Meriam and L. G. Kraige, 5th edition, Wiley, 2017.
6. Engineering Mechanics: Statics & Dynamics, Irving H. Shames, 4th edition, Pearson Education, 2005.
7. Vector Mechanics for Engineers: Statics (V.1), Dynamics (V.2), F. P. Beer and E. R. Johnston, 10th SI edition, McGraw Hill Education, 2017

B. TECH. SEMESTER – I (CH/CL/IC/MH)
SUBJECT: COMPUTER PROGRAMMING (ES113)

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	40	0	50*	--	90

* TW marks include Viva based on TW

DETAILED SYLLABUS

1 INTRODUCTION:

Introduction to components of computer system, Idea of algorithm, Introduction to C, Constants, Variables & Data types in C, Managing input and Output operators.

2 OPERATORS AND EXPRESSIONS:

C Operators: Arithmetic, relational, logical, increment &decrement, assignment a nd conditional, Arithmetic Expressions & Precedence Rule, Type conversion in C, Mathematical Functions.

3 DECISION MAKING AND BRANCHING:

Decision making with If & If...else statements, goto statements.

4 DECISION MAKING AND LOOPING:

The while statement, the break statement & the do... while loop, the for loop, Jum p within loops - Programs.

5 ARRAYS:

Array 1D, 2D, Character Array as String

6 USER DEFINED FUNCTIONS:

Categories of Functions (Including using built in library), Call by Value, Paramete r passing to function, Recursion.

7 STRUCTURE:

Defining structure, Assigning value to the structure members, Array of structure

8 POINTER:

Idea of pointer, declaration and Initialization of pointer, passing address as funct ion argument, passing array to function using pointer.

9 FILE HANDLING

(only if time is available, otherwise should be done as part of the lab)

TEXT/REFERENCE BOOKS:

1. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
3. Yashvant Kanetkar, Let Us C, 12th Edition, BPB Publication.

4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

B. TECH. SEMESTER – I (CH/CL/IC/MH)

SUBJECT: ENVIRONMENTAL STUDIES (SM101)

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
2	0	0	2	0	50	0	0	0	50

DETAILED SYLLABUS:

1 THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, scope and importance & Need for public awareness

2 NATURAL RESOURCES

Renewable and non-renewable resource: Natural resources and associated problems, Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams, and their effects on forests and tribal people, Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefit and problems, Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies, Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Role of an individual in conservation of natural resources. Equitable use of resources of sustainable lifestyles

3 ECOSYSTEMS

Concept of an ecosystem, Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

4 BIODIVERSITY AND ITS CONSERVATION

Introduction definition: Genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity, habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity

5 ENVIRONMENTAL POLLUTION

Definition, Causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards Solid waste management, causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides

6 SOCIAL ISSUES AND THE ENVIRONMENT

From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management**,** Resettlement and rehabilitation of people: its problems and concerns. Case studies**,** Environmental ethics: Issues and possible solutions**,** Climate change: Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies: Wasteland reclamation, Consumerism and waste products, Environment Protection Act: Air (Prevention and Control of Pollution) Act, Water (Prevention &Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation**,** Public awareness

7 HUMAN POPULATION AND THE ENVIRONMENT

(Population growth, variation among nations, population explosion, Family Welfare Program, environment and human health, human rights, Value education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environmental and human health, Case studies.

8 FIELD WORK

Visit to a local area to document environmental assets (river/forest/grassland/hill/mountain) Visit to a local polluted site - Urban/Rural/Industrial/Agricultural, Study of common plants, insects, birds, Study of simple ecosystems – pond, river, hill, slopes etc.

TEXT BOOKS/ REFERENCE BOOKS

1. Erach Bharucha Textbook of Environmental Studies; Second Edition, Universities Press: Hyderabad, 2013.
2. Poonia, M. P.; Sharma, S. C. Environmental studies; Khanna Publishing House: New Delhi, 2017.
3. Rajagopalan, R. Environmental Studies; Oxford University Press: India, 2015.
4. Varandani, N. S. Basics of Environmental studies; Lambert Academic Publishing: Germany, 2013.
5. Basak, A. Environmental Studies; Dorling Kindersley: India, 2009.
6. Dhameja, S. K. Environmental studies; S. K. Kataria and Sons: New Delhi, 2007.
7. Rao, C. S. Environmental Pollution Control Engineering; Wiley publishers: New Delhi, 2006.
8. Brunner, R. C. Hazardous Waste Incineration; McGraw Hill: Michigan, 1989.
9. Clark, R. S. Marine Pollution; Clanderson Press Oxford: Bath, 2001.

10. Trivedy, R. K. Handbook of Environmental Laws, Acts, Guidelines, Compliances & standards; B. S. publications: Hyderabad, 2005.
11. Jadhav, H.; Bhosale, V. M. Environmental Protection and Laws; Himalaya Pub. House: Delhi, 1995.
12. Agarwal, K. C. Environmental Biology; Nidi Publ.: Bikaner, 2001.
13. Bharucha, E. The Biodiversity of India; Mapin Publishing: Ahmedabad, India, 2002.
14. Cunningham, W.P.; Cooper; Gorhani, T. H. E.; Hepworth, M.T., Environmental Encyclopedia; Jaico Publ. House: Mumbai, 2001.
15. De, A. K. Environmental Chemistry; Wiley Eastern: New Delhi, 2006.
16. Gleick, H. P. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security; Stockholm Env. Institute Oxford Univ. Press: New York, 1993.
17. Hawkins, R.E., Encyclopedia of Indian Natural History; Bombay Natural History Society: Bombay, 1987.
18. Heywood, V. H.; Waston, R. T. Global Biodiversity Assessment; Cambridge Univ. Press: Cambridge, 1995.
19. Mckinney, M.L.; School, R.M. Environmental Science systems & Solutions; Web enhanced edition: USA, 1996.
20. Miller, T.G. Jr.; Spoolman, S. E. Environmental Science; Cengage learning: Wadsworth, 2014.
21. Odum, E.P. Fundamentals of Ecology; W.B. Saunders: USA, 1971.
22. Rao, M. N.; Datta, A.K. Waste Water treatment; Oxford & IBH Publ.: New Delhi, 1987.
23. Sharma, B. K., Environmental Chemistry; Goel Publ. House: Meerut, 2001.
24. Townsend, C., Harper, J.; Michael, B. Essentials of Ecology; Blackwell: Oxford, 2008.
25. Trivedi, R. K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II; B. S. Publications, Hyderabad, 2010.
26. Trivedi, R. K.; Goel, P. K. Introduction to air pollution; ABD Publishers: Jaipur, 2003.
27. Wanger, K. D., Environmental Management; W.B. Saunders Co. Philadelphia, USA, 1998

B. TECH. SEMESTER – I (CH/CL/IC/MH)

SUBJECT: WORKSHOP PRACTISE - I

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
0	0	0	2	1	0	0	50*	0	50

Reference Code ESC104A

* TW marks include Viva based on TW

LABORTORY WORKS/SCHEDULE:

Lab	Workshop-I
1	Introduction to Workshop, Basic Workshop types
2	Safety requirement in workshop, Safety rules
3	To Understand “5S" Concept for Workplace
4	Demonstration of Tin smithy Tools and it's exercise
5	To make job for Tin smithy shop
6	Demonstration of Plumbing tools, It’s accessories.
7	To make job for Plumbing shop
8	Introduction to Fabrication shop, Welding Equipment
9	To make job for Fabrication shop
10	Introduction of Machine shop
11	Introduction and Demonstration of Lathe machine.
12	Introduction and Demonstration of Milling and Radial Drilling m/c

TEXT/ REFERENCE BOOKS

1. Work shop technology, A. K. Hajrachaudhari & S. K. Hajrachaudhari
2. ITB Hand book, Engineering industry training board
3. Work shop Technology Vol. I & II, Gupta & Kaushik

B. TECH. SEMESTER – II (CH/CL/IC/MH)

SUBJECT: MATHEMATICS – II (BS203)

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	1	0	4	4	60	40	0	0	100

DETAILED SYLLABUS

1 SERIES SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS BY POWER SERIES METHOD:

Introduction, Validity of series solution of the equation, General Method, Forms of series solution.

2 PARTIAL DIFFERENTIAL EQUATIONS:

Basic Concepts, Classification and Solutions of partial differential equations: Lagrange's linear equation of first order, Non-linear equations of first order-Charpit's method, Homogenous linear equations with constant coefficient to find the complementary functions and the particular integral, Introduction to non-homogenous linear equations with constant coefficients, Method of separation of variables.

3 MULTIVARIABLE CALCULUS (INTEGRATION

Multiple Integration: Double integrals (Cartesian), Change of order of integration in double integrals, Change of variables (Cartesian to polar), Introduction to Triple integrals (Cartesian), Vector line integrals, Vector surface integrals, Theorems of Green, Gauss and Stoke's.

4 LAPLACE TRANSFORM:

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions, finding inverse Laplace transform by different methods, Convolution theorem, Evaluation of integrals by Laplace transform, Solving ODE by Laplace Transform method.

TEXT/REFERENCE BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 40th Edition, 2007.
2. G. B. Thomas and R. L. Finney, Calculus and Analytic geometry,9thEdition, Pearson, Reprint,2002.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. W. E. Boyce and R. C. Di Prima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India,2009.
5. S. L. Ross, Differential Equations, 3rd Ed., Wiley India,1984.

6. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India,1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications,1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill,2004.
9. N. P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.

B. TECH. SEMESTER – II (CH/CL/IC/MH)

SUBJECT: ENGINEERING GRAPHICS (ES203)

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	3	6	4.5	60	40	50	0	150

Reference Code ESC102

* TW marks include Viva based on TW

DETAILED SYLLABUS

1 INTRODUCTION TO ENGINEERING DRAWING

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic section curves (Ellipse, Parabola, Hyperbola), Cycloidal Curves (Cycloid, Epicycloid, Hypocycloid), Involutes; Archimedean Spiral

2 SOLID GEOMETRY

Projection of points, projection of lines and their applications. Projection of regular planes such as square, rectangle, triangle, circle, pentagon, hexagon, rhombus. Projection of right and regular solids inclined to both the planes (prisms, pyramids, cylinder and cone)

3 ORTHOGRAPHIC PROJECTIONS

First angle and third angle projection methods, conversion of pictorial views into Orthographic projections with dimensioning, sectional orthographic projection, special sections

4 SECTION OF SOLIDS AND DEVELOPMENT OF SOLIDS

Sections and Sectional Views of Right Angular Solids Covering, Prism, Cylinder, Pyramid, Cone

5 DEVELOPMENT OF SURFACES

Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

6 ISOMETRIC PROJECTIONS

Principles of Isometric projection – Isometric Scale, Isometric projection and view, Conversion of orthographic views to isometric projections and views

7 WORKING ENVIRONMENT OF CAD SOFTWARE

Menu bar, Quick access toolbar, Dashboard/Ribbon, Toolbars, drawing space, Navigation bar (View controls: zoom, pan, orbit,), Command prompt, Status bar, Drawing Area (Background, Crosshairs, Coordinate System), Shortcut Menu, Properties manager.

8 DRAWING CUSTOMIZATION

Setting up the drawing sheet (drawing sheet templates, drawing limits, drawing units etc.), Coordinate system (User coordinate system, Absolute and relative coordinates, Cartesian and Polar coordinates), Modes of drawing (Grid, Snap, Ortho, Osnap, Otrack, Polar tracking, Iso draft, etc.) Formatting (colours, line type, line weight, point style etc.).

9 PREPARING COMPUTER AIDED DRAWING

Exploring various commands with exercises of Orthographic drawing views and Isometric drawing views using different drawing tools, modifying tools, dimensioning tools etc.

10 PLOTTING AND EXCHANGING DRAWING

Printing/Plotting the drawing (page setup, plot area, plot scale, drawing orientation, plot options etc.), Drawing standard (DXF), Generating PDF drawing documents, file management.

TEXT/REFERENCE BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
3. Shah P. J., (2014) Engineering Graphics, S. Chand Publishing
4. Luzadder W., Duff J., (1992), Fundamentals of Engineering Drawing, Peachpit Press
5. Gill P. S., (2009), Engineering Drawing, S. K. Kataria & Sons
6. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

B. TECH. SEMESTER – II (CH/CL/IC/MH)

SUBJECT: BASIC ELECTRONICS

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	50	0	150

* TW marks include Viva based on TW

DETAILED SYLLABUS

1 TRANSISTOR & CHARACTERISTICS

Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration

2 FIELD EFFECT TRANSISTOR (FET)

Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits

3 TRANSISTOR AMPLIFIERS AND OSCILLATORS

Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift

4 OPERATIONAL AMPLIFIERS AND APPLICATIONS

Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, and inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator, wein bride oscillator.

5 DIGITAL ELECTRONICS FUNDAMENTALS

Difference between analogy and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification, Logic ICs, Implementation of combinational logic - half and full adder/subtractor, multiplexers, de-multiplexers.

6 SENSORS & SIGNAL CONDITIONING CIRCUITS

Types of sensors – pneumatic, electromagnetic, electronic, smart sensors. Diaphragm, bellows and bourdon tube, Resistive, Capacitive, Inductive, ultrasonic, LVDT, piezoelectric, optoelectronic transducers, thermocouple, RTD and thermistors, Application of sensors for flow, level, temperature and stress measurement, Bridge Circuit, Differential Amplifier, Instrumentation Amplifier

TEXT/REFERENCE BOOKS:

1. Principles of Electronics, 11thEdition By: V. K. Mehta & Rohit Mehta Publisher: S. Chand & Company
2. Electrical & Electronic Measurement & Measuring Instruments, 17th Edition By: A.K. Sawhney Publisher: Dhanpat rai
3. M. M. Mano, "Digital logic and Computer design", Publisher : Pearson Education India.

B. TECH. SEMESTER – II (CH/CL/IC/MH)

SUBJECT: MECHANICS OF SOLIDS

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	50	0	150

Reference Code ESC205

*TW marks include Viva based on TW

DETAILED SYLLABUS

1 Concept of stress and strain, elasticity, generalized Hooke's law for 3D, concept of isotropy and homogeneity, plane stress and plane strain idealization, axial, volumetric and thermal stresses and strains

2 Transformation of stress and strain at a point, Principal stresses and strains, Mohr's Circle, strain rossete

3 Mechanical properties of metals – elasticity, plasticity, strain hardening, hardness, toughness, fatigue, strain energy

4 Force-strain-deformation analysis for axial load, flexure, shear and torsion

TEXT/REFERENCE BOOKS:

1. Strength of Materials: Part– I and II, Stephen Timoshenko, 3rd Edition, CBS Publisher, 2002.
2. Strength of Materials, Sadhu Singh, 1st Edition, Khanna Book Publishing Company, 2016.
3. Advanced Mechanics of Solid, L. S. Srinath, 3rd Edition, McGraw Hill Publication, 2017.
4. Engineering Mechanics of Solids, E P Popov, 2nd Edition, Prentice Hall India Learning Pvt. Ltd, 2002.

B. TECH. SEMESTER – II (CH/CL/IC/MH)

SUBJECT: CHEMISTRY

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	0	3	3	100	0	0	0	100

Reference Code BSC102

DETAILED SYLLABUS:

1 ATOMIC AND MOLECULAR STRUCTURE

Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

2 SPECTROSCOPIC TECHNIQUES AND APPLICATIONS

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

3 INTERMOLECULAR FORCES AND POTENTIAL ENERGY SURFACES

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

4 USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

5 PERIODIC PROPERTIES

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

6 STEREOCHEMISTRY

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

7 ORGANIC REACTIONS AND SYNTHESIS OF A DRUG MOLECULE

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecules.

TEXT/REFERENCE BOOKS

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins (vi)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition.

B. TECH. SEMESTER – II (CH/CL/IC/MH)

SUBJECT: WORKSHOP PRACTISE - II

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
0	0	3	3	1.5	0	0	50*	0	150

Reference Code ESC104B

*TW marks include Viva based on TW

LABORTORY WORKS/SCHEDULE:

Lab	Workshop-II
1	Introduction to Carpentry Shop, application of various carpentry tools
2	Demonstration of Carpentry Job 1 & 2
3	To make Job 1 for Carpentry shop
4	To make Job 2 for Carpentry shop
5	Introduction to Black smithy shop and Demonstration of it's job
6	To make Job for Black smithy shop
7	Introduction to Fitting shop, to understand application of various tools of this shop
8	Demonstration of Fitting Job
9	To make job for Fitting shop
10	To make job for Fitting shop
11	Assignment for Carpentry shop
12	Assignment for Fitting shop

TEXT/ REFERENCE BOOKS

1. Work shop technology, A. K. Hajrachaudhari & S. K. Hajrachaudhari
2. ITB Hand book, Engineering industry training board
3. Work shop Technology Vol. I & II, Gupta & Kaushik

B. TECH. SEMESTER – III

SUBJECT: NUMERICAL TECHNIQUES

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	25	25	150

Reference Code BSC202

DETAILED SYLLABUS:

1 ERROR ANALYSIS

Significant figures, accuracy and precision, error definitions, round-off errors, truncation errors, Taylor series, total numerical error, blunders, formulation errors, and data uncertainty

2 ROOTS OF EQUATIONS

Introduction, bracketing methods: bisection method and false-position method, open methods: Newton-Raphson method, Secant and Modified Secant method, roots of polynomials

3 ALGEBRAIC EQUATIONS

Introduction, numerical solutions of linear algebraic equations: Cramer's rule, Gauss elimination method, numerical solution of nonlinear equations: Gauss-Jordan method, LU decomposition, special matrices: tridiagonal matrices analysis, Cholesky decomposition, Iterative methods: Gauss-Seidel method and Jacobi's method

4 CURVE FITTING AND INTERPOLATION

Introduction, least square regression: linear regression, polynomial regression
Introduction, Newton's forward and backward difference interpolation, Lagrange interpolation, inverse interpolation, spline interpolation

5 NUMERICAL DIFFERENTIATION AND INTEGRATION

Introduction, high accuracy differentiation formulas: forward, backward and central difference method, Richardson extrapolation, Newton-Cotes integration formulas: trapezoidal and Simpson's rule.

6 NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS AND PARTIAL DIFFERENTIAL EQUATIONS

Introduction, initial value problems: Euler's method, Heun's method, fourth order Runge-Kutta method, multistep methods: Milne's method and Adam's method
Elliptic equations: Laplace difference equation, Liebmann's iterative method, boundary conditions, parabolic equations: implicit method, explicit method, the Crank Nicolson method

TEXT/REFERENCE BOOKS

1. Numerical Methods for Engineers, Steven C. Chapra, Raymond P. Canale, Tata McGraw Hill
2. Numerical Methods, E Balagurusamy, Tata McGraw Hill
3. Applied Numerical Analysis, Curtis F. Gerald, Patrick O. Wheatley, Addison Wesley, Pearson
4. Numerical Methods in Engineering and Science, Grewal. B.S. and Grewal. J.S., Khanna Publishers, New Delhi
5. Applied Numerical Methods Using MATLAB, W.Y. Yang, W. Cao, T.S. Chung and J. Morris, Wiley India Edition
6. Numerical Methods for Engineers, S. K. Gupta, New Age International Publishers

B. TECH. SEMESTER – III

SUBJECT: ELECTRICAL MACHINES AND DRIVES

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	25	25	150

Reference Code ESC201

DETAILED SYLLABUS:

1 TRANSFORMERS & ITS SWITCHGEARS

General aspects, basic definition, working principle of transformer, types of transformers, transformer construction: core/shell/spiral transformers, transformers on no load & on load, vector diagrams, equivalent circuit, losses and condition for maximum efficiency, all day efficiency, Sumpner's test, conditions for parallel operation, introduction to 3-phase transformer, construction, instrument transformers, Relay, circuit breaker and isolator, fuses

2 ALTERNATOR

Introduction, constructional details, types, armature winding, EMF equation, factor affecting size of alternator, alternator operation on load, voltage regulation, losses and efficiency, parallel operation of alternators, armature reaction, damper winding

3 DC GENERATOR

Classification, working principle of generator, construction of DC Machines, types of DC generator, open circuit characteristic, external characteristic and internal characteristic of DC generator, efficiency and power stages with example, condition for maximum efficiency

4 DC MOTORS

Construction, types, principle of operation, torque equation, losses and efficiency, speed torque characteristics of shunt, series and compound motor, D.C. shunt motor 3–point starter, speed control of D.C. shunt and series motors, Stepper motor, Single line diagrams of DC motors

5 SINGLE PHASE, THREE-PHASE INDUCTION MOTOR & ITS SWITCHGEARS

Construction, principle of operation, production of magnetic field, comparison between three phase and single-phase induction motors, speed and slip, rotor current, relation between rotor copper loss and rotor input, torque of an induction motor, torque slip curve, losses and efficiency, starters for three phase induction motor, speed control of three phase induction motor, single line diagram of induction motor

6 INTRODUCTION TO DRIVES

Introduction to Thyristor, Insulated Gate Bipolar transistors (IGBTs), Power MOSFET, general configuration of a motor drive, matching power electronic converter and motor, thyristor controlled single phase and three phase converter drive, modes of operation, block diagram and DC drive examples

TEXT/REFERENCE BOOKS

1. Power systems, V. K. Mehta, S. Chand publication
2. Principles of power systems, V.K. Mehta, S. Chand publication
3. Electrical Technology- Vol. II, B. L. Theraja, S. Chand publication
4. A course in power systems, J. B. Gupta, S. K. Kataria Publication
5. Electrical power systems, S. L. Upal, Khanna Publishers
6. A course in Electrical Power, P. V. Gupta, M. L. Soni, U. S. Bhatnagar, Dhanpat Rai & Co.
7. Theory & Performance of Electrical Machines, J. B. Gupta, Katson books
8. Power Electronics, P.S. Bimbhra, Khanna Publishers

B. TECH. SEMESTER – III

SUBJECT: FLUID MECHANICS

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	25	25	150

Reference Code ME203A

DETAILED SYLLABUS:

1 FLUID PROPERTIES AND PRESSURE MEASUREMENT

Properties of fluid: Mass Density, specific weight, specific gravity and specific volume, Types of fluid, Newton's law of viscosity, continuum concept of a fluid, viscosity, surface tension and capillarity, vapor pressure, cavitation, compressibility, Pressure, Pascal's law, hydrostatic law, hydrostatic paradox, absolute and gauge pressures, measurement of pressure, manometers: simple and differential manometers

2 FLUID STATICS

Total pressure force and center of pressure, hydrostatic force on submerged surfaces -horizontal, inclined, vertical and curved surfaces, buoyancy, stability of floating body and submerged body, metacenter, analytical method to determine meta-centric height

3 FLUID KINEMATICS

Langrangian approach and Eulerian approach, types of flow, streamline, stream tube, path line and streak line, continuity equation, continuity equation in differential form for cartesian coordinate system, local and convective acceleration, translation, rotation and deformation of fluid element, rotation and vorticity, stream function and velocity potential function, stream lines and equipotential lines, relation between stream function and velocity potential, flow nets

4 FLUID DYNAMICS

Newton's Laws of Motion, Euler's Equation, Bernoulli's Equation, venturimeter, orifice meter and pitot tube, impulse-momentum equation and its application, moment of momentum equation, vortex flow, forced and free vortex flow, equation of motion for vortex flow, equation of forced and free vortex flow, dimensionless parameters and their significance, Dimensional analysis.

5 VISCOUS FLOW

Concepts of laminar and turbulent flows, Reynolds number and Reynold's experiment, exact solution of Navier -Stokes equation for simple flows, relation between shear stress and pressure gradient, concept of developing and fully developed flow, Flow of viscous fluid in circular pipes - Hagen-Poiseuille law, laminar flow between parallel plates for moving and stationary plates

6 FLOW THROUGH PIPES

Loss of energy in pipes, friction factor, Moody's Chart, Darcy Weisbach Equation, major and minor losses in pipes, hydraulic gradient lines and total energy line, pipes connected in series and parallel, equivalent pipe, branched pipes, flow through orifices and mouthpieces

TEXT / REFERENCE BOOKS

1. Fluid Mechanics and Hydraulic Machines, R.K. Bansal, Laxmi Prakashan
2. Fluid Mechanics and Fluid Power Engineering, D.S. Kumar, S. K. Kataria & Sons
3. Fluid Mechanics, Yunus A. Cengel, McGraw Hill Publication
4. Fluids Mechanics, F.M. White, McGraw-Hill Inc
5. Fluid Mechanics and Hydraulic Machines, Sukumar Pati, McGraw-Hill Inc
6. Introduction to Fluid Mechanics and Fluid Machines, S. K. Som., G. Biswas, Tata McGraw Hill Co. Pvt. Ltd

B. TECH. SEMESTER – III

SUBJECT: MATERIAL SCIENCE AND METALLURGY

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	25	25	150

Reference Code ME205

DETAILED SYLLABUS:

1 STRUCTURE OF MATERIALS

Crystalline structure of solids, crystalline materials vs amorphous materials, concept of unit cell and space lattice, lattice parameters, Miller indices, crystal structure of ferrous and non-ferrous metals, crystal imperfections, atomic packing factors for various cubic systems, Bragg's law

2 MECHANICAL PROPERTY AND MEASUREMENTS

Tensile, compression and torsion test, Young's modulus, relations between true and engineering stress-strain curves, generalized Hook's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery, Hardness: Rockwell, Brinell and Vickers and their relation to strength

3 PHASE DIAGRAM AND IRON-CARBON EQUILIBRIUM DIAGRAM

Alloys, substitutional and interstitial solid solutions, phase diagrams, interpretation of binary phase diagrams and microstructure development, eutectic, peritectic, peritectoid, and monotectic reactions. Iron- Iron carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron

4 STEELS AND HEAT TREATMENTS

Introduction and purpose of heat treatments, classification of heat treatment processes, annealing, tempering, normalising and spheroidising, isothermal transformation diagram for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructure and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening. Property variation with microstructure, classification and application of steels, transformation product of austenite, TTT and CCT curves, critical cooling rate. Introduction and applications of various case hardening and surface hardening treatments

5 FERROUS-NON-FERROUS ALLOYS, COMPOSITES & OTHER NON-METALS

Classification of steels, alloying of steels, properties of various stainless steels and tool steels, designation of steels. Cast irons; grey, white, malleable and spheroidal cast irons. Copper and copper alloys, brasses, equivalent zinc in brasses, season cracking of brasses, aluminium bronzes, tin bronzes, beryllium bronzes, silicon bronzes, copper nickel alloys, aluminium and aluminium alloys, nickel and nickel alloys, bearing materials, Ceramic materials, polymers, composites, particles-

reinforced composites, fiber reinforced composites, Material standards and its equivalency (ISO, ASTM, DIN, JIS).

6 NON-DESTRUCTIVE TESTING

Introduction to non-destructive testing, radiography testing, dye penetration testing, magnetic particle testing, ultrasonic testing, Jominy end quench test, macro-examination, spark test, macro-etching, microscopic examinations, electron microscopy, magnetic testing, chemical analysis of steel and iron, NDT certification and its applicability to industry.

TEXT / REFERENCE BOOKS

1. Material Science & Engineering, V. Raghvan, PHI Learning Pvt Ltd.
2. Introduction to Physical Metallurgy, Sidney H Avner, Tata Mcgraw-Hill
3. Material Science and Engineering, W. Callister, Willey Publication
4. The science and engineering of Materials, Donald Askland and Pradeep Phule, Wadsworth Publishing.
5. Material Science and Metallurgy for Engineers, V.D. Kodgire, Everest Publishing House
6. Elements of Material Science and Engineering, Lawrence Vlack, PEARSON
7. Physical Metallurgy for Engineers, Donald S Clark & Wilbur R Varney, East-west press pvt Ltd.

B. TECH. SEMESTER – III

SUBJECT: KINEMATICS OF MACHINES

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	1	2	7	5	60	40	25	25	150

Reference Code ME304A

DETAILED SYLLABUS:

1 MECHANISM AND MACHINES

Terminology and definitions, mechanism & machines. rigid and resistance body, link, kinematic pair types of motion, degrees of freedom, classification of Kinematic pairs, kinematic chain, linkage, kinematic inversions of single and double slider crank chain, four bar chain mechanism with lower pairs, straight line mechanism and approximate straight-line mechanism, quick return mechanisms, Steering gear mechanisms

2 VELOCITY ANALYSIS

Vectors, displacement of a rigid body, relative displacement, definition of velocity, angular velocity, rotation of a rigid body, translation and rotation of a rigid body, relative velocity method, instantaneous axes of motion, properties of instantaneous centers, the Aronhold Kennedy theorem of three centers, velocity analysis by instantaneous centers.

3 ACCELERATION ANALYSIS

Definition of acceleration, angular acceleration, a general case of acceleration, radial and transverse components of acceleration, the Coriolis component of acceleration, examples of Acceleration analysis, acceleration diagrams

4 BELTS, ROPES & CHAIN DRIVES

Introduction, belt and rope drives, open and crossed belt drives, velocity ratio, slip, materials for belt and ropes, law of belting, length of belt, ratio of friction tensions, power transmitted, centrifugal effect on belts, maximum power transmitted by a belt, initial tension, creep, chain drive-chain length, angular speed ratio, classification of chains

5 GEARS & GEAR TRAINS

Introduction, classification of gears, gear terminology, law of gearing, velocity of sliding, forms of teeth, cycloidal profile teeth, involute profile teeth, comparison of cycloidal and involute tooth forms, birth of contact, arc of contact, number of pairs of teeth in contact, interference in involute gears, minimum number of teeth, interference between rack and pinion, undercutting, introduction to helical, spiral, worm and bevel gears

6 CAMS

Introduction, types of cams, types of followers, cam terminology, displacement diagrams, motions of the follower, graphical construction of cam profile

TEXT / REFERENCE BOOKS

1. Theory of Machines, S. S. Rattan, Tata McGraw-Hill Publishing Co. Ltd New Delhi
2. Theory of Machines, P. L. Ballaney, Khanna Publishers, New Delhi
3. Theory of Machines and Mechanisms, Joseph Shigley and John Uicker, Jr., McGraw Hill
4. Theory of Mechanisms & Machines, Amitabha Ghosh & Ashok Mallik, Affiliated East-West Press Pvt. Ltd
5. Theory of Machines, Thomas Bevan, CBS publishers and distributors
6. Theory of Machines, Sadhu Singh, Pearson Education
7. Mechanism and Machine Theory, J.S. Rao and R.V. Dukkipati, New Age International Publisher
8. Kinematics & Dynamics of Machinery, Charles Wilson & J. Peter Sadler, Pearson Education

B. TECH. SEMESTER – III

SUBJECT: ENGLISH

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
2	0	2	4	3	40	0	50*	0	90

Reference Code HSMC-01

*TW marks include Viva based on TW

DETAILED SYLLABUS:

1 VOCABULARY BUILDING

The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.

2 BASIC WRITING SKILLS

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

3 IDENTIFYING COMMON ERRORS IN WRITING

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés

4 NATURE AND STYLE OF SENSIBLE WRITING

Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion

5 WRITING PRACTICES

Comprehension, Précis Writing, Essay Writing

6 ORAL COMMUNICATION

(This unit involves interactive practice sessions in Language Lab) Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common, Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations

TEXT / REFERENCE BOOKS

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

B. TECH. SEMESTER – IV

SUBJECT: APPLIED THERMODYNAMICS

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	25	25	150

Reference Code ME202

DETAILED SYLLABUS:

1 EXERGY: WORK POTENTIAL OF ENERGY

Overview of laws of thermodynamics, exergy associated with kinetic and potential energy, reversible work and irreversibility, second law efficiency

THERMODYNAMIC RELATIONS

Maxwell relations, Clapeyron equation, Clausius-Clapeyron equation

2 GAS POWER CYCLE

Basic considerations in the analysis of power cycles, air-standard cycles: assumptions, Otto cycle, diesel cycle, dual cycle and their comparison, simple Brayton cycle and its modification-intercooling, reheating and regeneration

3 VAPOUR POWER CYCLES

The Carnot vapour power cycle, simple Rankine cycle and its energy analysis, modified Rankine cycle: superheating, reheating and regeneration

4 FUELS AND COMBUSTIONS

Calorific values of fuel, requirements of good fuel, proximate and ultimate analysis of fuel, theoretical determination of calorific value using Dulong's formula, air requirement for combustion, boiler performance

5 REFRIGERATION CYCLE

Reversed Carnot cycle, Joule-Thompson effect, analysis of ideal vapour compression refrigeration cycle, actual vapour Compression refrigeration cycle, refrigerants and its properties, selection, air refrigeration (Bell-Coleman) cycle

6 PSYCHROMETRY AND AIR-CONDITIONING

Psychrometric properties and processes, adiabatic saturation temperature, psychrometric chart, human comfort and industrial air-conditioning

TEXT / REFERENCE BOOKS

1. Thermodynamics- An engineering approach, Yunus A. Cengel, Michael A. Boles., Tata McGraw Hill publishing co. ltd.
2. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill publishing co. ltd.
3. Fundamental of thermodynamics, Sonntag. R.E., Borgnakke C. and Van Wylen G.J, John Wiley and Sons.
4. Fundamentals of engineering thermodynamics, Moran M.J. and Shapiro H.N., John Wiley and Sons.

B. TECH. SEMESTER – IV

SUBJECT: ADVANCE SOLID MECHANICS

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	2	5	4	60	40	25	25	150

Reference Code ME302

DETAILED SYLLABUS:

1 STRESSES AND STRAINS IN THREE DIMENSIONS

Solid mechanics approaches, concept of continuum, homogeneity and isotropy, types of forces on a body, state of stress at a point, rectangular stress components, stress sign convention, equality of cross shear, traction on an arbitrary surface, principal stresses and planes, stress invariants, hydrostatic and deviatoric stress tensor, Mohr's circle for general state of stress, plane of maximum shear, stress transformations, octahedral planes and stresses, differential equation of equilibrium

Difference between displacement and deformation, strain at a point, strain displacement relationship, engineers and mathematician's strain tensors, change in length of a linear element – Total strain concept, rigid body rotation, cubical dilatation, principle axes of strain and principal strain, strain deviator, strain invariants, strain transformation, compatibility conditions, stress-strain relationship and elastic constants required for different types of materials, stress strain relationship for isotropic material, plane stress and plane strain

2 THEORIES OF ELASTIC FAILURE UNDER STATIC LOADING

Concept of factor of safety, factors affecting factor of safety, maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, maximum strain energy theory, maximum shear strain energy theory, region of safety for all theories

3 THICK CYLINDERS

Cylinder Classification, design of thick cylinders, Lame's theory, Design based on various failure theories, cylinders subjected to external pressure, Methods of prestressing of cylinders, Analysis of compound cylinders

4 COLUMNS AND STRUTS AND STRESSES DUE TO ROTATION

Classification of columns, strength of columns, end conditions and equivalent length, Euler's formula, Rankine's hypothesis, columns subjected to eccentric loading, beam columns

Stresses in rotating ring, stresses in rotating thin solid and hollow disc, stresses in thin disc with a pin hole, disc of uniform strength

5 SLOPE AND DEFLECTION OF BEAMS

Introduction, Beam deflection, relation between slope, deflection and radius of curvature, slope and deflection at a section by various methods

6 BENDING OF CURVED BARS

Introduction, Stresses in curved bars (Winkler-Bach theory) (Rectangular section, Circular section, Triangular section, Trapezoidal section, T-Section)

TEXT / REFERENCE BOOKS

1. Advanced Mechanics of Solids, L. S. Srinath, Tata McGraw Hill
2. Strength of Materials, R. K. Rajput, S. Chand & Co. Ltd.
3. Solid Mechanics, S. M. A. Kazimi, Tata McGraw Hill
4. Strength of Materials, D. S. Bedi, Khanna book publishing co. Pvt ltd.
5. Elements of Strength of Materials, Timoshenko S. P. and Young D.H., East-West Press Pvt. Ltd.
6. Mechanics of Materials, Timoshenko and Gere, CBS Publishers
7. Mechanics of Structures, S. B. Junarkar, Charotar Publishers

B. TECH. SEMESTER – IV

SUBJECT: MANUFACTURING TECHNOLOGY-I

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	4	7	5	60	40	25	25	150

Reference Code ME302

DETAILED SYLLABUS:

1 SAND CASTING PROCESS

Principal of casting process, different types of patterns, pattern materials, pattern allowances, pattern colours, types of sand, moulding materials and core, moulding processes, melting practice and metal pouring, gating system design, fettling process and casting defects

2 SPECIAL CASTING PROCESSES

Gravity die casting, pressure die casting, centrifugal casting, investment casting, continuous casting, vacuum casting, squeeze casting, comparison with conventional sand casting process

3 LATHE MACHINE

Function, working principle, classification, specifications, main parts, feed mechanism, lathe accessories, lathe operations, cutting tool materials, tool geometry of single point cutting tool, cutting Parameters: speed, feed and depth of cut, machining time, material removal rate, specification of lathe machine, capstan and turret lathe, working principle, parts

4 MILLING, SHAPER AND PLANNER MACHINE

Working principle, main parts, classification of milling machines, specification, milling machine mechanism, work holding devices, cutter holding devices, different milling cutters, tool geometry of plain milling cutter, milling operations, cutting parameters, machining time, milling attachments, principle of indexing, types of indexing

Function of shaper, working principle, classification, main parts, driving mechanism of shaper, feed mechanism of shaper, different operations on shaper machine, cutting parameters: speed, feed and depth of cut, machining time, specification of shaper machine

Working principle of planer, classification, difference between shaper and planer, planner operations, specification of planner machine

5 DRILLING, BORING AND GRINDING MACHINE

Working principle of drilling, classification, main parts, specification, different operations on drilling, machining time

Working principle & types of boring machines, boring tools

Working principle, main parts, classification of grinding machines, specification, Grinding operations, types of grinding wheels, wheel marking, truing, glazing, loading

6 INTRODUCTION TO ADDITIVE MANUFACTURING

Additive manufacturing – basics, processes and applications

TEXT / REFERENCE BOOKS

1. Element of Workshop Technology, S. K. Hajra Choudhury,Vol. 1, Media Promoters and publishers Pvt.
2. Element of Workshop Technology, S. K. Hajra Choudhury,Vol. 2, Media Promoters and publishers Pvt.
3. Foundary Technology, O. P. Khanna, Dhanpat Rai Publication
4. A course in Workshop Technology, B.S.Raghuwanshi, Dhanpat Rai & Sons, Delhi
5. Elements of Lathe work, B.Brushtein and V.Dementyev, Peace Publishers, Moscow
6. Manufacturing Engg. And Technology, S. Kalpakajain, PHI/Pearson
7. H.M.T, "Production Technology", Tata McGraw Hill
8. Manufacturing Processes for Engineering Materials, Kalpakjain S. and Schmid Steven R., Pearson Publication
9. Workshop Technology Vol. I, II & III, Chapman
10. Manufacturing Technology – 1 Foundary, Forming and Welding, P. N. Rao

B. TECH. SEMESTER – IV

SUBJECT: DYNAMICS OF MACHINE

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	1	2	5	5	60	40	25	25	150

Reference Code ME304B

DETAILED SYLLABUS:

[1] STATIC FORCE ANALYSIS

Introduction, conditions of static equilibrium, equilibrium of different members, free body diagrams, principle of super position, static force analysis of various mechanism, principle of virtual work, static force analysis with friction

[2] DYNAMIC FORCE ANALYSIS

Introduction, D–Alembert's principle, equivalent offset inertia force, dynamic analysis of simple mechanisms, combined static and inertia force analysis of different mechanisms, dynamic force analysis of reciprocating engine: inertia of reciprocating mass and connecting rod, dynamically equivalent system

[3] FLYWHEEL

Introduction, function, turning-moment diagrams, fluctuation of energy, dimensions of flywheel rims

[4] BALANCING

Introduction, static balancing, dynamic balancing of several masses in different planes, balancing of reciprocating and rotary masses

[5] GOVERNORS

Introduction, different types of governors, various terminologies, effort and power of a governor, controlling force

[6] GYROSCOPE

Concept of gyroscope, angular velocity, angular acceleration, gyroscopic couple, gyroscopic effect on aviation, marine and automobiles

TEXT / REFERENCE BOOK

1. Theory of Machines, S S Rattan, Tata McGraw Hill.
2. Theory of Machines, R. S. Khurmi and J. K. Gupta, S. Chand and Company Ltd.
3. Theory of Machines and Mechanisms, Joseph Shigley and John Uicker, Jr., McGraw Hill.
4. Theory of Mechanisms & Machines, Amitabha Ghosh & Ashok Mallik, Affiliated East-West Press Pvt. Ltd.
5. Kinematics & Dynamics of Machinery, Charles Wilson & J. Peter Sadler, Pearson Education.

6. Dynamics of Machinery, Farazdak Haideri, Nirali Publication.
7. Mechanism and Machine Theory, J.S. Rao and R.V. Dukkipati, New Age International Publisher

B. TECH. SEMESTER – IV

SUBJECT: MACHINE DRAWING AND INDUSTRIAL DRAFTING

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
0	0	4	4	2	0	0	25	25	50

Reference Code ME308

DETAILED SYLLABUS:

PART A: MACHINE DRAWING

1 FUNDAMENTALS OF MACHINE DRAWING

Introduction to Machine drawing, conventional representations of various machine elements such as threaded parts, bearing, gears, spring, etc. conventional representation of part materials, standard abbreviations.

2 DETACHABLE FASTNERS

Introduction, screw thread nomenclature, forms of thread, thread designation, drawing representations of threads: normal, schematic and conventional. part drawing exercises of threaded fasteners such as bolts, nuts, screws, studs, nut locking arrangements

3 PERMANENT FASTNERS

Rivets and riveted joints, BIS symbols for riveted joints. types of welded joints, BIS symbols for welded joints. drawing exercises for representation of riveted joints and welded joints

4 ASSEMBLY DRAWING

Detail drawing of machine components. assembly drawings of various machines, mechanisms and equipment such as cotter joint, knuckle joint, flange coupling, universal coupling, screw jack etc. from detail drawings, sketches and actual machine components

5 PRODUCTION DRAWING

Introduction to limits, fits, dimensional tolerance, surface roughness and their drawing representation. Geometric dimensioning and tolerancing: basic terminology, indication of geometric tolerance in drawing

PART B: COMPUTER AIDED DRAFTING

1 DRAWING OBJECTS

Starting with AutoCAD, AutoCAD dialog boxes, co-ordinate Systems, drawing line, circle, arc, rectangle, ellipse, polygons

2 EDITING SKETCHED OBJECTS

Editing sketches, moving, copying, pasting, offsetting, scaling, chamfering, trimming, mirroring. filleting, sketched objects

3 DIMENSIONING

Giving dimensions and annotations to drawings, creating linear, rotated, angular, aligned, base line dimensions, modifying dimensions, showing surface roughness symbols, weld symbols, dimensional tolerances, geometric tolerances

4 PLOTTING

Plotting the drawings in AutoCAD, plotting drawing using the plot dialog box, adding plotters and using plot styles, plotting sheets

5 DRAWING EXERCISES WITH AUTOCAD

Orthographic drawing and Isometric drawing of objects, drawing of machine parts, detail and assembly drawing of machines

6 3D MODELING

Creating a 3D model of any object using AutoCAD, generating drawings from the 3D model.

TEXT / REFERENCE BOOK

1. Machine Drawing, K. L. Narayana, P. Kannaiah, K. Venkata Reddy, 3rd edition, New age international (P) Ltd.
2. Machine Drawing, Basudeb Bhattacharyya, Oxford University Press
3. Machine Drawing, N. D. Junnarkar, Pearson Education Pvt. Ltd
4. Machine Drawing - P.S. Gill, S.K. Kataria & Sons New Delhi.
5. Machine Drawing - N. Sidheshwar, P. Kannaiah. McGraw-Hill India.
6. Engineering Drawing Practice for Schools and Colleges SP 46: 2003- BIS (Bureau of Indian Standards).
7. AutoCAD 2017 for Engineers & Designers- Prof. Sham Tickoo. Dreamtech Press.
8. Design of Machine Elements - V. B. Bhandari, Tata McGraw-Hill Publishing Co. Ltd.
9. A text book of Machine Design - P. C. Sharma, D. K. Aggarwal, S. K. Kataria & Sons.
10. PSG Design data book.

B. TECH. SEMESTER – IV

SUBJECT: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
1	0	2	3	2	0	0	100*	0	100

No Reference Code
*TW marks include Viva based on TW

DETAILED SYLLABUS:

1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Meaning and definition of artificial intelligence, Physical Symbol System Hypothesis, production systems, Characteristics of production systems; Breadth first search and depth first search techniques. Heuristic search Techniques: Hill Climbing, Iterative deepening DFS, bidirectional search.

2 KNOWLEDGE REPRESENTATION

Knowledge Representation, Problems in representing knowledge, knowledge representation using propositional and predicate logic, logical consequences, syntax and semantics of an expression. Forward and backward reasoning. Proof methods, substitution and unification, conversion to clausal form, normal forms, resolution, refutation, deduction.

3 NATURAL LANGUAGE PROCESSING & VISUAL PERCEPTION

Language & its comprehension, reading, understanding conversation and essays. Language context, language in a social context, Introduction to problem solving, decision making and reasoning, Visual perception from sensation to representation, approaches to perception, perception of object sand forms, role of environment in seeing, deficits in perception, and perception in practice. Automatic and controlled processes in attention.

4 INTRODUCTION TO MACHINE LEARNING

Preliminaries, what is machine learning; varieties of machine learning, learning input/output functions, sample application. Boolean functions and their classes, CNF, DNF, decision lists. Version spaces for learning, version graphs, learning search of a version space, candidate elimination methods

TEXT / REFERENCE BOOK

1. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-GrawHill
2. Introduction to AI & Expert System: Dan W.Patterson, PHI
3. Introduction to Machine learning, Nils J.Nilsson
4. Introduction to Machine Learning with Python A guide for data scientists, Andreas, C. Muller & Sarah Guido, O'Reilly
5. Artificial Intelligence by Luger (Pearson Education)
6. Machine learning for dummies, IBM Limited ed, by Judith Hurwitz and Daniel Kirsch
7. Russel & Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.

B. TECH. SEMESTER – IV

SUBJECT: UNIVERSAL HUMAN VALUES

Teaching Scheme (Hours/week)					Examination Scheme				
Lect	**Tut**	**Prac**	**Total**	**Credits**	**Ext**	**Sess.**	**TW**	**Prac**	**Total**
3	0	0	3	3	60	0	0	0	60

Reference Code HSMC-02

DETAILED SYLLABUS:

1 COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

Purpose and motivation for the course, recapitulation from Universal Human Values-I, self-Exploration–what is it?-Its content and process; 'Natural Acceptance' and experiential validation-as the process for self-exploration, continuous happiness and prosperity-A look at basic human aspirations, right understanding, relationship and physical facility-the basic requirements for fulfillment of aspirations of every human being with their correct priority, understanding happiness and prosperity correctly-a critical appraisal of the current scenario, method to fulfill the above human aspirations: understanding and living in harmony at various levels

2 UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', understanding the needs of Self ('I') and 'Body'- happiness and physical facility, understanding the body as an instrument of 'I' (I being the doer, seer and enjoyer), understanding the characteristics and activities of 'I' and harmony in 'I' , understanding the harmony of I with the body: sanyam and health; correct appraisal of physical needs, meaning of prosperity in detail, programs to ensure sanyam and health

3 UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN- HUMAN RELATIONSHIP

Understanding values in human-human relationship; meaning of justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; trust and respect as the foundational values of relationship, understanding the meaning of trust; difference between intention and competence, understanding the meaning of respect, difference between respect and differentiation; the other salient values in relationship, understanding the harmony in the society (society being an extension of family): resolution, prosperity, fearlessness (trust) and co-existence as comprehensive human goals, visualizing a universal harmonious order in society- undivided society, universal order- from family to world family

4 UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

Understanding the harmony in the nature, interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in

nature, understanding existence as co-existence of mutually interacting units in all pervasive space, holistic perception of harmony at all levels of existence, include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

5 IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

Natural acceptance of human values, definitiveness of ethical human conduct, basis for humanistic education, humanistic constitution and humanistic universal order, competence in professional ethics: a. ability to utilize the professional competence for augmenting universal human order b. ability to identify the scope and characteristics of people friendly and eco-friendly production systems c. ability to identify and develop appropriate technologies and management patterns for above production systems, case studies of typical holistic technologies, management models and production systems, strategy for transition from the present state to universal human order: a. at the level of individual: as socially and ecologically responsible engineers, technologists and managers b. at the level of society: as mutually enriching institutions and organizations

TEXT / REFERENCE BOOK

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan
3. Human Values, A.N. Tripathi, New Age Intl. Publishers