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.

Date: 06/04/2021

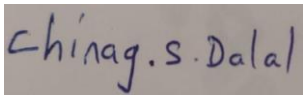
Minutes of Board of Studies
Department of Instrumentation and Control Engineering
Faculty of Technology, Dharmsinh Desai Univesity, Nadiad
Venue: (On line) on Google Meet, Time: From 8 PM on wards

Following Board of Studies members were present
1) Shri Jagdish Shukla, Director, Servilink Systems Pvt. Ltd, Vadodara, External Board member.
2) Prof (Dr.) Chetan Bhatt, Principal, Govt. MCA College, Maninagar, Ahmedabad, External Board member.
3) Prof.(Dr.) V. A. Shah, Chairman, Professor & Head, I.C Department, FoT, D.D.University, Nadiad, Internal Board member.
3) Prof. C. S. Dalal, Associate Professor, I.C Department, FoT, D.D.University, Nadiad, Internal Board member.
3) Prof. J. G. Bhatt, Associate Professor, I.C Department, FoT, D.D.University, Nadiad, Internal Board member.
3) Prof. H. R. Patel, Assistant Professor, I.C Department, FoT, D.D.University, Nadiad, Internal Board member.
3) Prof. T. J. Patel, Assistant Professor, I.C Department, FoT, D.D.University, Nadiad, Internal Board member.

1) The board has discussed and approved the Provisional Course Structure for UG Semester 1 to 8 courses as per Annexure – I.
2) The board has discussed and suggested the new subject name Cyber Physical Systems (Program Elective II) instead of Wireless Communication (Program Elective II) in B.Tech V semester.

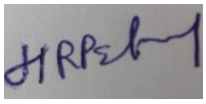
Shri Jagdish Shukla
Director,
Servilink Systems Pvt. Ltd,
Vadodara,
External Board member

Prof. (Dr.) Chetan Bhatt
Principal
Govt. MCA College, Maninagar
Ahmedabad
External Board member

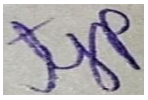


Prof. C. S. Dalal
Associate Professor
I.C Department, FoT, D.D. University,
Nadiad
Internal Board member

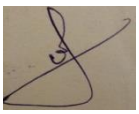
Prof. J. G. Bhatt
Associate Professor
I.C Department
FoT, D.D. University,
Internal Board member



Prof. H. R. Patel
Assistant Professor
I.C Department
FoT, D.D. University,
Internal Board member



Prof. T. J. Patel
Assiatant Professor
I.C Department
FoT, D.D. University,
InternalBoard member



Prof. (Dr.) V. A. Shah
Chairman,
Professor and Head
I. C Department, FoT, D.D.University
Internal Board member

Date: 06/04/2021

Annexure – I

Sem.	Course Title	Subject Category	AICTE Code	Parent Dept.	Teaching Scheme					Examination Scheme			
					Th	Tut	Prac	Total	Credits	Th Ext	Th Int	TW	Total
I	Mathematics -I	Basic Sc.- Core	BSC103	Maths	3	1	0	4	4.0	60	40	0	100
	Thermodynamics	Engg Sc. - Core	ESC 209	Mech	3	0	2	5	4.0	60	40	50	150
	Mechanics	Basic Sc.- Core	BSC101	Civil	3	1	0	4	4.0	60	40	0	100
	Elements of Electrical Engineering	Engg Sc. - Core	ESC101	EC	3	0	2	5	4.0	60	40	50	150
	Computer Programming	Engg Sc. - Core	ESC-103	*Dept	2	0	3	5	3.5	40	0	50	90
	Workshop Practice -1	Engg Sc. - Core	ESC104a	Mech	0	0	2	2	1.0	0	0	50	50
	Environment Studies	Mandatory Course	MC-II	CH	2	0	0	2	0.0	40	0	0	40
					16	**2**	**9**	**27**	**20.5**	**320**	**160**	**200**	**680**
II	Mathematics -II	Basic Sc.- Core	BSC104	Maths	3	1	0	4	4.0	60	40	0	100
	Engineering Graphics	Engg Sc. - Core	ESC102	Mech	3	0	3	6	4.5	60	40	50	150
	Chemistry	Basic Sc.- Core	BSC102	Chem	3	0	0	3	3.0	60	0	0	60
	Basic Electronics	Engg Sc. - Core	ESC201	EC	3	0	2	5	4.0	60	40	50	150
	Mechanics of Solids	Engg Sc. - Core	ESC	Civil	3	0	2	5	4.0	60	40	50	150
	Electronic Workshop	Engg Sc. - Core	ESC	Dept	0	0	3	3	1.5	0	0	50	50
					15	**1**	**10**	**26**	**21**	**300**	**160**	**200**	**660**

Sem.	Course Title	Subject Category	AICTE Code	Parent Dept.	Teaching Scheme					Examination Scheme				
					Th	Tut	Prac	Total	Credits	Th Ext	Th Int	TW	PR	Total
III	Mathematics -III	Basic Sc.- Core	BSC	Maths	3	0	0	3	3.0	60	0	0	0	60
	Linear Electronics I	Open Subject	OS	EC	4	0	2	6	5.0	60	40	25	25	150
	Electronic Measurement	Open Subject	OS	EC	2	1	2	5	4.0	60	40	25	25	150
	Network Analysis	Open Subject	OS	EC	3	1	2	6	5.0	60	40	25	25	150
	Digital Electronics	Open Subject	OS	EC	3	1	2	6	5.0	60	40	25	25	150
	English	HSMC	HSMC	HM	2	0	2	4	3.0	40	0	0	50	90
					17	**3**	**10**	**30**	**25.0**	**340**	**160**	**100**	**150**	**750**
IV	Control Theory	PCC	PCC	IC	2	1	0	3	3.0	60	0	0	0	60
	Linear Electronics II	Open Subject	OS	EC	4	0	2	6	5.0	60	40	25	25	150
	Power Electronics	PCC	PCC	IC	3	0	2	5	4.0	60	40	25	25	150
	Electrical Machines and Power	Open Subject	OS	EC	3	0	2	5	4.0	60	40	25	25	150
	Control System Components	PCC	PCC	IC	2	1	0	3	3.0	60	0	0	0	60
	Effective Communication	HSMC	HSMC	HM	2	0	2	4	3.0	40	0	0	50	90
					16	**2**	**8**	**26**	**22**	**340**	**120**	**75**	**125**	**660**

Sem.	Course Title	Subject Category	AICTE Code	Parent Dept.	Teaching Scheme					Examination Scheme				
					Th	Tut	Prac	Total	Credits	Th Ext	Th Int	TW	PR	Total
V	Microcontroller Fundamentals	PCC	PCC	IC	3	0	2	5	4.0	60	40	25	25	150
	Instrumentation Software Tools (Program Elective I)	PEC	PEC	IC	2	0	3	5	3.5	40	0	25	25	90
	Modeling, Simulation and Evolutionary Techniques (Program Elective I)	PEC	PEC	IC	2	0	3	5	3.5	40	0	25	25	90
	Measurement Techniques	PCC	PCC	IC	3	0	2	5	4.0	60	40	25	25	150
	Process Measurement	PCC	PCC	IC	3	0	2	5	4.0	60	40	25	25	150
	Communication Systems (Program Elective II)	PEC	PEC	IC	3	0	2	5	4.0	60	40	25	25	150
	Cyber Physical Systems (Program Elective II)	PEC	PEC	IC	3	0	2	5	4.0	60	40	25	25	150
	Financial and Managerial Accounting	HSMC	HSMC	HM	2	0	0	2	2.0	40	0	0	0	40
					16	**0**	**11**	**25**	**21.5**	**320**	**160**	**125**	**125**	**730**
VI	Microcontroller Applications (Program Elective III)	PEC	PEC	IC	3	0	2	5	4.0	60	40	25	25	150
	Embedded Systems (Program Elective III)	PEC	PEC	IC	3	0	2	5	4.0	60	40	25	25	150
	Instrumentation Systems	PCC	PCC	IC	3	0	2	5	4.0	60	40	25	25	150
	Power Plant Automation (Program Elective IV)	PEC	PEC	IC	2	1	0	3	3.0	60	0	0	0	60
	Analytical Instrumentation (Program Elective IV)	PEC	PEC	IC	2	1	0	3	3.0	60	0	0	0	60
	Process Instrumentation and Control	PCC	PCC	IC	3	0	2	5	4.0	60	40	25	25	150
	Automation Systems Integration	PCC	PCC	IC	3	0	2	5	4.0	60	40	25	25	150
	Engineering Economics and Principles of Management	HSMC	HSMC	HM	2	0	0	2	2.0	40	0	0	0	40
					16	**2**	**8**	**25**	**21**	**340**	**160**	**100**	**100**	**700**

Sem.	Course Title	Subject Category	AICTE Code	Parent Dept.	Teaching Scheme					Examination Scheme				
					Th	Tut	Prac	Total	Credits	Th Ext	Th Int	TW	PR	Total
VII	Biomedical Instrumentation	PCC	PCC	IC	3	0	2	5	4.0	60	40	25	25	150
	Digital Signal Processing (Program Elective V)	PEC	PEC	IC	2	1	2	5	4.0	60	40	25	25	150
	Industrial Electronics & Drives (Program Elective V)	PEC	PEC	IC	2	1	2	5	4.0	60	40	25	25	150
	Advanced Control Theory & Design	PCC	PCC	IC	2	1	0	3	3.0	60	0	0	0	60
	Process Control	PCC	PCC	IC	3	0	2	5	4.0	60	40	25	25	150
	Robotics Engineering	PCC	PCC	IC	2	1	2	5	4.0	60	40	25	25	150
	Industrial Exposure & Practice	PROJ	PROJ	IC	0	0	6	6	3.0	0	0	50	50	100
	Universal Human Values	HSMC	HSMC	HM	3	0	0	3	3.0	60	0	0	0	60
					15	**3**	**14**	**32**	**25**	**360**	**160**	**150**	**150**	**820**
VIII	Project and Industrial Training	PROJ	PROJ	IC	0	0	24	24	12.0	0	0	100	300	400
	Seminar	PROJ	PROJ	IC	0	0	6	6	3.0	0	0	100	0	100
					0	**0**	**30**	**30**	**15**	**0**	**0**	**200**	**300**	**500**

Course Code	Definition
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OS	Open Subject
PROJ	Project
MC	Mandatory Course

Credits Summary for B.Tech IC

Semester	OS	HSMC/MC	BSC	ESC	PCC	PEC	PROJ	Total
Sem I		0	8	12.5				**20.5**
Sem II			7	14				**21**
Sem III	19	3	3					**25**
Sem IV	9	3			10			**22**
Sem V		2			12	7.5		**21.5**
Sem VI		2			12	7		**21**
Sem VII		3			15	4	3	**25**
Sem VIII							15	**15**
Total Credits	28	13	18	26.5	49	18.5	18	**171**
Required as per AICTE	18	12	25	24	48	18	15	**160**
Percentage of Total Credits	**16.37**	**7.60**	**10.53**	**15.50**	**28.65**	**10.82**	**10.53**	**100.00**

Subject Summary for B.Tech IC

Semester	OS	HSMC/MC	BSC	ESC	PCC	PEC	PROJ	Total
Sem I		1	2	4				**7**
Sem II			2	4				**6**
Sem III	4	1	1					**6**
Sem IV	2	1			3			**6**
Sem V		1			3	2		**6**
Sem VI		1			3	2		**6**
Sem VII		1			4	1	1	**7**
Sem VIII							2	**2**
Total Subjects	6	6	5	8	13	5	3	**46**
Percentage of Total Subjects	**13.04**	**13.04**	**10.87**	**17.39**	**28.26**	**10.87**	**6.52**	**100.00**

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 – 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)												

SYLLABI BOOK

BACHELOR OF TECHNOLOGY
ELECTRONICS & COMMUNICATION ENGINEERING

Department of Electronics & Communication Engineering
Faculty of Technology
Dharmsinh Desai University
Nadiad – 387 001, Gujarat, India.

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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
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Date: 15/07/2021

A meeting of Board of Studies was held today, following members of Board of Studies were present at the meeting.

SR	NAME	DESIGNATION	SIGN
1	Dr. Hiren Patel	Chairman	
2	Dr. Shalini Gupta	Member	
3	Dr. Hitesh Dewan	Member	
4	Dr. Jigar Purani	Member	
5	Dr. Rakesh Makwana	Member	
6	Dr. Urvi Shah	Member	
7	Dr. Kevin Parikh	Member	
8	Dr. Ina Patel	Member	
9	Dr. Rahul Dhanak	Member	

Dr Hiren Patel suggested to conduct course in manner of lectures hands on and live surgical demonstration. Dr Hitesh suggested to course should be conducted by senior faculty members of dept of oral surgery, periodontics and prosthodontics. Dr Shalini suggested to invite final year, intern and post graduate students. Dr. Kevin insisted to have participation of private practioners also.

15/7/21

(Dr. Hiren Patel)
Dean,
Faculty of Dental Science,
Dharmsinh Desai University,
Nadiad

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Date:12/07/2021

NOTICE

Agenda for Board of Studies Meeting

The meeting of Board of Studies is to be held on 15/07/2021 to discuss to conduct the implant education modules in our institute.

SR	NAME	DESIGNATION	SIGN
1	Dr. Hiren Patel	Chairman	
2	Dr. Shalini Gupta	Member	
3	Dr. Hitesh Dewan	Member	
4	Dr. Jigar Purani	Member	
5	Dr. Rakesh Makwana	Member	
6	Dr. Urvi Shah	Member	
7	Dr. Kevin Parikh	Member	
8	Dr. Ina Patel	Member	
9	Dr. Rahul Dhanak	Member	

12/7/21

(Dr. Hiren Patel)
Dean,
Faculty of Dental Science,
Dharmsinh Desai University,
Nadiad

Copy to,
Members of Board of Study (Under Graduate)

Date: 10/10/2017

A meeting of Board of Studies was held today, following members of Board of Studies were present at the meeting.

SR	NAME	DESIGNATION	SIGN
1	Dr. Hiren Patel	Chairman	
2	Dr. Shalini Gupta	Member	
3	Dr. Haren Pandya	Member	
4	Dr. Jigar Purani	Member	
5	Dr. Kevin Parikh	Member	
6	Dr. Bela Dave	Member	
7	Dr. Ina Patel	Member	

Dean Sir Dr. Hiren Patel suggested to include dental photography as a course in undergraduate curriculum as a prime requirement for data collection. Dr. Shalini Gupta suggested to purchase upgraded equipment for the same. Dr. Haren Pandya suggested to design a course consisting of theoretical and practical aspects of photography. Dr. Jigar Purani proposed to take guidance from Dr. Bhupesh Patel, Professor and Head of Department of Oral Pathology, who has in depth knowledge of photography equipments as well as techniques. Finally, all members of board of studies concluded to prepare precise course outline for dental photography and send it to the academic council for approval.

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NOTICE

Date:3/10/2017

Agenda for Board of Studies Meeting

The meeting of Board of Studies is to be held on10/10/2017 to discuss regarding the introduction of a course on dental photography in undergraduate curriculum.

SR	NAME	DESIGNATION	SIGN
1	Dr. Hiren Patel	Chairman	
2	Dr. Shalini Gupta	Member	
3	Dr. Haren Pandya	Member	
4	Dr. Jigar Purani	Member	
5	Dr. Kevin Parikh	Member	
6	Dr. Bela Dave	Member	
7	Dr. Ina Patel	Member	Ina B. Patel

(Dr. Hiren Patel)
Dean,
Faculty of Dental Science,
Dharmsinh Desai University,
Nadiad.

Copy to, Members of Board of Study (Under Graduate)

Date: 12/02/2019

A meeting of Board of Studies was held today, following members of Board of Studies were present at the meeting.

SR	NAME	DESIGNATION	SIGN
1	Dr. Hiren Patel	Chairman	
2	Dr. Shalini Gupta	Member	
3	Dr. Hitesh Dewan	Member	
4	Dr. Jigar Purani	Member	
5	Dr. Rakesh Makwana	Member	
6	Dr. Urvi Shah	Member	
7	Dr. Kevin Parikh	Member	
8	Dr. Ina Patel	Member	
9	Dr. Rahul Dhanak	Member	

Rotary endodontics and implantology are pivotal parts of recent dentistry nowadays. So, to upgrade the knowledge and skills of undergraduate students in the same, the board of studies discussed to introduce course including lecture series, hands on and demonstration. Dr. Hiren Patel suggested to hand over the course design of rotary endodontics to the department of conservative dentistry and for implantology course department of oral and maxillofacial surgery, prosthodontics and periodontics should be involved. All the members unanimously agreed that the course design should be completed as early as possible and sent to academic council for approval.

DHARMSINH DESAI UNIVERSITY
FACULTY OF DENTAL SCIENCE
(Recognized by the Dental Council of India, New Delhi)
College Road, **Nadiad** - 387001. Website: www.ddu.ac.in
Mobile: 98247 27077 Ph: 0268- 2527077, 2522994, Email: ddudental@gmail.com, fods@ddu.ac.in.

Date: 05/02/2019

NOTICE

Agenda for Board of Studies Meeting

The meeting of Board of Studies is to be held on 12/02/2019 to discuss regarding the introduction of implantology and rotary endodontics course in undergraduate curriculum.

SR	NAME	DESIGNATION	SIGN
1	Dr. Hiren Patel	Chairman	
2	Dr. Shalini Gupta	Member	
3	Dr. Hitesh Dewan	Member	
4	Dr. Jigar Purani	Member	
5	Dr. Rakesh Makwana	Member	
6	Dr. Urvi Shah	Member	
7	Dr. Kevin Parikh	Member	
8	Dr. Ina Patel	Member	
9	Dr. Rahul Dhanak	Member	

(Dr. Hiren Patel)
Dean,
Faculty of Dental Science,
Dharmsinh Desai University,
Nadiad.

Copy to, Members of Board of Study (Under Graduate)

Date: 08/02/2021

A meeting of Board of Studies was held today, following members of Board of Studies were present at the meeting.

SR	NAME	DESIGNATION	SIGN
1	Dr. Hiren Patel	Chairman	
2	Dr. Shalini Gupta	Member	
3	Dr. Hitesh Dewan	Member	
4	Dr. Jigar Purani	Member	
5	Dr. Rakesh Makwana	Member	
6	Dr. Urvi Shah	Member	
7	Dr. Kevin Parikh	Member	
8	Dr. Ina Patel	Member	
9	Dr. Rahul Dhanak	Member	

To uplift the morale of the student who had returned to college post-COVID pandemic, it was discussed in the meeting to introduce a course on yoga, physical and mental health awareness. Dr. Rakesh Makwana, a member of the BOS committee itself, is a trained yoga expert, he volunteered to design and conduct this course. All the members welcomed and appreciated his proposal.

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Date: 01/02/2021

NOTICE

Agenda for Board of Studies Meeting

The meeting of Board of Studies is to be held on 08/02/2021 to discuss regarding the introduction of yoga, physical and mental health awareness course in undergraduate curriculum.

SR	NAME	DESIGNATION	SIGN
1	Dr. Hiren Patel	Chairman	
2	Dr. Shalini Gupta	Member	
3	Dr. Hitesh Dewan	Member	
4	Dr. Jigar Purani	Member	
5	Dr. Rakesh Makwana	Member	
6	Dr. Urvi Shah	Member	
7	Dr. Kevin Parikh	Member	
8	Dr. Ina Patel	Member	
9	Dr. Rahul Dhanak	Member	

(Dr. Hiren Patel)
Dean,
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Nadiad.

Copy to, Members of Board of Study (Under Graduate)

Faculty of Technology
Dharmsinh Desai University

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Minutes of the Meeting of Board of Studies (BoS) for Instrumentation and Control Engineering Department

Date: 8th April, 2022
Venue: Board Room, Faculty of Technology, Dharmsinh Desai University, Nadiad.

Members Present:

(1) **Prof. (Dr.) V. A. Shah**, Professor and Head, Instrumentation and Control Engineering Department, Faculty of Technology, Dharmsinh Desai University, Nadiad – As Chairman.
(2) **Prof. C. S. Dalal**, Associate Professor, Instrumentation and Control Engineering Department, Faculty of Technology, Dharmsinh Desai University, Nadiad – As Internal Expert
(3) **Prof. J. G. Bhatt**, Associate Professor, Instrumentation and Control Engineering Department, Faculty of Technology, Dharmsinh Desai University, Nadiad – As Internal Expert
(4) **Prof. H. R. Patel**, Assistant Professor, Instrumentation and Control Engineering Department, Faculty of Technology, Dharmsinh Desai University, Nadiad – As Internal Expert
(5) **Prof. T. J. Patel**, Assistant Professor, Instrumentation and Control Engineering Department, Faculty of Technology, Dharmsinh Desai University, Nadiad – As Internal Expert
(6) **Shri Jagdish Shukla**, Director, Servilink Engineers Pvt. Ltd., Vadodara – As External Expert
(7) **Prof. (Dr.) Chetan B. Bhatt**, Professor (I.C Engineering) and Principal, Government MCA College Maninagar, Ahmedabd - As External Expert

1) The board has discussed and approved the course contents as per Annexure-I to be taught by Instrumentation and Control Engineering Department faculty members for SEM-III & IV as per AICTE model curriculum, The said courses teaching and exam scheme for B.Tech SEM-III & IV are following.

Sem	Subject	AICTE Code Ref.	Teaching Scheme			Total	Credit	Exam Scheme (Marks)				
			Lect	Tut	Prac			Th.	Int.	TW	Prac.	Total
I	Mathematics -I	BSC103	3	1	0	4	4	60	40	0	-	100
	Thermodynamics	ESC 209	3	0	2	5	4	60	40	50	-	150
	Mechanics	BSC101	3	1	0	4	4	60	40	0	-	100
	Elements of Electrical Engineering	ESC101	3	0	2	5	4	60	40	50	-	150
	Computer Programming	ESC-103	2	0	3	5	3.5	40	0	50	-	90
	Workshop Practice -1	ESC104	0	0	2	2	1	0	0	50	-	50
	Environment Studies	MC-II	2	0	0	2	0	40	0	0	-	40
			16	**2**	**9**	**27**	**20.5**	**320**	**160**	**200**	**0**	**680**

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NAAC ACCREDITED

Sem	Subject	AICTE Code Ref.	Teaching Scheme			Total	Credit	Exam Scheme (Marks)				
			Lect	Tut	Prac			Th.	Int.	TW	Prac.	Total
II	Mathematics -II	BSC104	3	1	0	4	4	60	40	0	-	100
	Engineering Graphics	ESC102	3	0	3	6	4.5	60	40	50	-	150
	Chemistry	BSC102	3	0	0	3	3	60	0	0	-	60
	Basic Electronics	ESC201	3	0	2	5	4	60	40	50	-	150
	Mechanics of Solids	ESC105b	3	0	2	5	4	60	40	50	-	150
	Electronic Workshop	ESC	0	0	3	3	1.5	0	0	50	-	50
			15	**1**	**10**	**26**	**21**	**300**	**160**	**200**	**0**	**660**
III	Mathematics -III	BSC201	3	1	0	4	4	60	40	0	0	100
	Electronic Measurement	PCC(EC22)	2	1	2	5	4	60	40	25	25	150
	Network Analysis	ESC(EC06)	3	1	2	6	5	60	40	25	25	150
	Digital Electronics	PCC(EC03)	3	0	2	5	4	60	40	25	25	150
	English	HSMC101	2	0	2	4	3	40	0	0	50	90
	Universal Human Values-II	HSMC301	3	0	0	3	3	60	0	0	0	60
			16	**3**	**8**	**27**	**23**	**340**	**160**	**75**	**125**	**700**
IV	Control Theory	PCC(EC19)	2	0	2	4	3	60	0	25	25	110
	Analog Electronics	PCC(EC09)	3	1	2	6	5	60	40	25	25	150
	Power Electronics	PCC(ECEL14)	3	0	2	5	4	60	40	25	25	150
	Electrical Machines and Power	PCC(ESCXX)	3	0	2	5	4	60	40	25	25	150
	Control System Components	PCC(EC19)	2	0	2	4	3	60	0	25	25	110
	Technical Communication Skills	HSMC201	2	0	2	4	3	40	0	0	50	90
			15	**1**	**12**	**28**	**22**	**340**	**120**	**125**	**175**	**760**

2) The board has also discussed and proposed provisional teaching and exam scheme of IC department subjects for B.Tech SEM-V to VIII as per AICTE model Curriculum guideline. The said courses teaching and exam scheme for B.Tech SEM-V & VIII are following.

Proposed provisional teaching and exam scheme of IC department subjects for B.Tech SEM-V to VIII as per AICTE model Curriculum guideline.

Sem	Subject	AICTE Code Ref.	Teaching Scheme			Total	Credit	Exam Scheme (Marks)				
			Lect	Tut	Prac			Th.	Int.	TW	Prac.	Total
			15	**1**	**12**	**28**	**22**	**340**	**120**	**125**	**175**	**760**
V	Microcontroller Fundamentals	PCC	3	0	2	5	4	60	40	25	25	150
	Instrumentation Software Tools **(Program Elective I)**	PEC	3	0	2	5	4	60	40	25	25	150
	Modeling, Simulation and Evolutionary Techniques **(Program Elective I)**	PEC	3	0	2	5	4	60	40	25	25	150
	Sensors and Transducers	PCC	3	0	2	5	4	60	40	25	25	150
	Process Measurement	PCC	3	0	2	5	4	60	40	25	25	150
	Communication Systems **(Program Elective II)**	PEC	2	1	0	3	3	60	0	0	0	60
	Cyber Physical Systems **(Program Elective II)**	PEC	2	1	0	3	3	60	0	0	0	60
	Entrepreneurship and Innovation	OEC	3	0	0	3	3	60	0	0	0	60
			17	**1**	**8**	**26**	**22**	**360**	**160**	**100**	**100**	**720**

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Sem	Subject	AICTE Code Ref.	Teaching Scheme			Total	Credit	Exam Scheme (Marks)				
			Lect	Tut	Prac			Th.	Int.	TW	Prac.	Total
VI	Microcontroller Applications **(Program Elective III)**	PEC	3	0	2	5	4	60	40	25	25	150
	Embedded Systems **(Program Elective III)**	PEC	3	0	2	5	4	60	40	25	25	150
	Instrumentation Systems	PCC	3	0	2	5	4	60	40	25	25	150
	Power Plant Automation **(Program Elective IV)**	PEC	2	1	0	3	3	60	0	0	0	60
	Analytical Instrumentation **(Program Elective IV)**	PEC	2	1	0	3	3	60	0	0	0	60
	Process Instrumentation and Control	PCC	3	0	2	5	4	60	40	25	25	150
	Automation Systems Integration	PCC	3	0	2	5	4	60	40	25	25	150
	Economics and Management	HSMC	2	0	0	2	2	40	0	0	0	40
	Introduction to R Programming	OEC	2	0	2	4	3	60	0	25	25	110
			18	**1**	**10**	**29**	**24**	**400**	**160**	**125**	**125**	**810**

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Sem	Subject	AICTE Code Ref.	Teaching Scheme			Total	Credit	Exam Scheme (Marks)				
			Lect	Tut	Prac			Th.	Int.	TW	Prac.	Total
VII	Biomedical Instrumentation	PCC	3	0	2	5	4	60	40	25	25	150
	Digital Signal Processing **(Program Elective V)**	PEC	2	1	2	5	4	60	40	25	25	150
	Industrial Electronics & Drives **(Program Elective V)**	PEC	2	1	2	5	4	60	40	25	25	150
	Advanced Control Theory & Design	PCC	2	1	0	3	3	60	0	0	0	60
	Process Control	PCC	3	0	2	5	4	60	40	25	25	150
	Robotics Engineering **(Program Elective VI)**	PEC	2	1	2	5	4	60	40	25	25	150
	Fundamentals of Machine Learning **(Program Elective VI)**	PEC	2	1	2	5	4	60	40	25	25	150
	Industrial Exposure & Practice	PROJ	0	0	2	2	1	0	0	50	50	100
	Smart Instrumentation	OEC	3	0	0	3	3	60	0	0	0	60
			15	**3**	**10**	**28**	**23**	**360**	**160**	**150**	**150**	**820**
VIII	Industrial Internship	PROJ	0	6	24	30	18	0	0	150	350	500
			0	**6**	**24**	**30**	**18**	**0**	**0**	**150**	**350**	**500**
					Total Credit	173.5						

3) The board has discussed and approved the Instrumentation and Control Engineering department Vision, Mission, Program Educational Objectives (PEOs), and Program Specific Outcomes (PSOs) of the B.Tech program.

The university Vision statement needs modification. Faculty of Technology should have separate Vision & Mission statements.

The detail scheme and course syllabus for B.Tech SEM-III & IV subjects are as attached in Annexure – I.

The Instrumentation and Control Engineering department Vision, Mission, Program Educational Objectives (PEOs), and Program Specific Outcomes (PSOs) of the B.Tech program is attached in Annexure-II.

[SHRI JAGDISH SHUKLA]
Director, Servilink Systems Pvt. Ltd., Vadodara
External Expert

[PROF. (DR.) CHETAN B. BHATT]
Prof. (I.C Engineering) & Principal
Government MCA College
Maninagar, Ahmedabad
External Expert

[PROF. (DR.) V. A. SHAH]
Chairman
Head of Department

[PROF. C. S. DALAL]
Associate Professor-IC Engg. Dept. Internal Expert

[PROF. J. G. BHATT]
Associate Professor-IC Engg. Dept.
Internal Expert

[PROF. H. R. PATEL]
Assistant Professor
I.C Engg. Dept
Internal Expert

[PROF. T.J.PATEL]
Assistant Professor -IC Engg. Dept. Internal Expert

Submitted to: Prof. K. N. Sheth, Dean, Faculty of Technology, Dharmsinh Desai University, Nadiad

Annexure-I

B. TECH. SEMESTER – III (IC)
SUBJECT: MATHEMATICS - III

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

Reference Code BSC201a

A. COURSE OVERVIEW:

The course is designed to provide the fundamental aspects of complex numbers. It covers comprehensive knowledge of numerical techniques to find roots of the equation, solve first order differential equations, and solve simultaneous equations. It includes procedures for numerical differentiation and numerical integration, and interpolation methods. It focuses on in-depth understanding of concepts associated with probability, discrete and continuous probability distributions, and relationship between independent variable and dependent variable. These concepts are extensively used in engineering and its applications.

B. DETAILED SYLLABUS

1 **NUMERICAL METHODS:** Solution of algebraic and transcendental equations by regula-falsi method and Newton-Raphson's method, solution of linear simultaneous equations by Gauss-Jordan and Gauss-Seidel method, numerical methods to solve first order and first degree ordinary differential equations by Runge's method and Runge-Kutta method, numerical integration using trapezoidal rule, Simpson's one-third rule, and Simpson's three-eighth rule.

2 **FINITE DIFFERENCES AND INTERPOLATION:** Finite difference: Introduction to forward difference, backward difference, central difference, shift, and averaging operators. Newton's forward and backward difference interpolation formula, central difference interpolation formula by Stirling formula and Bessel's formula. Lagrange's interpolation formula for unequal interval. Numerical differentiation: Derivatives using forward difference, backward difference, and central difference (Stirling's) formula for tabulated values, maxima and minima of a tabulated function

3 **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.

4 **PROBABILITY DISTRIBUTIONS AND STATISTICS:** Probability distributions: Binomial distribution, Poisson distribution, and normal distribution, calculation of errors: probable error and standard error, coefficient of correlation, rank correlation, lines of regression, curve fitting: method of least square approximation for straight line, parabola, second degree parabola, and non-polynomial approximation.

C. RECOMMENDED 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.

D. COURSE OUTCOMES

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

- Understand and represent the complex numbers in Argand diagram.
- Analyze and understand the basic concepts and terminologies of probability and probability distribution functions..
- Evaluate and examine the linear and non-linear regression between two variables.
- Extend the learning of differential calculus:methods to solve and analyze the higher order differential equations.
- Interpolate and extrapolate the given data with the help of difference operator.
- Investigate and solve the ordinary differential equations by numerical techniques.

B. TECH. SEMESTER – III (IC)
SUBJECT: ELECTRONIC MEASUREMENT

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	1	2	5	4	60	40	25	25	150

Reference Code EC22

A. COURSE OVERVIEW

The creating sound background for understanding of operating principle, working and application of various electronic instruments. By offering these course department encourages to use sensors for measurement of various parameters like temperature, pressure, level and flow. Moreover, design and analysis of various bridge circuits and meter circuit utilized in electronic measurement.

B. DETAILED SYLLABUS

NO. TOPIC

[1] MEASUREMENT AND ERROR

Accuracy and Precision, Definitions, Significant Figures, Types of Error, Statistical Analysis, Probability of Errors, Limiting Errors , Problems.

[2] SYSTEM OF UNITS OF MEASUREMENTS

Fundamental and Derived Units, System Of Units, Electric and Magnetic Units, International System of Units, Other System of Units, Conversion of Units.

[3] STANDARDS OF MEASUREMENTS

Classification of Standards, Standards of Mass, Length and Volume, Time and Frequency Standards, Electrical Standards, Standards of Temperatureand Luminous Intensity, IEEE standards.

[4] 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.

[5] ELECTRONIC INSTRUMENTS FOR MEASURING BASIC PARAMETERS

Amplified DC Meter, AC Voltmeter using Rectifiers, True RMS- Responding Voltmeter, Electronic Multimeter, Analog Voltmeter, Differential Voltmeters, Digital Voltmeters, Component Measuring Instruments, Q Meter, Vector Impedance Meter, Vector Voltmeter, RF Power and Voltage Measurement.

[6] 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.

[7] ELECTROMECHANICAL INDICATING INSTRUMENTS

Suspension Galvanometer, Torque and Deflection of the Galvanometer, Permanent-Magnet Moving coil Mechanism, DC Ammeters, DC voltmeters, Voltmeter Sensitivity, Series ohmmeter, Shunt ohmmeter, Multi meter or VOM, Calibration of DC Instruments, Thermo instruments, Electrodynamometers in Power Measurements, Watt Meter, Instrument Transformers

C. RECOMMENDED 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

D. COURSE OUTCOMES

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

- Study of various parameters based on measurement and error.
- Study of system units of Measurements like, fundamental and derived units, Electric and Magnetic units and conversion of units.
- Design and extend meter circuit like DC Ammeter, DC Voltmeter & series type ohmmeter for given specification.
- Illustrate the working of instrument for measuring AC parameters like voltage, current, power factor and energy.
- Design DC bridges for measurement of low & medium value of resistance like Wheatstone bridge, kelvin's double bridge.
- Design AC bridges for measurement of primary and secondary parameters of components.
- Compare various voltmeters like amplified DC meter, AC voltmeter using rectifier, True rms responding voltmeter and electronic multimeter for improving accuracy of measurement.
- Illustrate the working of various oscilloscope for measuring voltage, frequency and phase. Applications of various transducers used in measurement systems.

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

Reference Code EC06

A. COURSE OVERVIEW

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.

B. DETAILED SYLLABUS

NO **TOPIC**

[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.

C. RECOMMENDED 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

D. COURSE OUTCOMES

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

- 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
- Apply Thevenin's and Norton's theorem to complex RLC networks in order to simplify the network and determine load voltage / current
- Understand behaviour of mutually coupled coils and determine direction of induced current using dot convention
- Compute response of the network for given excitation using classical (solving differential equations) as well as transform methods
- Use Laplace transform method to find out response of the network to given waveforms
- Design RLC series network to generate response with specific frequency for given step input.
- 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.
- Design stable electrical network with the help of poles and zeros.

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	-	2	5	4	60	40	25	25	150

Reference Code EC03

A. COURSE OVERVIEW

Computer systems and digital communications have affected positively every aspect of our life. Digital Electronics is the foundation of these systems. On completion of the subject students will have the skills and confidence to conceive and implement a digital system. The objective of this course is to provide the fundamental concepts associated with the digital logic and circuit design. To apply the laws involved in the Boolean algebra for the simplification of logic functions which results in the minimization of hardware requirements. To design and analysis of combinational and sequential circuits utilized in the different digital circuits and systems.

B. DETAILED SYLLABUS

NO. TOPIC

[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.

C. RECOMMENDED 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

D. COURSE OUTCOMES

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

- Analyze 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.
- Optimize the Boolean expressions by using minimization techniques as K-Map method and Tabulation Method with "don't care" conditions up to 6 variables.
- Apply Boolean algebra and able to minimize Boolean expressions. Synthesize the Boolean expressions using AND-OR-INVERT functions as well as universal gates.
- Illustrate the conversion of Boolean expressions from SOP to POS forms and vice versa.
- Design the combinational circuits like Multiplexers, Decoders, Encoders, Code Converters, and Arithmetic Comparison Circuits using basic gates.
- Design and Implement the digital circuit using combinational blocks like multiplexers, de-coder, PLA, PAL for given problem statement.
- Construct sequential circuits like asynchronous/ synchronous counters, shift registers and FSM using flip-flops.
- Design memory elements like basic latch, gated S-R latch, D latch, Master-Slave and edge triggered D flip-flop and J-K flip flop using gates.
- Analyze and troubleshoot sequential circuits for given input conditions and reconstruct the same to resolve the issues found while troubleshooting.
- Simulate and analyse the combinational and sequential circuits using MULTISIM and QUARTUS-II EDA tool.

B. TECH. SEMESTER – III (IC)
SUBJECT: ENGLISH (HSMC101)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	prac	Total
2	0	2	4	3	40	-	-	50	90

Reference Code HSMC101

A. COURSE OVERVIEW

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

B. DETAILED SYLLABUS

1 VOCABULARY BUILDING:
1.1The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

2 BASIC WRITING SKILLS:
2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

3 IDENTIFYING COMMON ERRORS IN WRITING:
3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

4 NATURE AND STYLE OF SENSIBLE WRITING:
4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

5 WRITING PRACTICES:
5.1 Comprehension

5.2 Précis Writing
5.3 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

C. RECOMMENDED 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 Pushp Lata. 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 thier writing in effective way
- Ractify 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 – III (IC)
SUBJECT: UNIVERSAL HUMAN VALUES-II

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	0	0	3	3	60	-	-	-	60

Reference Code HSMC301

A. COURSE OVERVIEW

Universal human values is a course which help the student to see the need for developing a holistic perspective of life. To sensitize the student about the scope of life – individual, family, society and nature/existence. Strengthening self-reflection. To develop more confidence and commitment to understand, learn and act accordingly.

B. DETAILED SYLLABUS

NO. TOPIC

1 COURSE INTRODUCTION

Need, Basic Guidelines, Content and Process for Value Education Self Exploration–what is it? - its 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, 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-human relationship; 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 relationship, Understanding the harmony in the society (society being an extension of 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 transition from the present state to Universal Human Order

C. RECOMMENDED TEXT / REFERENCE BOOKS

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:

- Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
- Students would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
- They would have better critical ability.
- It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction
- Students would also become sensitive to their commitment towards what they have under-stood

B. TECH. SEMESTER – IV (IC)
SUBJECT: CONTROL THEORY (IC407)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	0	2	4	3	60	-	25	25	110

Reference Code EC19

A. COURSE OVERVIEW

This course is designed to provide complete overview of control theory used in an Instrumentation and Control engineering. The students can differentiate between an open loop and closed control systems, find transfer function of control systems using a block diagram reduction technique and a signal flow graph technique, find sensitivity and stability of a linear control system, analyse control systems using time domain and frequency domain analysis techniques and co-relate time domain and frequency domain specification terms.. The concept of this subject is useful to the students for understanding the concept of control systems, sensitivity and stability and its time domain and frequency frequency domain analysis.

B. DETAILED SYLLABUS

NO	TOPIC
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, linearizing effect of feedback, regenerative feedback, Basics of Feed forward Control System with example.
4	**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.
5	**THE ROOT LOCUS TECHNIQUE:** Introduction, Rules of construction of root loci, sketching of root locus and applications
6	**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.

B. RECOMMENDED TEXT / REFERENCE BOOKS

1. Control System Engineering: By Nagrath & Gopal
2. Control systems Engineering: By – U. A. Patel, Mahajan Publishing House
3. Problems and Solutions of Control Systems With Essential Theory: by Jairath, CBS Publisher
4. Modern Control Engineering: By K. Ogata , Prentice Hall
5. A course in control engineering: By A. Subbarao and Parag R. Desai. Dhanpat Rai Publications Ltd.
6. Automatic Control System: By S.N.Verma , Khanna Publications
7. Feedback Control Systems: By Di Staffeno

D. COURSE OUTCOMES

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

- Understand the classification of control system and basic components of closed loop and open loop control system.
- Apply basic concept of mathematical modeling and understand the feedback characteristics of control system
- Understand and analyze LTI Systems using various stability analysis techniques.
- Analyze time and frequency response of control system

B. TECH. SEMESTER – IV (IC)
SUBJECT: ANALOG 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

Reference Code EC09

A. COURSE OVERVIEW

The course is designed for a smooth transition from the world of physics to electronics and computations for the first-year students of different branches of engineering; the course combines basic electrical circuit and electronics components into a single unified treatment and provides a strong background to understand the role of electronics in contemporary world of system designs.

This course provides the concepts associated with Transistor fundamentals, biasing of BJTs and MOSFETs using basic circuits. Technical details of the typical circuits that are used in our day-to-day life like rectifiers, voltage regulators, and amplifiers are discussed in this course. The sensors useful for automation in different engineering fields are also shown as integral part of electronic circuits in this subject.

B. DETAILED SYLLABUS

NO. TOPIC

[1] FREQUENCY RESPONSE OF AMPLIFIERS
Effect of Coupling and Emitter Bypass Capacitors on Low frequency response, The RC-Coupled Amplifier, The Hybrid Pi Transistor Model at High Frequencies, Variations of Hybrid Pi Parameters, The CE short-circuit Current Gain, The Generalized Voltage-Gain Function, Single-Stage CE Transistor Amplifier Responses, The Gain-Bandwidth Product, Emitter Follower at High Frequencies, High-Frequency Response of Two Cascaded CE Transistor Stages, Step Response of an Amplifier.

[2] FIELD EFFECT TRANSISTORS
The Junction Field-Effect Transistor, The JFET Volt-Ampere Characteristics, Fabrication of JFETs, The Enhancement Metal-Oxide-Semiconductor Field-Effect, Transistor (MOSFET), The Depletion MOSFET, Biasing the Field-Effect Transistor, The JFET or MOSFET Small-Signal Model, The JFET as Voltage-Controlled Resistor (VCR).

[3] OPERATIONAL_AMPLIFIER CHARACTERISTICS
The Basic Operational Amplifier, The Differential Amplifier, The Emitter-Coupled Differential Amplifier, Transfer Characteristics of a Differential Amplifier, Operational Amplifier Design Techniques, Offset Error Voltages and Currents, Measurement of Operational Amplifier Parameters, Frequency Response of Operational Amplifiers

[4] Operational AMPLIFIER SYSTEMS
Basic Operational Amplifier Applications, Differential (Instrumentation) Amplifiers, AC-Coupled Amplifier, Analog Integration and Differentiation, Electronic Analog Computation, Active Filters, Active Resonant Band pass Filters, Precision AC/DC Converters, Sample-and-Hold Systems, Logarithmic and Exponential Amplifier, Digital-to-Analog(D/A) Converters, Analog-to-Digital(A/D) Converters, Instrumentation Amplifier.

[5] WAVESHAPING AND WAVEFORM GENERATORS
Clipping (Limiting Circuits), Clipping at Two Independent Levels, Comparators, Applications of Comparators, Regenerative Comparators (Schmitt Trigger), Square- Wave and Triangular-Waves Generators, Pulse Generators, Voltage Time-Base Generators, Astable and monostable multivibrator using op-amp, Sinusoidal Generators, The Phase-Shift Oscillator, A General Form of Oscillator Configuration, The Wien Bridge Oscillator,

Crystal Oscillators, Timer 555- Astable and Monostable mode

[6] **POWER CIRCUITS AND SYSTEMS**

Large-Signal Amplifiers, Harmonic Distortion, Amplifier Classification, Efficiency of a Class A Amplifier, Class B Push-Pull Amplifiers, Class AB Operation, Regulated Power Supplies, series voltage regulator

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Jacob Millman & Christos C. Halkias, Integrated Electronics, 1st Edition, Tata McGraw Hill
2) Robert L. Boylstead & Louis Nashelsky, Electronic Devices &Circuit Theory, 8th Edition, Prentice Hall of India
3) K. R. Botkar, Integrated Circuits, 9th Edition, Khanna Publications
4) Op - Amp and Linear Integrated Circuits, Ramakant A. Gayakwad, 4th Edition, Pearson Education

D. COURSE OUTCOMES

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

- Analyse class A, Class B, Class AB and Push-Pull amplifier in terms of operating characteristics, harmonic distortion and power efficiency.
- Design regulated power supply to provide constant voltage with specified minimum load current for the given specification.
- Computation of transfer gain, input and output impedance of various types of negative feedback amplifiers.
- Design analog circuits using OPAMPs for specific applications like comparator, DAC, volt and current meters
- Develop OPAMP circuits to perform mathematical operations like addition, subtraction, multiplication, division, integration, differentiation, logarithm, antilogarithm
- Design different types of waveform generators using discrete components and OPAMP and IC 555 like astable and Monostable Multivibrator
- Design analog active filters using OPAMP and Sinusoidal Oscillator for given frequency and gain.

B. TECH. SEMESTER – IV (IC)
SUBJECT: POWER ELECTRONICS (IC 4XX)

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

Reference Code ECEL14.

A. COURSE OBJECTIVE

Industrial automation has been contributing immensely in the growth of the manufacturing seector and country at large. At field level, power electronics is playing a game changer role in automatic adjustments of final control elements. On completion of this course, students will learn and develop skills to understand and implement a thyristor based control system. The objective of this course is to provide the fundamental concepts associated with the construction and working of thyristor based circuits. To study the design and to analyze industry grade high power circuits utilized in the different automatic systems is one of the main goals of this course.

B. DETAILED SYLLABUS

1 POWER ELECTRONICS APPLICATIONS

Introduction, Thyristor applications, Advantages and disadvantages of thyristor converter systems, Power semiconductor converters

2 POWER SEMICONDUCTOR DEVICES

Introduction, Power semiconductor devices, Power diode, Types of power diodes, Performance parameters of power diodes, Series operation of power diodes, Parallel operation of power diodes, Hybrid devices

3 THYRISTOR PRINCIPLES AND CHARACTERISTICS

Introduction, Thyristor construction, Thyristor operation and characteristics, Firing circuit design considerations, Requirements of firing circuits, Thyristor transient characteristics, Thyristor types, Series and parallel operations of thyristors, Ratings of thyristors, Relative performance of power electronic devices

4 TRIGGERING DEVICES

Introduction, Triggering devices, Uni Junction Transistor (UJT), Characteristics and applications of UJT, Programmable Uni-junction Transistor (PUT), DIAC, Silicon Controlled Switch (SCS), Silicon Unilateral Switch (SUS), Silicon Bilateral Switch (SBS)

5 REGULATORS AND POWER SUPPLIES

Introduction, Filter voltage regulation and ripple voltage, Voltage multiplier circuits, Zener voltage regulators, Complete voltage regulated power supply, IC voltage regulators

6 THYRISTOR COMMUTATION CIRCUITS

Introduction, Turn-off characteristics, Commutation of a thyristor, Natural commutation, Forced commutation, Conditions for commutation, Classification of forced commutation methods-Class A, B, C, D, E and F type commutation

7 THYRISTOR TRIGGERING CIRCUITS

Introduction, Requirements of triggering circuits, Thyristor firing circuits, Pulse transformer triggering, Control of converter, Firing angle control, Firing SCR by UJT, TRIAC firing circuit, Phase control of SCR by Pedestal and Ramp

C. RECOMMENDED TEXT / REFERENCE BOOKS

1. A Textbook on Power Electronics, Harish C. Rai, Galgotia Publications
2. Power Electronics, MD Singh and KB Khanchandani, Tata McGraw Hill Publication
3. Power Electronics, PC Sen, Tata McGraw Hill Publication
4. Thyristor: Theory and Applications, RK Sugandhi and KK Sugandhi, New Age Pub.
5. An Introduction to Thyristors and their applications, Ramamurthy, East West Pub.

D. COURSE OUTCOMES

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

- Gain knowledge of the family of semiconductor devices and compare the operational characteristics of various power semiconductor devices
- Gain knowledge of the series and parallel operations of power diodes and their applications.
- Understand the construction and principles of operation of thyristors and their firing considering SCR as case study, understand the ratings and relative performance
- Understand the fundamentals of thyristor triggering and typical characteristics of various triggering devices, understand various thyristor firing techniques
- Understand the fundamentals of thyristor commutation, understand various thyristor commutation methods
- Understand the operation of various regulators and their applications in power supply circuits

B. TECH. SEMESTER – IV (EC/IC)
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

Reference Code ESCXXX

A. COURSE OVERVIEW

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. After studying this course, the students will be able to identify and troubleshoot electrical faults in switchgear.

B. DETAILED SYLLABUS

NO. TOPIC

[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.

C. RECOMMENDED 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.

D. COURSE OUTCOMES

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

- Analyse important parameters such as regulation, efficiency, output power and losses of AC electrical machines like transformer, auto-transformer and induction motor.
- Analyse no load and load characteristics of DC shunt, series and compound DC machines.
- Evaluate synchronous reactance of an alternator and discriminate magnetic effects like magnetising, demagnetising and cross magnetising on operation of an alternator.
- Explain split phase mechanism to make single phase induction motor self-starting and classify types of single phase induction motors.
- Compare and conclude merits and demerits of conventional and non-conventional electrical energy generation power plants.
- Analyse effect of power factor improvement in AC electrical power system. Analyse and compute diversity factor, load factor, demand factor and average load.
- Choose the best material considering conductivity, tensile strength, durability, considering cost, life, fault frequency and safety for underground and overhead transmission line.
- Illustrate relay circuit breaker coordination to protect electrical system. Choose required protective devices like fuses, circuit breakers, relays or isolator switch to protect against electrical faults.

B. TECH. SEMESTER – IV (IC)
SUBJECT: CONTROL SYSTEM COMPONENTS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	-	2	4	3	60	-	25	25	110

Reference Code EC19

A. COURSE OBJECTIVES

This course is designed with the objective of making students -

- To understand the working principle, construction of various electrical, mechanical, electromagnetic, hydraulic and optoelectronic components used in control systems
- To analyse operation of various electrical, mechanical, electromagnetic, hydraulic and optoelectronic components used in control systems
- Applications of various electrical, mechanical, electromagnetic, hydraulic and optoelectronic components used in control systems
- Appraise design feature of control system components
- Determine basic structure of Control System Problem.

B. DETAILED SYLLABUS

1 INTRODUCTION TO CONTROL PROBLEM

Control systems: Terminology and basic structure, the genesis and essence of feedback control theory, Feedback control structure.

2 MECHANICAL COMPONENTS

CAMS AND FOLLOWERS:

Introduction, Components of Cam, Types of Cam, Types of Followers, Classifications, Cam Motions, Cam Terminology, Cam Profile

GEARS, CLUTCHES, BREAKS:

Introduction of Gears, Clutches, Brake.

3 ELECTRO-MECHANICAL COMPONENTS

SERVO MOTOR:

Introduction, DC Servomotors, AC Servomotors

STEPPER MOTORS:

Introduction, PM type Stepper Motor, VR type Stepper Motor, Hybrid Stepper Motor, Disc Magnet Stepper Motor, Applications of Stepper Motors

UNIVERSAL MOTOR:

Construction, Operation, Speed control

TACHOMETERS:

Introduction, Characteristics requirement, DC Tachogenerator, AC Tachogenerators, Tachometer Applications, characteristics of Tachogenerator

SOLENOIDS:

Introduction,Construction, Working, Selection and different types of Solenoid.

4 OPTO-ELECTRONIC DEVICES

Classification, Photo conductive, Photo Voltaic & Photoemissive sensors , Liquid Crystal Display.

5 SAFETY AND AUXILIARY COMPONENTS

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

SWITCHES:

Single pole, double pole, electro mechanical Switches

POTENTIOMETER:

Introduction, Type of Potentiometers, Applications, Selection of Potentiometers.

6 HYDRAULIC SYSTEMS

Introduction, Advantages & Disadvantages of Hydraulic Systems, Components of Hydraulic System, Classification of Hydraulic Systems, Pump-Controlled Hydraulic System, Pump Controlled Hydraulic Motor, Hydraulic Transmission Lines, Hydraulic Power Supply, Hydraulic Valves.

C. RECOMMENDED TEXT / REFERENCE BOOKS

1. Control systems components, By: M.D. Desai, PHI publication, 2008
2. Control systems principle and design, 4th Edition, By: M.Gopal, Tata McGraw-Hill Education publication, 2015
3. Electronic Devices and Circuits – An Introduction, By: Mottershed, Prentice hall publication, 1997
4. Modern Control Technology: Components and systems, By: Kilian, Cengage Learning publication, 1996
5. Mechanical & Industrial Measurements, 11th Edition, By: R. K. Jain, Khanna Publishers, 2011

D. COURSE OUTCOMES

After completing this course students will be able to:

1. Describe construction, operation & behaviour of electrical, mechanical and hydraulic control system components
2. Interpret the characteristics of electrical, mechanical and hydraulic control system components
3. Describe various standards used for selection of electrical, mechanical and hydraulic control system components
4. Select electrical, mechanical and hydraulic control system components
5. Develop and build basic applications of electrical control system components
6. Describe Identify different control problem

B. TECH. SEMESTER – IV (IC)
SUBJECT: TECHNICAL COMMUNICATION SKILLS

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

Reference Code HSMC201

A. COURSE OVERVIEW

The course is designed to help students learn technical communication and ethics in engineering. It helps students to understand the importance of self development and moral reasoning along with building positive self esteem.

B. DETAILED SYLLABUS

NO. TOPIC

[1] INTRODUCTION
Basics and importance of Technical Communication, General and Technical Communication, objectives and Characteristics of Technical Communication, Process of Communication, interpersonal and organisational Communication levels, Non-verbal communication.

[2] TECHNICAL WRITING
Writing technical reports, technical proposals, Formal letters, memos, Email, Email etiquettes, Business letters, Research papers and technical descriptions, application letter writing, resume writing, follow-up letter writing, Minutes of meeting, Making notes.

[3] TECHNICAL COMMUNICATION
Effective public Speaking, Formal Presentations, Presentation aids, Interviews, Group discussions, Telephone Etiquettes.

[4] ENGINEERING ETHICS
Ethics and excellence in Engineering, Role and responsibility of engineer, Moral reasoning and Code of ethics.

[5] SELF DEVELOPMENT AND SELF-ESTEEM
Importance of Attitude, Goal setting, Self-esteem, Steps to building positive Self-esteem

C. RECOMMENDED TEXT / REFERENCE BOOKS

1) Raman Sharma, Technical Communications, 3rd Edition, Oxford Publication, London
2) David F. Beer and David McMurrey, Guide to writing as an Engineer, 3rd Edition, John Willey, NewYork
3) Shiv Khera, You Can Win, Macmillan Books, New York
4) Diane Hacker, Pocket Style Manual, Bedford Publication, New York
5) Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York

6) Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi
7) Xebec, Presentation Book, TMH New Delhi

D. COURSE OUTCOMES

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

- Describe Verbal and Non Verbal aspects of Communication
- Write technical documents for professional communication
- Practice etiquettes in communication at workplace
- Demonstrate ethics and moral reasoning in engineering
- Practice positive attitude and set long term/short term goals
- Plan self development and build positive self esteem

Department of Instrumentation and Control Engineering

Faculty of Technology

Dharmsinh Desai University

Annexure-II

Department Vision:

To lead the field of Instrumentation and Control engineering towards inclusive excellence through integration of teaching, learning and industry interaction, advancement of the knowledge base by multidisciplinary research, innovations, scholarships and services to the society.

Department Mission:

- Set-up a mechanism for creating better quality professionals in Instrumentation and Control
- Engineering to match the needs of industries.
- Adapt systems and methods for meaningful collaboration with stakeholders.
- Take-up socially relevant and nationally important issues and problems as project assignments.
- Inculcate creativity, entrepreneurial attitude and values amongst learners.

Department of Instrumentation and Control Engineering

Faculty of Technology

Dharmsinh Desai University

For UG Program

Program Educational Objectives (PEOs)

PEO1: Core Competency: Students will be able to solve real world problems using foundation of mathematics and science.

PEO2: Breadth: Students will apply current industry accepted practices, new and emerging technologies to analyze, design, implement, and maintain the state-of-art solutions.

PEO3: Learning Environment: Enhance research capabilities through self-learning to assimilate and practice emerging theories and technologies.

PEO4: Professionalism: Inculcate professional and ethical attitude and ability to relate automation and control issues to society at large as well as exhibit teamwork and effective communication skills.

Program Specific Outcomes (PSOs)

PSO1: Design and deploy Instrumentation systems to enhance the performance of the industrial and real-life applications.

PSO2: Design innovative systems and control methodologies to cater the needs of the core industrial problems.

PSO3: Be successfully employed or accepted for higher studies and demonstrate a pursuit of lifelong learning.

Program Outcomes (POs)

On successful completion of the Program, engineering graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals to Instrumentation and Control discipline to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities.

PO6: 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.

PO7: 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.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

B. TECH. SEMESTER – V (IC)

SUBJECT: (IC-5XX) INSTRUMENTATION SOFTWARE TOOLS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Pract.	Total		Ext.	Sess.	TW	Pract.	Total
3	0	2	5	4	60	40	25	25	150

Type of Course: Program Elective Course – I (PEC)

Prerequisite: Basic knowledge of matrix algebra, computer programming, measurement and control theory

Rationale: The course provides learning of Simulation and GUI Designing software. Using simulation software, the students can design-develop models, study, analyze and solve engineering problems. Using GUI development platform, simple-effective-user friendly GUIs can be designed and implemented for need based custom application.

A. OBJECTIVES OF THE COURSE

- To enable students to design models and study their simulations to consolidate theoretical learning
- To enable students to design GUIs and develop their applications for human machine interactions
- To learn application of tools for experimentation, projects, etc. for implementation and detailed analysis

B. DETAILED SYLLABUS

Computing with Scilab

[A] Introduction to Scilab
The Scilab, Scilab architecture, Installation and setting up Scilab, Scilab environment, Syntax

[B] Scilab data types
Constants, Constant matrices, String matrices, Polynomials, Boolean operations, Matrix operations

[C] Programming with Scilab
Programming structures: Operators–General, Arithmetic, Conditional, Boolean type operators Structures–Conditional, Loop structures: FOR loop, DO WHILE Loop, Functions, Selected data types

[D] Graphics under Scilab
The graphics window, The media, Plotting parameters, 2D plotting, Graphics library

[E] Formatted Input and Output (Lab content)
Scilab environment, General display commands, Output commands, Input commands, Commands for files

Virtual Instrumentation using LabVIEW

[F] Graphical system design (Lab content)
Introduction, Graphical System Design (GSD) model, Design flow with GSD, Virtual Instrumentation, Virtual Instrument (VI) and Traditional Instrument, Hardware and software in VI, VI for test, control and design, GSD using LabVIEW, Graphical programming and textual programming

[G] Introduction to LabVIEW
Introduction, Advantages of LabVIEW, Software environment, Creating and saving a VI, Front panel toolbar, Block Diagram toolbar, Palettes – Tools, controls and functions palettes, Front Panel controls and indicators, Block diagram – terminals, nodes, functions, SubVIs, Express Vis and wires, Data types, Data flow diagram

[H] Modular Programming

Introduction, Modular programming in LabVIEW, Build a VI front panel and block diagram, Icon and connector pane, Creating an icon, Building a connector pane, Displaying SubVIs and express Vis as icons or expandable nodes, Creating SubVIs from sections of a VI, opening and editing SubVIs

[I] Repetition and Loops

Introduction, FOR loops, WHILE loops,

[J] Arrays

Introduction, Arrays in LabVIEW, Creating one-dimensional array controls, indicators and constants, Creating two-dimensional arrays

[K] Clusters

Introduction, Creating cluster controls, indicators and constants, Order of cluster elements, Cluster operations, Assembling-Disassembling clusters, Conversions between Arrays and Clusters

[L] Plotting data (Lab content)

Introduction, Types of waveforms, Waveform graphs, Waveform charts, Waveform data type, XY graphs

[M] Structures

Introduction, Case structures, Formula nodes

C. COURSE OUTCOMES

At the completion of the course, students will be able to:

i. understand the significance and application of an engineering simulation platform
ii. use open source SCILAB software platform and write text/graphical based simulation programs
iii. build models for simulation, study and analysis to suit customized requirements
iv. understand significance and application of an engineering Graphical User Interface (GUI) design platform
v. use LabVIEW software tools and write simple graphical programs
vi. build applications for remote data acquisition and monitoring to suit customized requirements

Mapping of CO's and PO's

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	●				●					●	●	●
ii	●	●	●		●	●			●	●		●
iii	●	●	●	●	●	●	●	●	●	●		●
iv	●				●					●	●	●
v	●	●	●		●	●			●	●		●
vi	●	●	●	●	●	●	●	●	●	●		●

Mapping of CO's and PO's (number grading)

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	3	0	0	0	3	0	0	0	0	1	1	1
ii	3	3	1	0	3	1	0	0	1	1	0	1
iii	3	3	3	2	3	1	1	1	1	1	0	1
iv	3	0	0	0	3	0	0	0	0	1	1	1
v	3	3	1	0	3	1	0	0	1	1	0	1
vi	3	3	3	2	3	1	1	1	1	1	0	1

D. RECOMMENDED TEXTBOOKS

[1] Virtual Instrumentation using LabVIEW, Jovitha Jerome, Prentice Hall of India
[2] Programming in Scilab 4.1 by Vinu V. Das, Newage Publication

E. REFERENCE BOOKS AND 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 and logical operators in Scilab
9. Graphical data presentation in Scilab
10. File handling in Scilab

B. TECH. SEMESTER – VI (IC)

SUBJECT: (IC-6XX) INSTRUMENTATION SYSTEMS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Pract.	Total		Ext.	Sess.	TW	Pract.	Total
3	0	2	5	4	60	40	25	25	150

Type of Course: Program Core Course (PCC)

Prerequisite: Basics of automatic control, Computer networking, Automation system design, Microprocessors

Rationale: This course provides useful information regarding standard P&I diagrams and their interpretation. The course also provides knowledge about development and application of computer network based automation systems (such as DCS) for automatic industrial process control. This course also provides useful information regarding industrial networking, modern telemetry solutions, standard instrument installation practices and safety instruments and related aspects.

A. OBJECTIVES OF THE COURSE

- To study, interpret, design, and apply P&I diagrams
- To study computer network based automation system (DCS) and related terminologies
- To learn standard instrument installation procedures, safety instruments and related aspects
- To familiarize with modern telemetry solutions

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] NETWORKING FUNDAMENTALS
Computer networking fundamentals and standards, Communication protocols, Concept of open architecture, DCS & Field bus, Introduction to OLE and OPC, PC based DCS, SCADA.

[C] INDUSTRIAL NETWORKING:
An introduction to networking in process automation, HART network, Foundation field bus network, PROFIBUS-PA, Infrared, Radio and Wireless LAN networks.

[D] 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 some popular DCS.

[E] 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.

[F] SAFETY DEVICES:
Pressure safety valves, pressure relief valves, pressure switch, rupture disc, flame arrester.

NOTE: Installation of various types of instruments to be covered in laboratory from Andrews Vol. II, Page No. 1 to 22

C. COURSE OUTCOMES

After completion of the course, students should be able to:

i. to understand, interpret, design and apply P&I diagrams
ii. to understand evolution and design of the architecture of the computer network based automation system (DCS) architecture, relevant terminologies, and different popular brands
iii. to study and understand recommended standard installation procedures for instruments, safety devices, and modern industrial telemetry systems

Mapping of CO's and PO's

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	●		●		●			●	●	●		●
ii	●		●		●			●	●	●		●
iii	●		●		●			●	●	●		●

Mapping of CO's and PO's (number grading)

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	3	0	3	0	3	0	0	1	1	1	0	1
ii	3	0	3	0	3	0	0	1	1	1	0	1
iii	3	0	3	0	3	0	0	1	1	1	0	1

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 AND NOTES

[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)

F. LIST OF EXPERIMENTS

1. Instrumentation Symbols, Coding, Diagrams, Graphics and their interpretation
2. Instrument Air Supply System: Compressor, Pressure Switch, Air Filter Regulator
3. Strip Chart Recorder
4. Current-to-Pressure Convertor (I/P Convertor)
5. Pressure-to-Current Convertor (P/I Convertor)
6. HART protocol and Smart transmitter
7. Interfacing of DP based Smart Flow Transmitter with Digital Flow Indicating Totalizer

8. Single Loop Programmable Controller (SLPC)
9. Supervisory Control And Data Acquisition System (SCADA)
10. Distributed Control System (DCS)

B. TECH. SEMESTER – V (IC)

SUBJECT: (IC-5XX) MODELING, SIMULATION, AND EVOLUTIONARY TECHNIQUES

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Pract.	Total		Ext.	Sess.	TW	Pract.	Total
3	0	2	5	4	60	40	25	25	150

Type of Course: Program Elective Course – I (PEC)

Prerequisite: Basic knowledge of matrix algebra, computer programming, measurement and control theory

Rationale: This course provides knowledge about modeling and simulation of various types of controllers. Using this learning, students can build and analyze different models of controllers and advanced control algorithms leading to intelligent process control strategies.

A. OBJECTIVES OF THE COURSE

To make the students

- describe importance and fundamental concepts, terminologies and applications of modeling, simulation and evolutionary techniques
- list and select system models, sets and fractals as per behavioral characteristics
- design and apply Fuzzy Logic Controller(s) (FLC), evaluate their performance and modify their design suitably as necessary
- describe simulation study, state and apply its step wise procedures, and analyze-select best-feasible models and study techniques
- explain Artificial Neural Network(s) (ANN), Genetic Algorithms (GA), state and apply step wise procedures for controller optimization

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] 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.

[C] FUZZY LOGIC CONTROL (FLC):

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] 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

[E] 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. COURSE OUTCOMES

After completion of the course students should be able to:

i. understand simulation based study and examine-choose suitable models and techniques
ii. design and apply Fuzzy Logic Controller(s) (FLC), evaluate their performance and modify their design suitably as necessary
iii. describe Artificial Neural Network(s) (ANN), Genetic Algorithms (GA); and list and apply step wise procedures for controller optimization

Mapping of CO's and PO's

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	●	●	●	●	●							●
ii	●	●	●	●	●							●
iii	●	●	●	●	●							●

Mapping of CO's and PO's (number grading)

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	3	3	2	3	1	0	0	0	0	0	0	1
ii	3	3	3	3	2	0	0	0	0	0	0	1
iii	3	3	3	3	2	0	0	0	0	0	0	1

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] Genetic Programming – On the Programming of Computers by Means of Natural Selection by John R. Koza, A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England.
[5] Process Control and Optimization, Instrument Engineer's Handbook, Volume II by Bela G. Liptak, 2006 Edition, Taylor and Francis, CRC Press, USA.
[6] Optimization of PID controller using Ant Colony and Genetic Algorithms by Unal, Tpuz and Erdal, 2013 edition, Springer
[7] Design of Fuzzy Controllers by Jan Jantzen, Tutorial Paper, Department of Automation, Technical University of Denmark, Denmark.
[8] Class Notes and Discussions in Theory and Laboratory Sessions

E. REFERENCE BOOKS AND NOTES

[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] M. Godoy Simoes, Bimal K. Bose and Ronald J. Spiegel, "Design and Performance Evaluation of a Fuzzy Logic based Variable Speed Wind Generation System", IEEE Trans. on Industry Applications, Vol. 33, pp. 956-965, July-Aug. 1997.
[4] Denn M. M., "Process Modelling", Longman, 1986.
[5] Holland C. D., "Fundamentals and Modelling of Separation Processes", Prentice Hall., 1975.

[6] Luyben W. L., "Process Modelling Simulation and Control for Chemical Engineers", 2nd Ed., McGraw Hill, 1990.
[7] Najim K., "Process Modelling and Control in Chemical Engineering", CRC, 1990.
[8] Aris R., "Mathematical Modelling, Vol. 1: A Chemical Engineering Perspective (Process System Engineering)", Academic Press, 1999.

F. LIST OF 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

B. TECH. SEMESTER – VII (IC)

SUBJECT: (IC-7XX) PROCESS CONTROL

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Pract.	Total		Ext.	Sess.	TW	Pract.	Total
3	0	2	5	4	60	40	25	25	150

Type of Course: Program Core Course (PCC)

Prerequisite: Basic control theory, control loop design, nature of industrial reactions and process parameters

Rationale: This course provides knowledge about conceptual and advanced level knowledge for development of industrial process control solutions. The course discusses in depth the nature and intricacies of different widely employed industrial equipments and their suggested control design schemes. In context with basic control algorithm of PID, the course provides useful knowledge regarding control strategies and advanced control strategies for solving complex industrial process control problems.

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), etc.

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

[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, Steam turbine controls, Heat exchanger controls

[E] CONTROL SCHEMES:
Ratio control, Cascade control, Feed-forward control, Inverse-derivative control, Split range control, etc.

[F] ADVANCED PROCESS CONTROL:
Advance Control Systems – Adaptive Control, Valve Position Control (VPC), etc.

C. COURSE OUTCOMES

After completion of the course students should be able to:

i. To understand the fundamental concepts of process control, characteristics and behavior of typical variable and loop, and complex process control
ii. learn operation of most widely used industrial equipments and their suggested control schemes
iii. develop awareness regarding limitations of basic PID control, and useful understanding of various control strategies and advance control strategies

Mapping of CO's and PO's

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	●	●	●	●								●
ii	●	●	●	●								●
iii	●	●	●	●								●

Mapping of CO's and PO's (number grading)

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	2	2	2	3	0	0	0	0	0	0	0	1
ii	3	3	3	3	0	0	0	0	0	0	0	1
iii	3	3	3	3	0	0	0	0	0	0	0	1

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 AND NOTES

[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

1. To study the response of a bare thermometer
2. To study the response of thermometer with thermo-well
3. To study the open loop response of a first order system
4. To study the open loop response of a 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 a first order mixing process
9. To study the response of transportation lag
10. To study the responses of single tank and two tank systems

B. TECH. SEMESTER – VII (IC)

SUBJECT: (IC-7XX) SMART INSTRUMENTATION

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Pract.	Total		Ext.	Sess.	TW	Pract.	Total
3	0	0	3	3	60	0	0	0	60

Type of Course: Open Elective Course (OEC)

Prerequisite: Basic concepts of sensing, measurement and telemetering techniques, microprocessors, etc.

Rationale: This course provides knowledge regarding different types of sensors and their usage for transducer design. The course also discusses usage of microprocessors for development of smart instrumentation and networking. Relevant international standards are also included in the discussion.

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

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

C. COURSE OUTCOMES

After completion of the course students should be able to:

i. develop awareness regarding sensor technologies, special types of sensors, and relevant terminologies
ii. familiarize regarding wired-wireless networking techniques along with relevant terminologies and technical specifications
iii. study IEEE 1451 family of standards with each sub-standard information and their application for smart transducers development

Mapping of CO's and PO's

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	●		●		●			●		●		●
ii	●		●		●			●		●		●
iii	●		●		●			●		●		●

Mapping of CO's and PO's (number grading)

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	1	0	2	0	3	0	0	1	0	3	0	1
ii	2	0	2	0	3	0	0	3	0	3	0	1
iii	3	0	2	0	3	0	0	2	0	3	0	1

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 AND NOTES

[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.

ADVANCED JAVA PROGRAMMING

(MCA 344)

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

COMPUTER NETWORKS AND SECURITY

(MCA 304)

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

The course aims to provide understanding of computer networks and data communication. It covers various networking devices, layered task and Open Systems Interconnection (OSI) model. The course introduces the learners to computer network security, information security and various cryptographic techniques.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Data Communications, Networks and Types of Networks, Protocols and Standards, Layered Tasks, The OSI Model, TCP/IP Protocol Suit	6	CO1
[2]	Analog and Digital Data, Analog and Digital Signals, Periodic and Non-periodic Signals , Sine Wave, Phase, Wavelength, Time and Frequency Domains, Composite Signals, Bandwidth, Bit Rate, Bit Length , Digital Signal as a Composite Analog Signal, Attenuation, Distortion, Noise Guided Media: Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable, Unguided Media: Radio Waves, Microwaves, Infrared.	6	CO3
[3]	Error Detection and Correction: Types of Errors, Redundancy, Detection Versus Correction, Forward Error Correction Versus Retransmission, Coding Block Coding: Error Detection, Error Correction, Hamming Distance, Minimum Hamming Distance Cyclic Codes: Cyclic Redundancy Check, Checksum: One's Complement, Internet Checksum Framing: Fixed-Size Framing, Variable-Size Framing, Connecting Devices: Passive Hubs, Repeaters, Active Hubs, Bridges, Two-Layer Switches, Routers, Three-Layer Switches, Gateway.	6	CO2
[4]	IPv4 Addresses: Address Space, Notations, Classful Addressing, Classless Addressing, Network, Address Translation (NAT) Need for Network Layer, Internet as a Datagram Network, Internet as a Connectionless Network IPv4: Segment Header Format, Datagram, Fragmentation, Checksum, Options IPv6: Advantages, Packet Format, Extension Headers Forwarding Techniques, Forwarding Process, Routing Table.	8	CO2
[5]	Process-To-Process Delivery: Client/Server Paradigm, Multiplexing and Demultiplexing, Connectionless Versus Connection-Oriented Service, Reliable Versus Unreliable User Datagram Protocol (UDP): Well-Known Ports for UDP, User Datagram Checksum, UDP Operation, Use of UDP	6	CO3

	TCP Services, TCP Features, Segment, Segment Header Format, A TCP Connection, Flow Control, Error Control, Congestion Contro		
[6]	Name Space: Flat Name Space, Hierarchical Name Space Domain Name Space, Distribution of Name Space: Hierarchy of Name Servers, Zone, Root Server, Primary and Secondary Servers, DNS in the Internet: Generic Domains, Country Domains, Inverse Domain, Resolution: Resolver, Mapping Names to Addresses, Mapping Address to Names, Recursive Resolution, Iterative Resolution, Caching, DNS Messages and Types of Records Introduction to Telnet, SMTP, FTP, WWW	6	CO3
[7]	Computer Security Concepts, Security Attacks, Security Services, Security Mechanisms, Techniques, Model for Network Security	4	CO1
[8]	Symmetric Encryption: Principles, Symmetric Block Encryption Algorithms (Data Encryption Standard, Triple DES, Advanced Encryption Standard), Random and Pseudorandom Numbers, Stream Ciphers and RC4, Cipher Block Modes of Operation Public Key Cryptography: Approaches to Message Authentication, Secure Hash Functions, Message Authentication Codes, Public-Key Cryptography Principles, Public-Key Cryptography Algorithms (RSA and Deffie-Hellman Exchange), Digital Signatures.	14	CO4
[9]	The Need For Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configurations	4	CO1

C. TEXT BOOKS

1. Behrouz Fourozan. *Data Communication and Networkin; 4th ed.;* Tata McGraw-Hill Publications
2. William Stallings. *Network Security Essentials By Applications and Standards; 4th ed*.; Pearson

D. REFERENCE BOOKS

1. Andrew S. Tanenbaum. *Computer Networks*; Prentice Hall Publications
2. William Stallings. *Cryptography and Network Security- Principles and Practice; 7th ed.;* Pearson
3. Behrouz A. Fourouzan. *Cryptography & Network Security*; *Special Indian Edition*; Tata McGraw-Hill
4. Atul Kahate. *Cryptography and Network Security;* Tata McGraw-Hill

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand Networking fundamentals and importance of Computer and Network security Practice Signals, error detection, correction and IP addressing
CO2	Apply	Practice Signals, error detection, correction and IP addressing
CO3	Understand	Interpret functionalities of OSI layers
CO4	Apply	Demonstrate the use of various Cryptographic techniques for secure communication over the networks.

F.COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	-	1	-	-	-	3	-	2	-	1	-	2
CO2	3	3	3	-	-	-	2	-	2	-	3	-	2
CO3	3	2	1	-	-	-	3	-	2	-	1	-	2
CO4	2	3	3	-	-	-	2	-	2	-	3	-	2
Avg	2.75	2	2	-	-	-	2.5	-	2	-	2	-	2

Mobile Application Development
(MCA 303)

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	-	-

WEB DEVELOPMENT WITH PHP

(MCA 302)

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

C. TEXT BOOKS

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

PYTHON PROGRAMMING

(MCA 331)

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 helps the learners build foundation in programming using Python. The course covers various Python standard libraries and object-oriented features. The course also covers working with Python modules, sequences, exception handling and interfacing databases.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Introduction to Python Programming Environment, Writing and Executing Basic Python Program. Data types: Built-in Types, str, bytes, Literals, type() function. Operators: Arithmetic, Assignment, Relational, Logical, Boolean, Bitwise, Membership, Identity. Input & Output statements, Command line arguments. Control Statements: if, else, elif, while, for, break, continue, pass, assert, return.	6	CO1 CO2
[2]	List: create, update, delete elements, list methods, indexing and slicing. Tuple: create, basic operations, functions to process tuple. Dictionary: create, update, delete elements, dictionary methods.	8	CO1
[3]	Difference between Function and Method, Create and Use Function, Return Multiple Results from Function, Pass by ObjectReference. Arguments: Positional, Keyword, Default, Variable length. Local and Global Variables, Global Keyword, Passing group of Elements to Function. Anonymous Functions: Using Lambdas with: filter(), map() and reduce()	10	CO1 CO2
[4]	Create Class and its Objects, Self variable, Constructor, Instance methods, Class methods, Static methods. Inheritance: Constructors in Inheritance, Overriding Super Class Constructors and Methods, super(), Method Overloading and Overriding. Abstract class, Interface.	8	CO1
[5]	Types of Errors, Exceptions, Handling Exceptions, Types of Exceptions, Assert and Except Statements.	4	CO1
[6]	Introduction, Working with MySQLdb module, Establish connection, Create database and table, CRUD operations, Invoke stored procedure.	6	CO1 CO3
[7]	Introduction: single and multi tasking, Difference between Process and Thread. Create Thread: Without Using a Class, Using a Thread Class. Thread Class Methods, Single Tasking Using a Thread, Multitasking	6	CO1

	Using Multiple Threads. Thread Synchronization, Communication between Threads.		
[8]	numpy arrays: zeros(), ones(), reshape(), hstack(), vstack(), arange(), linspace(), logspace(), asarray(), dot(), matmul(), indexing and slicing.	6	CO1 CO2
	pandas: Work with Series and Dataframe: create, delete rows and columns, index and select data, handle missing data, iterate over rows and columns matplotlib: Plotting- bar graph, histogram, pie chart, line graph.		CO3
[9]	Django Introduction, Setup environment, Create project, Life Cycle, Admin Interface, Create Views, Models, Page Redirection, Process Form.	6	CO4

C. TEXT BOOKS

1. R Nageswara Rao. *Core Python Programming; 2nd Edition*; Dreamtech press

D. REFERENCE BOOKS

1. https://www/djangoproject.com
2. John V Guttag. *Introduction to Computation and Programming Using Python; 6th edition*; Prentice Hall of India
3. Sanjeev Jaiswal and Ratan Kumar. *Learning Django Web Development*; PACKT

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Create	Create Basic Desktop Applications using Python Programming Language
CO2	Create	Develop Scientific Programs using numpy and pandas
CO3	Apply	Plot Diversified Charts
CO4	Create	Create Basic Web Applications using Django Framework

F.COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3	2	2	-	2	-	2	1	2	1	2
CO2	3	3	2	2	3	-	2	-	2	3	2	3	2
CO3	2	1	1	2	3	-	2	-	2	1	2	2	2
CO4	2	2	2	2	2	-	2	-	2	3	2	2	2
Avg	2.5	2	2	2	2.5	-	2	-	2	2	2	2	2

SOFTWARE DESIGN AND TESTING

(MCA 301)

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	3	CO5

	Testing Techniques.		
[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

C. TEXT BOOKS

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	-	-	-	-

Dharmsinh Desai University, Nadiad-387001.

Minutes for Academic Council Meeting
25th April 2019 at 11.00 am

Following members were present in the meeting:

1)Dr H M Desai 2)Prof D G Panchal 3) Dr B N Suhagia 4) Dr R N Misra 5) Dr Ravindra Dholakia 6) Dr N K Patel 7) Dr Hiren Patel 8) Dr J G Buch 9)Prof R K Jain, Registrar (Member Secretary)

1.It was resolved to consider the Minutes of the last meeting held on 27th December 2018 at 11.00 am approved since there was no written dissent received.

2.The Academic Council members discussed, deliberated and resolved to take on record the following agenda and proposals from those received from various Board of Studies :

2.1. **Faculty of Technology** :

2.1.1.1 Department of Chemical Engineering

B.Tech. :

1) It was resolved to update the content of "Chemical Engineering Material and Safety " subject of Semester VII and renaming the subject as "Chemical Process Safety"

2) It was resolved to approve Panel of examiners for B Tech and M Tech program.

M.Tech. :

1) It was resolved to approve introducing new subject "Research Methodology and Professional Communication" at MTech Semester III as per AICTE Guidelines.

Details given in Annexure- I

2.1.1.2 Department of Civil Engineering

B.Tech. :

1) It was resolved to approve detailed and updated syllabus for Semester VII as per CBCS.

2) It was resolved that the Industrial Training Program remains unaltered at Semester VIII

Details given in Annexure-II

2.1.1.3 Department of Electronics and Communication

B.Tech. :

1) It was resolved to shift laboratory hours of Audio Video Engineering subject (lab) from Semester VI to Semester IV

2) It was resolved to approve introduction of new subject Automated Electronics at Semester VI

Details given in Annexure - III

2.1.1.4 Department of Instrument & Control

M.Tech. :

1)It was resolved to approve detailed Syllabus of subject "Digital Control System" at Semester-I Which was introduced in place of Advanced Digital Signal Processing subject as per approval in previous AC meeting.

2)It was resolved to approve introduction of "Pedagogic Practice" at M Tech Semester-II

3)It was resolved to approve introduction of new audit courses as per AICTE Guidelines.

Details given in Annexure-IV

2.1.1.5 Department of Information Technology

B.Tech. :

1) It was resolved to approve changes in the list of Experiments to be performed at Semester III in the subject "Computer Peripherals"

2) It was resolved to approve updating of topics and changes in the list of Experiments to be performed at Semester VII in the subject "E-Commerce & E-Security"

3) It was resolved to approve updating of topics and changes in the list of Experiments to be performed at Semester VII in the subject "Distributed Computing"

4) It was resolved to approve changes in the list of Experiments to be performed at Semester VII in the subject "Data Analysis and Information Extraction"

Details given in Annexure-V

2.1.1.6 Department of Mechanical Engineering

B.Tech. :

1) It was resolved to offer two different subjects of Mechanical engineering department at B Tech Sem I(CH/CL/MH/IC) and B Tech Sem I (EC/CE/IT) as under:

	B Tech (CH/CL/MH/IC)	B Tech (EC/CE/IT)
Semester I	Elements of Mechanical Engg	Engineering Graphics
Semester II	Engineering Graphics	Elements of Mechanical Engg

2)It was resolved to approve change of name of subject Heat Power to Elements of Mechanical Engineering B Tech First Year program

3)It was resolved to approve shifting of subjects as under:

Two subjects Production Technology and Mechanical Vibrations are shifted from Semester VI to Semester VII.

4)It It was resolved to approve introduction of new subject "production Planning and Control" at

B Tech Semester VII

5)It It was resolved to approve teaching scheme for all subjects at Semester VII made

3 Lectures/ week instead of 4 Lectures/week

6)It It was resolved to approve Course Structure of Elective III & IV 3-0-2

(Lectures-Tutorial-Practical)

M.Tech. :

1) It was resolved to approve introduction of subject Research Methodology & IPR at Semester I

2) It was resolved to exclude Laboratory Hours at Semester I in the subject "Advanced Machine Design" laboratory part is excluded.

3) It was resolved to approve change in teaching scheme at Semester I in the subject "Computer Aided Production Management" teaching scheme changed from 4-0-0 to 3-0-2

Details given in Annexure-VI

2.2 Faculty of Management & Information and Sciences:

2,2,1 Master of Computer Applications : (Refer Annexure VII for Details)

1. It was resolved approve new as well as revised syllabus for M C A in following Subjects Batch 2018-10 wef 2020 21
   - MCA Sem.-V : Software Testing
   - MCA Sem.-V : Mobile Application Development
   - MCA Sem.-V : Intelligent Systems
   - MCA Sem.-V : Service Oriented Architecture
   - MCA Sem.-V : Remote Sensing and GIS
   - MCA Sem.-V : Image Processing
   - MCA-Semester-II: Computer Graphics
   - Introduction of New subject Agile Methodology and Python Programming at MCA-Semester-III: Batch 2018-19 wef 2019-20

- Proposed modifications in syllabus contents of following subjects (teaching scheme w.e.f. 2018-19) were found suitable:
  - MCA-Semester-I: Linux Environment
  - MCA-Semester-I: Data Communication and Networking
- Approved modification in Teaching Scheme of 2018-19

Sr.	Semester	Subject	Semester
1	III	Operations Research	Semester – III
2	III	Agile Methodology and Python Programming	N/A (new subject)
3	V	Machine Learning	N/A (new subject)
4	V	Image Processing	Semester – V
5	V	Software Architecture and UI Design	Semester – V

- It was resolved to approve following Names of External Examiners in the Panel of Examiners:
  1. Mr Sandeep Kumar Das – Project Manager, Samyak Infotech Pvt. Ltd., Ahmedabad.
  2. Mr Shailesh Patel – IT Consultant, Ahmedabad.

2.3 Faculty of Pharmacy:

2.3.1 It was resolved to approve teaching scheme and syllabus for B Pharm semester V and VI as recommended by Pharmacy Council of India (Refer Annexure VIII for Details)

B. PHARM SEMESTER-V

Table-V: Course of study for semester V

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP501T	Medicinal Chemistry II – Theory	3	1	4
BP502T	Industrial PharmacyI– Theory	3	1	4
BP503T	Pharmacology II – Theory	3	1	4
BP504T	Pharmacognosy and Phytochemistry II– Theory	3	1	4
BP505T	Pharmaceutical Jurisprudence – Theory	3	1	4
BP506P	Industrial PharmacyI – Practical	4	-	2
BP507P	Pharmacology II – Practical	4	-	2
BP508P	Pharmacognosy and Phytochemistry II – Practical	4	-	2
	Total	**27**	**5**	**26**

B. PHARM SEMESTER-VI

Table-VI: Course of study for semester VI

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP601T	Medicinal Chemistry III – Theory	3	1	4
BP602T	Pharmacology III – Theory	3	1	4
BP603T	Herbal Drug Technology – Theory	3	1	4
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	3	1	4
BP605T	Pharmaceutical Biotechnology – Theory	3	1	4
BP606T	Quality Assurance –Theory	3	1	4
BP607P	Medicinal chemistry III – Practical	4	-	2
BP608P	Pharmacology III – Practical	4	-	2
BP609P	Herbal Drug Technology – Practical	4	-	2
	Total	**30**	**6**	**30**

2.3.2 It was resolved to approve the Panel of Examiners for B Pharm and M Pharm program.(AnnexureIX)

2.4 Faculty of Medical Sciences and Research:

2.4.1 It was resolved to approve Rules and Regulations for ensuing M B B S Program from Academic Year 2019-20 as under:

ACADEMIC RULES AND REGULATIONS: M.B.B.S.

[Note: These rules are based on GME Notifications of MCI up to May-2018 and will require amendment in case the GME is amended]

RMBBS 1.

Admission, selection, counseling, migration and training of MBBS students shall be in accordance with the "Regulations on Graduate Medical Education, 1987" and its amendments from time to time and Admission Rules of Govt. of Gujarat.

RMBBS 2.

Training period and time distribution:

(1) Every student shall undergo aperiod of certified study extending over 4½academic years divided into 9 semesters, (i.e.of 6months each from the date of commencement of his study for the subjects comprising the medical curriculum to the date of completion of the examination and followed by one year compulsory rotating internship. Each semester will consist of approximately 120 teaching day so 8hours each college working time including one hour of lunch.

(2) Theperiodof4½ years is divided into three phases as follows:-

a) **Phase-1**(two semesters) –consisting of Pre-clinical subjects (Human Anatomy, Physiology including Bio-Physics, Bio- chemistry and introduction to Community Medicine including Humanities).

b) **Phase-II** (3 semesters) -consisting of para-clinical/clinical subjects.
During this phase teaching of para-clinical and clinical subjects shall be done concurrently.

The para-clinical subjects shall consist of Pathology, Pharmacology, Microbiology, Forensic Medicine Toxicology and part of Community Medicine.
TheclinicalsubjectsshallconsistofallthosedetailedbelowinPhaseIII.

c) **Phase-III** (Continuation of study of clinical subjects for seven semesters after passing Phase-I)

The clinical subjects to be taught during Phase II &III are Medicine and its allied specialties, Surgery and its allied specialties, Obstetrics and Gynaecology and Community Medicine.

The Medicine and its allied specialties training will include General Medicine, Paediatrics, Tuberculosis and Chest, Skin and Sexually Transmitted Diseases, Psychiatry, Radio-diagnosis, Infectious diseases etc. The Surgery and its allied specialties training will include General Surgery, Orthopaedic Surgery including Physio-therapy and Rehabilitation, Ophthalmology, Otorhinolaryngology, Anaesthesia, Dentistry, Radio-therapy etc. The Obstetrics &Gynaecology training will include family medicine, family welfare planning etc.

RMBBS 3.

(a) Passing in Ist Professional is compulsory before proceeding to Phase II training.
(b) A student who fails in the II nd professional examination is allowed to continue studies in 3rd MBBS, however he is not allowed to appear IIIrd Professional Part I examination unless he passes all subjects of II nd Professional examination.
(c) Passing in III rd Professional(Part I) examination is not compulsory before entering for 8th &9th semester training, however passing of III rd Professional (Part I) is compulsory for being eligible for III rd Professional (Part II) examination.

RMBBS 4.

Prescribed Teaching Hours:-

Pre-Clinical Subjects:(Phase-1-FirstandSecondSemester)

Anatomy	650 Hrs.
Physiology	480Hrs.
Biochemistry	240 Hrs.
Community Medicine	60Hrs.

RMBBS 5.

ATTENDANCE: 75% attendance in a subject for appearing in the examination is compulsory inclusive of attendance in non-lecture teaching i.e. seminars, group discussions, tutorials, demonstrations, practical , hospital (Tertiary Secondary, Primary) posting and bedside clinics etc."

RMBBS 6.

Internal Assessment:

(i)It shall be based on day to day assessment, evaluation of student assignment, preparation for seminar, clinical case presentation etc.
(ii)Regular periodical examinations shall be conducted throughout the course. The questions of number of examinations is left to the Institution.
(iii) Day to day records should be given importance during internal assessment
(iv)Weightage for the internal assessment shall be 20% of the total marks in each subject
(v)student must secure at least 35% marks of the total marks fixed for internal assessment in a particular subject in order to be eligible to appear in final university examination of that subject."

RMBBS 7.

DISTRIBUTIONOFMARKS:

(A) First Professional examination:(Pre- clinical Subjects):

(a) **Anatomy**:

Theory-Two papers of 50markseach
(One applied question of 10marks in each paper) 100marks.

Oral(Viva) 20marks
Practical 40marks

Internal Assessment
(Theory-20;Practical-20) 40marks
Total 200marks

Details of Internal Assessment Marks Calculation:		
	Theory (Total 20)	Practical (Total 20)
1st Terminal Exam	5	5
Preliminary Exam	7.5	7.5
Day to Day Evaluation	7.5	7.5
TOTAL	20	20
Details of Day to Day Evaluation Calculation:		
1stPart Ending Test	1	1
2ndPart Ending Test	1	1
3rdPart Ending Test	1	1
4thPart Ending Test	1	1
5thPart Ending Test	1	1
6thPart Ending Test	1	1
Attendance, Seminar, Quiz etc	1.5	-
Attendance, Journal, Viva	-	1.5

(b) **Physiology including Biophysics**

Theory-Two papers of 50 marks each
(One applied question of 10marks in each paper) 100marks
Oral(Viva) 20marks
Practical 40marks
Internal Assessment
(Theory-20;Practical-20) 40marks
Total 200marks

Details of Internal Assessment Marks Calculation:		
	Theory (Total 20)	Practical (Total 20)
1st Terminal Exam	5	5
Preliminary Exam	7.5	7.5
Day to Day Evaluation	7.5	7.5
TOTAL	20	20
Details of Day to Day Evaluation Calculation:		
1st Periodic Test	1.5	1.5
2nd Periodic Test	1.5	1.5
3rd Periodic Test	1.5	1.5
4th Periodic Test	1.5	1.5
Attendance, Seminar, Quiz etc	1.5	-
Attendance, Journal, Viva	-	1.5

(c) **Biochemistry**:

Theory- Two papers of 50marks each
(One applied question of 10marks in each paper) 100marks
Oral(Viva) 20 marks
Practical 40marks
Internal Assessment
(Theory-20;Practical-20) 40marks
Total 200marks

Details of Internal Assessment Marks Calculation:		
	Theory (Total 20)	Practical (Total 20)
1st Terminal Exam	5	5
Preliminary Exam	7.5	7.5
Day to Day Evaluation	7.5	7.5
TOTAL	20	20

Details of Day to Day Evaluation Calculation:		
1st Periodic Test	1.5	1.5
2nd Periodic Test	1.5	1.5
3rd Periodic Test	1.5	1.5
4th Periodic Test	1.5	1.5
Attendance, Seminar, Quiz etc	1.5	-
Attendance, Journal, Viva	-	1.5

2.4.2 It was resolved to approve curriculum for First Year M B B S program based on GME Notifications of MCI up to May-2018 and will require amendment in case the GME is amended (Annexure x)

3.0 Research Program (Ph D): It was resolved to award Ph D degree on recommendations of all the three referees to the following student:

1 .Name of Research Scholar : Ms Reshu Gupta
Thesis Title: Development and Characterization of Carbonic Anhydrase Inhibitor based Opthalmic Nanoemulsion for Treatment of Ocular Hypertension.
Name of Guide: Dr Tejal G Soni,Professor, Faculty of Pharmacy D D University, Nadiad

4.0 The chair thanked all the members for their participation and valuable contribution.

PRODUCTION PLANNING AND CONTROL (MH711)

Teaching Scheme (Hours)			Examination Scheme					Credit Structure			
Lect	**Tut**	**Prac**	**Theory**	**Sess.**	**TW**	**Prac**	**Total**	**Lect**	**Tut**	**Prac**	**Total**
3	0	0	60	40	0	0	100	3	0	0	3

DETAILED SYLLABUS

Sr. No.	Contents
1	**PLANT LOCATION SELECTION AND LAYOUT** Types of Production System; Introduction, Objectives and Functions of Production Planning & Control; Importance of Plant Location; Choice of site for selection; Introduction to Plant Layout; Types of Plant Layout – Product, Process, Fixed Position and Cellular.
2	**FORECASTING MODELS** Nature and use of forecast, Different forecasting methods: Qualitative and Quantitative.
3	**AGGREGATE PLANNING AND MATERIAL PLANNING** Introduction to Aggregate planning strategies, Aggregate planning methods, Master production plan; Master Production Schedule (MPS); Materials Requirement Planning (MRP); Lot sizing in MRP Systems.
4	**PRODUCTION SCHEDULING** Techniques of Scheduling: Gantt Chart, Sequencing, Single Machine Scheduling, Flow Shop Scheduling, Job Shop Scheduling.
5	**WORK STUDY** Method Study: Objectives and procedure for methods analysis, recording techniques, Micro motion and macro-motion study; Principles of motion economy, Work Measurement: Objectives, Work measurement – time study, Determination of time standards: Observed time, basic time, normal time, rating factors, allowances, and standard time.
6	**LINE BALANCING AND STAISTICAL QUALITY CONTROL** Concept of mass production system, Objective of assembly line balancing, Rank positional weight method. SQC Concept, variable and attributes, introduction of control charts, and acceptance sampling.

TEXT BOOKS

1. Industrial Engineering and Production Management, M. Mahajan, Dhanpat Rai Publication.
2. Industrial Engineering and Production Management, Martand Telsang, S. Chand Publication.
3. Industrial Engineering, L. C. Jhamb, Everest Publishing House.
4. Production and Operation Management, R. Paneerselvam, PHI Publication

REFERENCE BOOKS

1. Modern Production Management, Buffa, John Willey Publication.
2. Theory and Problems in Production and Operation Management, S. N. Chary, Tata-McGraw Hill Publication.
3. Introduction to Work Study, G. Kanawaty, ILO Geneva
4. Industrial Engineering, V. Deshpande, M. Gor and J. Ravalji, Ria Publishing House

COURSE OUTCOMES

After successful completion of the course, students will be able to;

CO1 Understand various functions of Production Planning and Control, types of production system, and types of plant layout.
CO2 Apply suitable method for demand forecasting.
CO3 Evaluate various strategies for aggregate planning and material planning.
CO4 Apply suitable scheduling technique for given production process flow and time.
CO5 Understand tools of method study and time study for productivity improvement.
CO6 Remember important terms for Line Balancing problem and basic of Statistical Quality Control tools.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	-	-	3	-	-	-	-	-	-	-	-	-	2	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	2	3	-
CO4	2	-	-	3	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	-	-	3	-	-	-	-	-	-	3	-	-
CO6	2	-	3	-	-	-	-	-	-	-	-	-	3	-	-

1-Slightly; 2-Moderately; 3-Substantially

(MM114) – RESEARCH METHODOLOGY AND IPR

Teaching Scheme			Examination Scheme					Credit Structure			
Lec	Tu	Pra	Theor	Ses	T	Pra	Tota	Lec	Tut	Pra	Total
1	0	2	-	-	10	-	100	1	0	1	2

1. **OBJECTIVES OF THE COURSE**

A. The primary objective of this course is to develop a research orientation among the scholars and to acquaint them with fundamentals of research methods. Specifically, the course aims at introducing them to the basic concepts used in research and to scientific social research methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis. Understand research problem formulation, analyze research related information, and follow research ethics.

B. To develop an understanding of various research designs and techniques.

C. To identify various sources of information for literature review and data collection.

D. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular, Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

2. **DETAILED SYLLABUS**

1 Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

2 Unit 2

Effective literature studies approaches, analysis Plagiarism, Research ethics

3 Unit 3

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review

4 Unit 4

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT

5 Unit 5

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications

6 Unit 6

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Bio logical Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and

3. **LEARNING OUTCOME**

A. Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.
B. Have basic knowledge on qualitative research techniques.
C. Have adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis.
D. Have basic awareness of data analysis-and hypothesis testing procedures.
E. Develop understanding of the basic framework of research process.
F. Understand about the Property Rights, Licensing and respective tools.

4. **REFERENCE BOOKS**

7. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
8. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
9. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
10. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007
11. Mayall , "Industrial Design", McGraw Hill, 1992
12. Niebel, "Product Design", McGraw Hill, 1974
13. Asimov , "Introduction to Design", Prentice Hall, 1962
14. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016
15. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

B. TECH. SEMESTER – V (IC)

SUBJECT: (IC-5XX) MODELING, SIMULATION, AND EVOLUTIONARY TECHNIQUES

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect.	Tut	Pract.	Total		Ext.	Sess.	TW	Pract.	Total
3	0	2	5	4	60	40	25	25	150

Type of Course: Program Elective Course – I (PEC)

Prerequisite: Basic knowledge of matrix algebra, computer programming, measurement and control theory

Rationale: This course provides knowledge about modeling and simulation of various types of controllers. Using this learning, students can build and analyze different models of controllers and advanced control algorithms leading to intelligent process control strategies.

A. OBJECTIVES OF THE COURSE

To make the students

- describe importance and fundamental concepts, terminologies and applications of modeling, simulation and evolutionary techniques
- list and select system models, sets and fractals as per behavioral characteristics
- design and apply Fuzzy Logic Controller(s) (FLC), evaluate their performance and modify their design suitably as necessary
- describe simulation study, state and apply its step wise procedures, and analyze-select best-feasible models and study techniques
- explain Artificial Neural Network(s) (ANN), Genetic Algorithms (GA), state and apply step wise procedures for controller optimization

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] 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.

[C] FUZZY LOGIC CONTROL (FLC):

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] 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

[E] 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. COURSE OUTCOMES

After completion of the course students should be able to:

i. understand simulation based study and examine-choose suitable models and techniques
ii. design and apply Fuzzy Logic Controller(s) (FLC), evaluate their performance and modify their design suitably as necessary
iii. describe Artificial Neural Network(s) (ANN), Genetic Algorithms (GA); and list and apply step wise procedures for controller optimization

Mapping of CO's and PO's

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	●	●	●	●	●							●
ii	●	●	●	●	●							●
iii	●	●	●	●	●							●

Mapping of CO's and PO's (number grading)

POs COs	A	B	C	D	E	F	G	H	I	J	K	L
i	3	3	2	3	1	0	0	0	0	0	0	1
ii	3	3	3	3	2	0	0	0	0	0	0	1
iii	3	3	3	3	2	0	0	0	0	0	0	1

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] Genetic Programming – On the Programming of Computers by Means of Natural Selection by John R. Koza, A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England.
[5] Process Control and Optimization, Instrument Engineer's Handbook, Volume II by Bela G. Liptak, 2006 Edition, Taylor and Francis, CRC Press, USA.
[6] Optimization of PID controller using Ant Colony and Genetic Algorithms by Unal, Tpuz and Erdal, 2013 edition, Springer
[7] Design of Fuzzy Controllers by Jan Jantzen, Tutorial Paper, Department of Automation, Technical University of Denmark, Denmark.
[8] Class Notes and Discussions in Theory and Laboratory Sessions

E. REFERENCE BOOKS AND NOTES

[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] M. Godoy Simoes, Bimal K. Bose and Ronald J. Spiegel, "Design and Performance Evaluation of a Fuzzy Logic based Variable Speed Wind Generation System", IEEE Trans. on Industry Applications, Vol. 33, pp. 956-965, July-Aug. 1997.
[4] Denn M. M., "Process Modelling", Longman, 1986.
[5] Holland C. D., "Fundamentals and Modelling of Separation Processes", Prentice Hall., 1975.

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F. LIST OF 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