PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018
(AUTONOMOUS)
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
B. Tech PHARMACEUTICAL TECHNOLOGY
CURRICULUM
(Applicable to the candidates admitted during the academic year 2023-2024 onwards)

SEMESTER III							
S.No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
Theory							
1	BS	MA23301	Transform Techniques and Partial Differential Equations	3	1	0	4
2	PC	PT23301	Material and Energy Balance Computations	3	0	0	3
3	PC	PT23302	Pharmaceutical Chemistry	3	0	0	3
4	PC	PT23303	Physical Pharmaceutics	3	0	0	3
5	MC	MC23301	Environmental Sciences and Sustainability	2	0	0	0
Theory Cum Practical							
6	ES	PT23304	Fluid Mechanics and Mechanical Unit Operations	3	0	2	4
Practical							
7	PC	PT23305	Pharmaceutical Chemistry Laboratory	0	0	4	2
8	PC	PT23306	Physical Pharmaceutics Laboratory	0	0	4	2
9	EE	GE23301	Professional Development I	0	0	2	1
			TOTAL	**17**	**1**	**12**	**22**

SEMESTER IV							
S.No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
Theory							
1	BS	MA23403	Probability and Statistics	3	1	0	4
2	PC	PT23401	Pharmaceutical Analysis	3	0	0	3
3	PC	PT23402	Technology of Dosage Forms	3	0	0	3
4	PC	PT23403	Human Anatomy and Physiology	3	0	0	3
5	MC	MC23402	Human Values and Gender Equality	2	0	0	0
Theory Cum Practical							
6	PC	PT23404	Cell and Molecular Biology	3	0	2	4
Practical							
7	PC	PT23405	Pharmaceutical Analysis Laboratory	0	0	4	2
8	PC	PT23406	Technology of Dosage Forms Laboratory	0	0	4	2
9	EE	GE23401	Professional Development II	0	0	2	1
			TOTAL	**17**	**1**	**12**	**22**

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Pharmaceutical Technology
7/5/24
AUTONOMOUS

MA23301	TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS	3	1	0	4

(Common to Aero, Agri, BME, Biotech, Civil, Chemical, EEE, Food, Pharma, Mech, MCT, R&A)

COURSE OBJECTIVES

To enable the students to

1.	develop the knowledge of periodic and non-periodic functions and their representations using Fourier series.
2.	acquaint the student with Fourier transform techniques used in wide variety of situations.
3.	introduce the basic concepts of PDE for solving standard partial differential equations.
4.	acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
5.	develop Z transform techniques for discrete time systems.

UNIT I	FOURIER SERIES	12

Dirichlet's conditions; General Fourier series; Odd and even functions; Half range series; Statement of Complex form of Fourier series; Parseval's identity; Harmonic analysis.

UNIT II	FOURIER TRANSFORMS	12

Fourier integral theorem (without proof); Fourier transform pair; Sine and cosine transform - Properties; Transforms of elementary functions; Convolution theorem; Parseval's identity.

UNIT III	PARTIAL DIFFERENTIAL EQUATIONS	12

Formation of partial differential equations; Lagrange's linear equation; Solutions of four standard types of first order partial differential equations; Linear partial differential equations of second order with constant coefficients.

UNIT IV	FOURIER SERIES SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS	12

Solutions of One-dimensional wave and heat equation; Steady state two-dimensional heat equation.

UNIT V	Z -TRANSFORMS AND DIFFERENCE EQUATIONS	12

Z-transforms - Elementary properties; Inverse Z-transform; Method of partial fraction ; Residue method; Convolution theorem; Solution of difference equations by Z-transform.

	TOTAL PERIODS	60

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	classify the properties of periodic and non-periodic vibrations with the help of Fourier series.	Applying (K3)
CO2	apply the Fourier transform to convert the function from frequency domain to time domain.	Applying (K3)
CO3	demonstrate partial differential equations that occur in many engineering applications.	Applying (K3)
CO4	apply Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.	Applying (K3)
CO5	apply knowledge of Z transform to analyse linear time invariant systems.	Applying (K3)

TEXT BOOKS

1. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second Edition, Reprint, 2012.
2. Grewal. B.S, "Higher Engineering Mathematics", Forty fourth Edition, Khanna Publications, New Delhi, 2018.

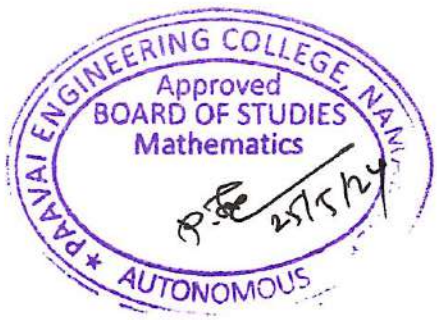
REFERENCES

1. Erwin Kreyszig, "Advanced Engineering Mathematics ", Tenth Edition, Wiley Publications, New Delhi, India, 2016.
2. Ramana. B.V., "Higher Engineering Mathematics", Tata Mc Graw Hill Publishing Company limited, New Delhi 2010.
3. Glyn James, "Advanced Modern Engineering Mathematics", Third Edition, Pearson Education 2007.
4. Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics", Tata Mc-Graw Hill Publishing Company limited, Sixth Edition, New Delhi, 2012.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	2	-	-	-	-	-	-	-	3	1	3
CO2	2	3	3	2	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	2	-	-	-	-	-	-	-	2	2	3
CO4	3	3	3	2	-	-	-	-	-	-	-	2	2	3
CO5	2	3	2	2	-	-	-	-	-	-	-	2	2	3



PT23301	MATERIAL AND ENERGY BALANCE COMPUTATIONS	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	understand the different system of units and conversion of systems
2.	acquire knowledge about ideal gas equation related to vapour and partial pressure
3.	study about the psychometric chart and calculate various attributes related to humidity
4.	learn the fundamentals of material balance for various unit operations
5.	Solve the concepts related combustion and energy balance

UNIT I	UNITS AND DIMENSIONS	9

Fundamental and derived units - Conversion, Dimensional consistency of equations, Conversions of equations; Dimensional and Dimensionless constants, Mass and Volume relations; Stoichiometric and Composition relations.

UNIT II	IDEAL GASES AND VAPOUR PRESSURE	9

Ideal gas law, Dalton's Law, Amagat's Law and Average Molecular Weight of Gaseous Mixtures; Effect of Temperature on Vapour Pressure, Vapour Pressure plot (Cox chart), Vapour Pressures of Miscible and Immiscible Liquids and Solutions, Raoult's Law and Henry's Law.

UNIT III	HUMIDITY AND SOLUBILITY	9

Partial saturation; Humidity- Absolute Humidity, Vaporization Process, Molal Humidity; Relative and Percentage Saturation, Dew Point, Humid Heat, Wet Bulb and Dry Bulb Temperatures; Use of Humidity charts; Adiabatic Vaporization and Adiabatic Saturation Temperature.

UNIT IV	MATERIAL BALANCE	9

Tie Substance - Limiting reactant, Excess reactant; General Material Balance Equation for Steady and Unsteady State; Typical Steady State Material Balances in Distillation, Absorption, Extraction, Crystallization; Combustion of Coal, Fuel Gases and Sulphur – Recycling Operations – Bypassing Streams – Degree of Conversion – Excess Reactant – Limiting Reactant – Selectivity and Yield.

UNIT V	ENERGY BALANCE	9

General Steady State Energy Balance Equation, Heat Capacity, Enthalpy, Heat of Formation, Heat of Reaction, Heat of Combustion and Calorific Values; Heat of Solution, Heat of Mixing, Heat of Crystallization, Determination of ΔHR at Standard and Elevated Temperatures; Theoretical Flame Temperature and Adiabatic Flame Temperature.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	apply the different system of units appropriately and convert one system from another.	Applying (K3)
CO2	evaluate problems based on ideal gases and using other laws	Analyzing (K4)
CO3	solve problems related to humidification and to use the humid chart	Analyzing (K4)

CO4	apply their knowledge about material balance in various chemical engineering operations	Applying (K3)
CO5	gain extensive knowledge on conversion and percent yield for single and multiple chemical reactions	Understanding (K2)

TEXT BOOKS

1. Narayanan, K.V. and Lakshmikutty, B. Stoichiometry and Process Calculations, 2nd Edition., PHI Learning Pvt. Ltd, 2017
2. Gavahane, K. A. Introduction to Process Calculations, Nirali Publication, 2016.

REFERENCES

1. Bhatt, B.I. and Thakore, S.M. Stoichiometry, 5th Edition, Tata McGraw Hill Education Pvt. Ltd, 2011.
2. Hougen, O. A., Watson, K. M., Ragatz, R. A., "Chemical Process Principles, Part-I Material & Energy Balances", Second Edition, CBS Publishers & Distributors, 2004
3. Venkataramani, V, Anantharaman, N and Meera Sheriffa Begum K. M. Process Calculations, 2nded.PHI Learning Pvt. Ltd, 2011
4. Himmelblau, D. M. and Riggs,B.J. Basic Principles and Calculations in Chemical Engineering, 8thEdition, Prentice Hall International series, 2012.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	-	-	1	-	-	-	1	3	2
CO2	3	3	3	2	1	-	-	1	-	-	-	1	3	2
CO3	3	2	2	2	1	-	-	1	-	-	-	1	3	2
CO4	3	2	3	2	1	-	-	1	-	-	-	1	3	1
CO5	-	-	2	1	3	1	-	-	-	1	-	-	-	1

PT23302	PHARMACEUTICAL CHEMISTRY	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	understand the basic concepts of chemical bonding, molecular geometry, hybridization, and the impact of intermolecular forces on pharmaceutical properties.
2.	describe the structure, nomenclature, properties, synthesis, and reactions of aliphatic, aromatic, and heteroaromatic compounds.
3.	apply common tests for purity and utilize chromatographic and spectroscopic methods to ensure pharmaceutical substance quality.
4.	analyse the mechanisms of organic reactions, including substitution, addition, elimination, and rearrangement reactions and apply them in pharmaceutical synthesis.
5.	understand the types, functions, and applications of pharmaceutical excipients and describe the nomenclature, isomerism, stability, and pharmaceutical applications of coordination compounds.

UNIT I	INTRODUCTION TO PHARMACEUTICAL CHEMISTRY	9

Introduction to pharmaceutical chemistry: scope and significance, Chemical bonding and molecular structure, Molecular geometry and hybridization, Intermolecular forces and their impact on properties, Structure-property relationships in pharmaceutical compounds

UNIT II	ORGANIC CHEMISTRY: ALIPHATIC, AROMATIC, AND HETERO AROMATIC COMPOUNDS	9

Overview of aliphatic, aromatic, and hetero aromatic compounds, Structure, nomenclature, and properties of alkanes, alkenes, alkynes, Aromaticity: benzene and its derivatives, Chemistry of heterocyclic compounds: pyridine, pyrimidine, purine, Synthesis and reactions of representative compounds in each class

UNIT III	PURITY IN PHARMACEUTICALS	9

Importance of purity in pharmaceutical substances, Basic principles of qualitative and quantitative analysis, Common tests for purity: melting point, boiling point, refractive index, principles, instrumentation and application of TLC, HPLC, UV-Vis

UNIT IV	ORGANIC REACTION MECHANISMS AND APPLICATIONS	9

Classification of organic reactions: substitution, addition, elimination, rearrangement, Mechanisms of organic reactions: nucleophilic, electrophilic, radical, Functional group transformations and their synthetic applications, Molecular rearrangements: sigmatropic, pericyclic, and electrocyclic reactions, Applications of organic reactions in pharmaceutical synthesis

UNIT V	PHARMACEUTICAL EXCIPIENTS AND COORDINATION CHEMISTRY	9

Pharmaceutical excipient: types, functions, and applications, Solvents, diluents, binders, lubricants, and preservatives, Introduction to coordination chemistry, Coordination compounds: nomenclature, isomerism, and stability, Pharmaceutical applications of coordination compounds: metal-based drugs, contrast agent.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand fundamental principles of pharmaceutical chemistry, including chemical bonding, molecular structure, and structure-property relationships.	Applying (K3)
CO2	demonstrate proficiency in analyzing and synthesizing organic compounds, including aliphatic, aromatic, and heteroaromatic compounds.	Analyzing (K4)
CO3	apply qualitative and quantitative methods to assess the purity of pharmaceutical substances using techniques such as melting point determination and chromatography.	Analyzing (K4)
CO4	analyze organic reactions and molecular rearrangements, applying them effectively in pharmaceutical synthesis.	Applying (K3)
CO5	describe the principles of coordination chemistry and apply its pharmaceutical applications, including metal-based drugs and contrast agents	Understanding (K2)

TEXT BOOKS

1. Rajasekaran V.N, Textbook of Pharmaceutical Inorganic Chemistry Theory and Practical, CBS Publishers, 2019.
2. Sharma R.K., Textbook of Coordination Chemistry, 1st Edition, Discovery Publishing House Pvt. Ltd.2011.

REFERENCES

1. Leroy G. Wade , Jan William Simek , Maya Shankar Singh , Organic Chemistry, 9 Edition, Pearson Publisher, 2019
2. Atherden, L.M. Bentley and Driver's Textbook of Pharmaceutical Chemistry, 8th Edition, Oxford Publisher, 2020.
3. Soni P. L., VandnaSoni, The Chemistry of Coordination Complexes and Transition Metals, 1 st Edition, CRC Press, 2021.
4. Jie Jack Li, Name Reactions A Collection of Detailed Mechanisms and Synthetic Applications, 6th Edition, Springer Publisher, 2021.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	-	-	1	-	-	-	1	3	2
CO2	3	3	3	2	1	-	-	1	-	-	-	1	3	2
CO3	3	2	2	2	1	-	-	1	-	-	-	1	3	2
CO4	3	2	3	2	1	-	-	1	-	-	-	1	3	1
CO5	-	-	2	1	3	-	-	-	-	-	-	-	-	1

PT23303	PHYSICAL PHARMACEUTICS	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	understand basic principles of Micrometrics and powder rheology.
2.	impart understanding of Surface and Interfacial Phenomenon, Viscosity & Rheology.
3.	provide a detailed knowledge of colloidal dispersion system.
4.	give a detailed explanation of diffusion, dissolution and protein binding.
5.	impart adequate information of the kinetics and drug stability

UNIT I	MICROMERITICS AND POWDER RHEOLOGY	9

Particle size and Distribution, Particle Number, Methods for Determining Particle Volume; Optical Microscopy, Sieving, Sedimentation, Dynamic Light Scattering (DLS) Technique, Zeta potential and zeta sizer, Measurement of Particle Shape, Specific Surface, Methods for Determining Surface Area, Permeability, Adsorption, Derived Properties of Powders, Porosity, Packing Arrangement, Densities, Bulkiness and Flow Properties.

UNIT II	SURFACE AND INTERFACIAL PHENOMENON, VISCOSITY & RHEOLOGY	9

Liquid Interface, Surface and Interfacial Tension, Surface Free Energy, Measurement of Surface And Interfacial Tensions, Free Energy, Spreading Coefficient, Adsorption at Liquid Interfaces, Surface Active Agents, HLB Classification, Solubilization, Detergency, Adsorption At Solid Interface, Solid Gas, And Solid-Liquid Interface, Complex Films, Electrical Properties of Interface; Newtonian System, Law of Flow, Kinematic Viscosity, Effect of Temperature on Viscosity, Non-Newtonian Systems, Plastic, Pseudoplastic, Dilatant, Thixotropy, Thixotropy in Formulation, Determination of Viscosity: Capillary, Falling Ball, Rotational Viscometers.

UNIT III	DISPERSION SYSTEMS	9

Colloidal Dispersions - Definition, Types, Properties of Colloids, Protective Colloids, Applications of Colloids in Pharmacy; Suspensions and Emulsions - Interfacial Properties of Suspended Particles, Settling in Suspension, Theory of Sedimentation, Effect of Brownian Movement, Sedimentation velocity and Sedimentation equilibrium for pharmaceutical product aggregation testing, Sedimentation Parameters, Wetting of Particles, Controlled Flocculation, Flocculation in Structured Vehicle, Rheological Considerations; Emulsions - Types, Theories, Physical Stability.

UNIT IV	DIFFUSION, DISSOLUTION, COMPLEXATION & PROTEIN BINDING	9

Definitions - Steady State Diffusion, Procedures and Apparatus for Diffusion, Dissolution and Drug Release, Factors affecting Dissolution, Complexation, and Protein Binding; Metal Complexes, Organic Molecular Complexes, Inclusion Compounds, Methods of Analysis of Complexes, Crystalline Structures of Complexes and Thermodynamic basis of Stability Constants; Protein Binding and Drug Action, Protein Binding Studies-surface plasma resonance.

UNIT V	KINETICS AND DRUG STABILITY	9
General Considerations and Concepts of Drug Reaction Kinetics; Zero Order, First Order and Pseudo First Order, Half-Life Determination, Influence of Temperature, Light, Catalytic Species, Solvent, and Other Factors, Stabilization of Drugs Accelerated Stability Study, Expiration Dating.		
	TOTAL PERIODS:	**45**

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand the principles of micrometrics and powder rheology	Understanding (K2)
CO2	understand the surface and interfacial phenomenon, viscosity and rheology	Understanding (K2)
CO3	gain knowledge about colloidal dispersion system.	Analyzing (K4)
CO4	impart a thorough understanding of the diffusion, dissolution and protein binding.	Applying (K3)
CO5	comprehend the basic mechanisms of the kinetics and drug stability.	Remembering (K1)

TEXT BOOKS

1. Manavalan, R. and Ramasamy. C. Physical Pharmaceutics 2nd Ed., Vignesh Publishers, 2015.
2. Subrahmanyam C.V.S.. Textbook of physical pharmaceutics, 4th Edn., Vallabhprakashan, 2018.

REFERENCES

1. Alfred N. Martin, Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, eighth edition, Lippincott Williams & Wilkins, 2023.
2. David B. Troy, Paul Beringer, Remington. The science and practice of pharmacy, 21st Edition, Lippincott Williams and Wilkins, 2006
3. Humphrey Moynihan and Abinacrean. Physicochemical Basis of Pharmaceuticals, Oxford University, Press, 2009.
4. Hadkar. U. B. Physical Pharmacy, Nirali Prakashan, 13th edition, 2017.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	2	-	-	2	-	-	-	-	2	2	-
CO2	2	1	-	2	-	2	-	-	-	-	-	-	-	2
CO3	2	1	-	3	1	-	-	1	-	-	-	-	2	1
CO4	3	1	3	2	3	1	1	-	-	-	-	1	1	2
CO5	1	1	2	1	3	-	-	-	-	1	-	-	-	1

MC23301	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	2	0	0	0

COURSE OBJECTIVES

To enable the students to

1.	establish the knowledge of precious resources of the environment and their various impacts.
2.	create awareness on ecosystem and biodiversity preserve.
3.	learn scientific and technological solutions to current day pollution issues.
4.	analyze climate changes, concept of carbon credit and the challenges of environmental management.
5.	understand green materials, energy cycles and the role of sustainable urbanization.

UNIT I	ENVIRONMENT AND NATURAL RESOURCES	6

Definition, scope and importance of Environment. Forest resources: Use and over-exploitation, deforestation, - mining, dams and their effects on forests and tribal people. Water resources: Use and over- utilization of surface and ground water, dams-benefits and problems. Food resources: effects of modern agriculture, fertilizer-pesticide problems. Role of an individual in conservation of natural resources.

UNIT II	ECOSYSTEMS AND BIODIVERSITY	6

Concept of an ecosystem: Structure and function of an ecosystem - ecological succession - food chains and food webs. Ecosystems- Types of ecosystem: Introduction - forest ecosystem and lake ecosystems. Biodiversity: Introduction - definition (genetic - species - ecosystem). Diversity - Value of biodiversity - Hotspots of biodiversity - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity

UNIT III	ENVIRONMENTAL POLLUTION	6

Pollution: Définition - air pollution - water pollution - marine pollution - noise pollution. Solid waste management: Causes - effects - control measures of urban and industrial wastes. Role of an individual in prevention of pollution - Electronic waste – Sources - Causes and its effects - Pollution case studies - Field study of local polluted site – Industrial/Agricultural.

UNIT IV	SUSTAINABILITY AND ENVIRONMENT	6

Sustainability - from unsustainability to sustainability-millennium development goals, and protocols. Sustainable development goals-targets, indicators and intervention areas. Climate change - acid rain - ozone layer depletion. Regional and local environmental issues and possible solutions - case studies. Concept of carbon credit, carbon footprint. Environmental management in industry - A case study.

UNIT V	SUSTAINABILITY PRACTICES	6

Zero waste and R concept, Circular economy, ISO 14000 Series, Environmental Impact Assessment - Sustainable energy: Non-conventional Sources, Green materials, Energy Cycles - carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economical and technological change.

	TOTAL PERIODS	30

COURSE OUTCOMES		
At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	find the method of conservation of natural resources.	Understanding (K2)
CO2	understand ecosystem and the conservation of biodiversity.	Understanding (K2)
CO3	aware of environmental pollution and interpret its effects.	Understanding (K2)
CO4	apply sustainable development for technological advancement and societal development.	Applying (K3)
CO5	measure the sustainability practices for green energy cycles.	Analyzing (K4)

TEXT BOOKS

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, 1st edition, 2017.
2. Gilbert M. Masters, Wendell P. Ela "Introduction to Environmental Engineering and Science", 3rd edition, Pearson, 2022.

REFERENCES

1. William P.Cunningham and Mary Ann Cunningham, "Environmental Science: A Global Concern",McGraw Hill, 16th edition, 2023.
2. C.S.Rao,, "Environmental Pollution and Control Engineering", New Age International (P) ltd Publication, New Delhi, 4th edition, 2021.
3. Erach Bharucha, "Textbook of Environmental Studies", Universities Press Pvt. Ltd., Hyderabad, 3rd edition, 2020.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 4th Edition, 2015.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	1	-	-	-	2	-	-	1	1	-	-	1	1
CO2	-	2	-	-	1	1	-	1	-	-	-	-	1	2
CO3	2	-	1	1	-	-	-	2	-	-	-	2	1	1
CO4	-	2	-	-	1	-	3	1	1	-	1	1	2	1
CO5	2	2	-	1	-	-	2	2	-	-	-	1	1	2

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Chemistry
28/5/24
AUTONOMOUS

PT23304	FLUID MECHANICS AND MECHANICAL UNIT OPERATIONS	3	0	2	4

COURSE OBJECTIVES

To enable students to

1.	understand the fundamental principles of fluid mechanics
2.	apply the concepts of flow patterns in pipes
3.	analyse different flow regimes in pipes and channels
4.	demonstrate knowledge of property and characteristics of pharmaceutical substances
5.	classify separation processes used in pharmaceutical industries

UNIT I	DIMENSIONS, UNITS AND PHYSICAL PROPERTIES OF FLUIDS	9

Introduction to fluids and the concept of viscosity, Newtonian and non-Newtonian fluids. Fluid Statistics: Fluid forces and pressure measurement. Kinematics: Eulerian and Lagrangian description of fluid motion, concept of local and convective accelerations, steady and unsteady flows.

UNIT II	FLOW PATTERNS IN PIPES AND CHANNELS	9

Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend. Incompressible Flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, friction from changes in velocity or direction.

UNIT III	FLOW IN IMMERSED BODIES	9

Drag and Drag coefficient, friction in flow through beds of solids, Ergun equations and motion of particles through fluids. Fluidization, Types of fluidization, Applications of fluidization, continuous fluidization, slurry and pneumatic transport.

UNIT IV	PROPERTY AND CHARACTERISTICS ANALYSIS	9

Properties, handling and mixing of particulate solids: Characterization of solid particles, properties of particulate masses, storage and mixing of solids, types of mixers, mixers for cohesive solids, mixers for free-flowing solids.

UNIT V	SEPARATION PROCESS OF FLUIDS	9

Filtration, cake filters, centrifugal filters, Principles of cake filtration. Separations based on motion of particles through fluids, gravity settling processes and centrifugal settling processes

LIST OF EXPERIMENTS

1. Studying the Characteristics of a centrifugal pump.
2. Flow rate measurement using various measurement techniques.
3. Determining the time of grinding in a ball mill.
4. Calibration of Rotameter, Major equipment – Rotameter Assembly.
5. Variation of Orifice coefficient with Reynolds Number- Orifice meter Assembly
6. Determination of Venturi coefficient– Venturi meter Assembly.
7. Calculation of surface area using pressure drop.

	TOTAL PERIODS:	75

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand fluid mechanics principles, behavior and flow patterns.	Understanding (K2)
CO2	apply knowledge of liquid flow characteristics, drag forces, and separation processes in pharmaceutical engineering.	Applying (K3)
CO3	demonstrate proficiency in solving engineering problems related to fluid dynamics, including flow in pipes and channels.	Analyzing (K4)
CO4	analyse separation processes such as filtration and centrifugal separation, processes in pharmaceutical industries.	Analyzing (K4)
CO5	apply fluid mechanics principles to solve complex engineering problems encountered in pharmaceutical engineering.	Applying (K3)

TEXT BOOKS

1. Christie John Geankoplis, Transport Processes and Separation Process Principles, Prentice Hall India 4th Edition, 2012.
2. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Ed., McGraw - Hill, International 7th Edition, 2017.

REFERENCES

1. P.Chattopadhyay, Unit operations, Vol-2, Khanna publishers.2018
2. Foust et al, Principles of Unit Operations, John Wiley, 2nd edition., 2008.
3. Nigel J.K Simpson, Solid phase extraction, principles, Techniques and applications 1st editions, 2000.
4. Coulson and Richardson, Chemical Engineering, Vol-I, PHI Pergamon Press, 2008.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	-	-	-	1	-	-	2	2	2
CO2	3	2	2	2	2	-	1	-	1	-	-	2	2	2
CO3	2	2	1	3	1	2	-	-	1	-	-	2	2	2
CO4	3	2	2	2	2	-	-	-	1	-	-	2	2	2
CO5	3	2	2	2	-	-	-	-	1	-	-	2	2	2

PT23305	PHARMACEUTICAL CHEMISTRY LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1.	demonstrate proficiency in fundamental laboratory techniques for accurate experimentation in pharmaceutical chemistry.
2.	apply qualitative analysis tests to identify organic functional groups, enhancing compound characterization skills.
3.	acquire competency in soil analysis, particularly in determining soil pH, for environmental assessment in pharmaceutical production.
4.	develop skills in conducting identification tests for cations and anions, aiding in the analysis of pharmaceutical samples.

LIST OF EXPERIMENTS

1. Determination of melting point.
2. Functional group test-1 (Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids)
3. Functional group test-2 (Aldehydes and Ketones, Alcohols, Esters, Aromatic and halogenated
4. Hydrocarbons, Nitro compounds and Anilides)
5. Limit test for the iron.
6. Limit test for the sulphates.
7. Limit test for the chlorides.
8. Soil analysis- Determination of pH of Soil.
9. Identification test for of cations.
10. Identification test for anions.
11. Small molecules-Crystallization

TOTAL PERIODS:	**60**

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	demonstrate proficiency in fundamental laboratory techniques for accurate experimentation in pharmaceutical chemistry.	Understanding (K2)
CO2	apply qualitative analysis tests to identify organic functional groups, enhancing compound characterization skills.	Applying (K3)
CO3	acquire competency in soil analysis, particularly in determining soil pH, for environmental assessment in pharmaceutical production.	Analyzing (K4)
CO4	develop skills in conducting identification tests for cations and anions, aiding in the analysis of pharmaceutical samples.	Applying (K3)

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	2	3	-	-	2	2	-	-	2	3	2
CO2	3	3	2	2	3	-	-	2	2	-	-	2	3	3
CO3	3	3	2	2	3	-	3	-	2	-	-	2	3	3
CO4	3	3	2	2	3	-	-	2	2	-	-	2	3	3

PT23306	PHYSICAL PHARMACEUTICS LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1.	familiarize students with fundamental laboratory techniques used in physical pharmaceutical chemistry.
2.	enable students to identify particle size and surface area using various techniques.
3.	assess the rheological properties of colloids using viscometers.
4.	equip students with skills in determination of sedimentation parameters, emulsion preparation and studies on protein binding drugs.

LIST OF EXPERIMENTS

1. polymorphs, their identification, and properties.
2. Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
3. Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
4. Determination of surface/interfacial tension, HLB value and critical micellar concentration (CMC) of surfactants.
5. Study of rheological properties of various types of systems using different viscometers.
6. Study of different types of colloids and their properties.
7. Preparation of various types of suspensions and determination of their sedimentation parameters.
8. Preparation and stability studies of emulsions.
9. Studies on different types of complexes and determination of their stability constants.
10. Studies on protein binding of drugs
11. Determination of half-life, rate constant and order of reaction.
12. Preparation of pharmaceutical buffers and determination of buffer capacity.
13. Determination of shelf life of a product based on Arrhenius principle

TOTAL PERIODS:	**60**

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	demonstrate proficiency in fundamental laboratory techniques for accurate experimentation in physical pharmaceutics	Understanding (K2)
CO2	acquire determination of derived properties of powders and particle size analysis.	Applying (K4)
CO3	preparation of various types of colloids, suspensions and emulsions.	Analyzing (K4)
CO4	acquire efficiency of protein binding of drugs, order of reaction and their half-life.	Applying (K3)

CO/PO MAPPING:														
Mapping of Course Outcomes with Programme Outcomes **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	-	-	1	-	-	-	-	2	2	-
CO2	3	2	2	1	-	2	-	-	-	-	-	-	-	2
CO3	2	1	-	3	1	-	-	1	-	-	-	-	2	1
CO4	3	1	3	2	3	1	1	-	-	-	-	1	1	2

GE23301	PROFESSIONAL DEVELOPMENT I	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1. enhance and evaluate the student's professional skills and introduce the function of corporate world.
2. enhance and develop the students behavioral, speaking and listening skills to face the interview.
3. solve advance level verbal aptitude tests to get placed in Tier I companies.
4. improve their reasoning skills to get placed in reputed companies.

UNIT I	SELF - UNDERSTANDING AND PERSONALITY ENHANCEMENT SKILLS	7

Introduction self-exploration; SWOT analysis - Types and barriers; Effective communication in workplace; Leadership skills; Decision making - Problem solving; Goal setting - Critical, strategic and lateral thinking; JAM level- I; Basic resume building level- I.

UNIT II	BEHAVIOURAL SKILLS, LISTENING AND SPEAKING SKILLS	7

Behavioural skills; Time management; Emotional intelligence; Analytical thinking- Listening; Listening and hearing; Self-introduction; Group discussion - Types and importance, evaluation criteria, do's and don'ts of GD; GD Level-1.

UNIT III	QUANTITATIVE APTITUDE	8

Number System; LCM and HCF; Simple interest and compound interest; Average; Pipes and cisterns; Area; Profit and loss.

UNIT IV	LOGICAL REASONING	8

Logical sequence; Analogy; Classification; Causes and effect; Making judgment; Directions.

	TOTAL PERIODS	30

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	define and analyze soft skills to improve the leadership skills.	Analyzing (K4)
CO2	demonstrate the behavioral skills through various activities.	Applying (K3)
CO3	develop the problem solving skills through quantitative aptitude.	Applying (K3)
CO4	illustrate the logical reasoning Skills to solve real world problems.	Analyzing (K4)

TEXT BOOKS

1. Agarwal, R.S. "Objective General English", S.Chand & Co.2021.
2. Agarwal, R.S. "Quantitative Aptitude", S.Chand & Co.2021.

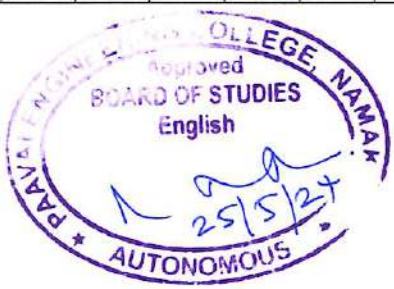
REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill, 2023.
2. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand & Co Ltd, New Delhi.2021.
3. Word Power Made Easy By Norman Lewis, Wr.Goyal Publications, 2021.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	3	3	2	3	-	3	1	1
CO2	-	-	-	-	-	-	2	3	2	3	-	3	1	1
CO3	3	2	2	2	-	1	-	-	-	-	2	-	2	2
CO4	2	1	3	2	-	3	3	1	-	1	2	-	2	2



MA23403	PROBABILITY AND STATISTICS	3	1	0	4

(Common to Agri, Biotech, Cyber, CSE, CSE(IOT), CSE(AI&ML), AI&DS, IT, Food, Pharma)

COURSE OBJECTIVES

To enable the students to

1.	analyse the concept of random variables and probability distribution in designing processes.
2.	differentiate the discrete and continuous two dimensional random variables.
3.	determine the concepts of hypotheses testing, its need and applications.
4.	equip with statistical techniques for designing experiments, analyzing, interpreting and presenting research data.
5.	emphasize the aspects of control charts in quality control.

UNIT I	RANDOM VARIABLES	12

Discrete and continuous random variables – Moments, Moment generating functions; Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions; Functions of random variables.

UNIT II	TWO - DIMENSIONAL RANDOM VARIABLES	12

Joint distributions; Marginal and conditional distributions; Covariance, Correlation and Linear regression; Transformation of random variables; Applications of Central limit theorem (for independent and identically distributed random variables).

UNIT III	TESTING OF HYPOTHESIS	12

Sampling distributions - Estimation of parameters; Statistical hypothesis; Large sample test for single mean and difference of means; Small samples - Tests based on t, Chi-square and F distributions for mean, variance and proportion; Contingency table (test for independent), Goodness of fit.

UNIT IV	DESIGN OF EXPERIMENTS	12

Completely randomized design; Randomized block design; One way and two way classifications- Latin square design - 2^2 factorial design.

UNIT V	STATISTICAL QUALITY CONTROL	12

Control charts for measurements (X and R charts) - Control charts for attributes (P, C and NP charts), Tolerance limits, Acceptance sampling - U-test and Sign test.

	TOTAL PERIODS	60

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	assign suitable probability distributions in engineering problems.	Applying (K3)
CO2	apply the concept of discrete and continuous two dimensional random variables.	Applying (K3)
CO3	apply the concept of testing of hypothesis for small and large samples in real life problems	Applying (K3)
CO4	analyse the principles to be adopted for designing the experiments.	Analysing (K4)
CO5	examine statistical data using control chart in quality control	Applying (K3)

TEXT BOOKS

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4thEdition, 2007.
2. Johnson. R.A. and Gupta. C.B., Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7thEdition, 2007.

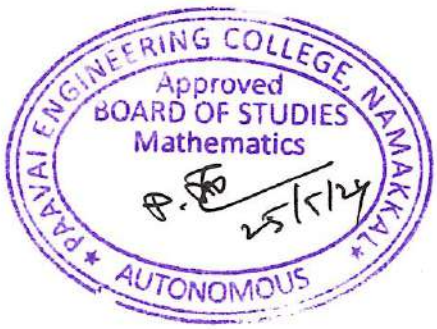
REFERENCES

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8thEdition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education Asia, 8thEdition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	-	-	-	-	-	-	-	3	1	3
CO2	3	2	3	3	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	2	-	-	-	-	-	-	-	2	2	3
CO4	3	3	2	2	-	-	-	-	-	-	-	2	2	3
CO5	3	3	2	3	-	-	-	-	-	-	-	2	2	3



PT23401	PHARMACEUTICAL ANALYSIS	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	facilitate students to acquire knowledge about the principles and operations of various modern analytical instruments.
2.	acquire knowledge about spectroscopy
3.	understand the basic concepts of advanced separation techniques.
4.	gain knowledge about spectroscopy and application in pharmaceutical industry.
5.	understand the basics concepts of different types of spectroscopy.

UNIT I	UV-VISIBLE SPECTROSCOPY	9

Introduction to electro maganetic spectrum, Electronic transitions and spectral shifts, Chromophores, Auxochromes, Beer and Lambert's law, Derivation and deviations. Instrumentation Sources of radiation, wavelength selectors, sample cells, Detectors - Barrier layer cell, Photo tube, Photo Multiplier Tude, Photo Diode Anoide detectors; Applications in pharmaceutical industries.

UNIT II	ATOMIC ABSORPTION SPECTROSCOPY	9

Principle, Instrumentation, Operation – single and double beam AAS; sampling technique – Detection limit, Principle, Instrumentation, Operation of flame photometry. Difference between Atomic absorption spectroscopy and Flame spectroscopy; Applications in pharmaceuticals.

UNIT III	PRINCIPLES OF INFRARED AND VIBRATIONAL SPECTROSCOPY	9

Instrumentation and Sampling Techniques of IR, Applications in Pharmaceutical Sciences; NMR principles, Instrumentation, Applications in Pharmaceuticals.

UNIT IV	MASS SPECTROMETRY AND XRD	9

Basic Principles, Instrumentation- mass spectroscopy; Chemical Ionization (CI), Electron Impact Ionization (EI), Quadrupole, Macro molecular crystallography, Matrix Assisted Laser Desorption Ionization (MALDI), Time of Flight (TOF); Applications in Pharmaceuticals. Basic instrumentation of XRD, and its pharmaceutical application.

UNIT V	CHROMATOGRAPHIC TECHNIQUES	9

Chromatography - Principles, Instruments and Practice; Planner- Column Chromatography, Gas Chromatography, FPLC, High performance liquid chromatography; Size exclusion chromatography; Ion exchange chromatography; Affinity Chromatography, Applications in Pharmaceuticals.

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	handle the modern analytical instruments like UV/Vis, IR, NMR, Mass spectroscopy and HPLC.	Applying (K3)
CO2	developability to involve in qualitative and quantitative analysis of various pharmaceutical agents.	Analyzing (K4)

CO3	involve in phytochemical and biological standardization of pharmaceutical products.	Understanding (K2)
CO4	gain the knowledge about spectroscopy	Applying (K3)
CO5	understand the principles of different chromatographic methods.	Analyzing (K4)

TEXT BOOKS

1. H. Beckett & J. B. Stenlake, "Practical Pharmaceutical Chemistry", Part II, 4th Edition, Bloomsbury Academic, 2001.
2. Hobert H. Willard, "Instrumental Methods of Analysis", 7th Edition, CBS Publishers & Distributors, 2004.

REFERENCES

1. Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, cirtemortcepS, "Identification of Organic Compounds", 8th Edition, Wiley, 2014.
2. Mendham J, "Vogel's Textbook of Quantitative Chemical Analysis", 6th Edition, Pearson Education 2009.
3. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, "Principles of Instrumental Analysis", 7th Edition, Brooks Cole, 2017.
4. William Kemp, "Organic Spectroscopy" W.H. Freeman, New York, 3rd Edition, 2011.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	1	1	1	-	1	-	3	3	3
CO2	2	2	1	1	2	1	1	1	-	1	-	3	3	3
CO3	3	3	2	2	2	1	1	-	-	-	-	3	2	2
CO4	3	2	2	1	2	1	2	1	-	-	-	3	2	3
CO5	2	2	3	1	3	2	1	2	-	1	-	2	3	2

PT23402	TECHNOLOGY OF DOSAGE FORMS	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	impart the knowledge on the principles of solid and semisolid dosage forms formulation and development.
2.	summarize the concepts involved in troubleshooting and improvement of solid dosage forms, semi-solid and semi-liquid dosage forms
3.	describe the various pharmaceutical dosage forms and their manufacturing techniques
4.	provide the knowledge on the formulation and evaluations of dosage forms.
5.	select the appropriate method of achieving a successful dosage form formulation.

UNIT I	PRE-FORMULATION STUDIES	9
Objectives, Physical, chemical & Micromeritic studies in pre-formulation, stability considerations, drug-excipients compatibility.		

UNIT II	TABLETS	9
Classification/types of tablets, formulation of tablets, granulation technology by various techniques, physics of tablets making, different types of tablet compression machinery and the equipment employed, tablet defects, evaluation of tablets Coating of Tablets: Types of coating, film-forming materials, formulation of the coating solution, equipment for coating (Wurster, FBE, pan), coating process, defects.		

UNIT III	CAPSULES	9
Introduction, types, advantages and disadvantages, material and method of preparation. Hard gelatin capsules, size of capsules, method of capsule filling, soft gelatin, capsule shell and capsule content, importance of base absorption and minimum per gram factors in soft capsules, evaluation of capsules. Microencapsulation: Introduction, techniques: Pan coating, Conservation-phase separation, Centrifugal extrusion, Spray–drying, Ionotropic gelation.		

UNIT IV	LIQUID ORALS PREPARATIONS	9
Liquid Dosages Forms: Introduction, types of additives used in formulations, Vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavors, and others, manufacturing packaging and evaluation of clear liquids, suspensions, and emulsions as per pharmacopoeia.		

UNIT V	PARENTERAL PRODUCTS	9
Formulation details, containers & closures, and selection: Prefilling treatment, washing of containers and closures, preparation of solution and suspensions, filling and closing of ampoules, vials, infusion fluids, lyophilization & preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products. Aseptic Techniques: The source of contamination and methods of prevention, design of the aseptic area, laminar flow bench services, and maintenance. Facility requirements- classification of clean rooms for manufacturing dosage forms, HVAC systems.		

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand the technology of various solid and semisolid dosage forms.	Understanding (K2)
CO2	recognize the formulation concepts and evaluate solid dosage forms to meet out the requirements.	Analyzing (K4)
CO3	recognize the formulation concepts and evaluate capsules forms to meet out the requirements.	Applying (K3)
CO4	organize the difference between theoretical and practical concept used in industry	Applying (K3)
CO5	apprehend the advances in solid dosage fom1s, semi solid dosage forms and dispersions	Analyzing (K4)

TEXT BOOKS

1. larry l. augsburger, stephen w. hoag, Pharmaceutical dosage forms: tablets, rational design and formulation, informa healthcare USA, inc, III rd edition, 2008.
2. Aulton, Michael E. "Pharmaceutics: The Science of Dosage Form Design" II nd Ed., Churchill Livingstone, 2002.

REFERENCES

1. Allen, Loyd V.. "Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems" IX th Ed., Wolters Kluwer/LippinCott Williams & Wilkins, 2011.
2. Gennaro, A.R., "Remington: The Science and Practice of Pharmacy", Vol. I and II, 21st Edition, Lippincott Williams and Willkins, 2005.
3. Cooper and Gunn's "Dispensing for Pharmaceutical Students", Edited by S J Carter, CBS Publishers, New Delhi, 2008.
4. Banker, G.S. and Rhodes, C.T., "Modern Pharmaceutics", 4th Edition, Informa Health Care, 2002.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	1	2	3	-	1	1	2	1	2	-	3	2
CO2	3	3	1	2	3	2	1	2	1	2	1	-	3	2
CO3	3	2	1	1	2	3	3	1	-	1	2	-	1	3
CO4	2	3	2	1	1	-	-	-	-	1	-	-	3	2
CO5	3	3	3	2	2	-	-	2	2	-	-	-	3	2

PT23403	HUMAN ANATOMY AND PHYSIOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	know about the cardiovascular system with its functions and its disorders.
2.	understand about the anatomy and mechanism of respiratory and circulatory system.
3.	learn the digestive systems and its disorders.
4.	describe about the urinary and reproductive system.
5.	comprehend the concepts of skeletal system.

UNIT I	CARDIOVASCULAR SYSTEM	9

Functional Anatomy of heart and Blood vessels, conducting system of heart, Heart sounds, cardiac cycle, ECG- Equipment and Interpretation Blood pressure and its regulation. Brief outline of cardiovascular disorders like hypertension, myocardial infarction, hyper trophic cardiomyopathy, congestive heart failure and cardiac arrhythmias.

UNIT II	RESPIRATORY AND CIRCULATORY SYSTEM	9

Anatomy & function of respiratory structures, Mechanism of respiration, regulation of respiration. Haemopoietic system: Composition, function of blood & its elements, erythropoiesis, blood groups, blood coagulation, Anemias and its types.

UNIT III	DIGESTIVE SYSTEMS	9

Digestive System Parts of digestive system, their structure and functions. Various gastrointestinal secretions & their role. Brief outline of peptic ulcer, ulcerative colitis, hepatic disorder.

UNIT IV	URINARY AND REPRODUCTIVE SYSTEM	9

Anatomy & physiology of urinary system, Physiology of urine formation, acid- base balance. Reproductive System: Anatomy & Physiology of Male & Female reproductive system, Menstruation

UNIT V	SKELETAL SYSTEM	9

Structure, composition & functions of skeleton. Physiology of skeletal muscle contraction, Classification of joints, Types of joints. Sense organs: Basic anatomy and physiology of the eye, ear, taste buds, nose, and skin.

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	identify various cardiovascular disorders.	Understanding (K2)
CO2	gain a comprehensive understanding of the respiratory problems and to analyse blood composition, grouping and functions.	Analyzing (K4)
CO3	analyse about common digestive disorders and how to maintain a healthy digestive system.	Analyzing (K4)
CO4	understand urine formation, acid-base balance, male and female reproductive anatomy and physiology, and the menstrual cycle.	Understanding (K2)
CO5	identify the components of the skeletal system and sense organs, explain their functions	Understanding (K2)

TEXT BOOKS

1. Guyton, A.C. and Hall, J.E. —Textbook of Medical Physiology, 14th Edition, 2021.
2. Ganong's, Review of Medical Physiology, 26th Edition (A Lange Medical book series) McGraw – Hill (International Ed.) 2019.

REFERENCES

1. Waugh, Anne and Allison Grant —Ross and Wilson Anatomy and Physiology in Health and Illnessl, 14th Edition, Churchill – Livingstone / Elsevier), 2022.
2. Gillian Pocock, Christopher D. Richards, The human Body – An introduction for Biomedical and Health Sciences, Fifth Edition, Oxford University Press, USA, 2017.
3. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", - 4 th Edition, W.B. Saunders Company, 2015.
4. Elaine.N.Marieb, "Essential of Human Anatomy and Physiology", Eleventh Edition, Pearson Education, New Delhi, 2015.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	-	2	-	-	-	-	2	2	-
CO2	2	2	1	2	-	2	-	-	-	-	-	-	-	2
CO3	2	2	1	2	1	-	-	1	-	-	-	-	2	1
CO4	3	2	2	2	3	1	1	-	-	-	-	1	1	2
CO5	2	2	2	2	3	1	-	-	-	1	-	-	-	1

MC23402	HUMAN VALUES AND GENDER EQUALITY	2	0	0	0

COURSE OBJECTIVES

To enable the students to

1.	define different types of human values and their impact on individual behaviour and societal norms.
2.	apply principles of personal development such as self-confidence, self-discipline, and resilience to navigate modern challenges effectively.
3.	evaluate the role of values in shaping professional ethics, civic sense and global citizenship.
4.	examine the socio-economic factors influencing gender inequality and explore avenues for empowerment and advocacy.
5.	critically analyze prevalent issues and challenges faced by women, including gender-based violence, discrimination, and cultural biases, and propose measures for their eradication.

UNIT I	HUMAN VALUES	6

Value Education - Definition, Types of values; Human values - Acceptance, Consideration. Appreciation, Listening. Empathy, Sympathy, Honesty, Integrity, Wisdom, Decision making, Self-actualization, Character formation towards positive personality, Contentment; - Religious Values - Humility, Compassion, Gratitude. Peace, Justice, Freedom, Equality.

UNIT II	PERSONALITY DEVELOPMENT	6

Personal Development - Introspection, Self-confidence, Self-discipline; Flexibility -Peer pressure - Sensitization towards Gender Equality; Reliability; Unity; Modern Challenges of Adolescent Emotions and behavior - Comparison and Competition, Positive and Negative attitudes; Family values; Self-improvement - Physical exercises, Meditation ,Yoga.

UNIT III	VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT	6

Professional Values -. Integrity, Responsibility, Punctuality, Dedication - Perseverance - Competence; Civic sense and Responsibility; Global Values - Computer Ethics, Moral Leadership, Code of Conduct; Corporate Social Responsibility; Aesthetic values; National Integration and International understanding of Religious Values – Spirituality, thought process.

UNIT IV	GENDER EQUALITY	6

Gender Equality - Definition, Empowerment, Economic Equality; Condition of Women in India-Education, Healthcare, Political Representation, Gender-based Violence; Challenging Stereotypes: Parental and Caregiving Responsibilities; Legal and Policy Reform; Cultural Shifts; Global Perspective; Male Chauvinism; Sustainable Development..

UNIT V	WOMEN ISSUES AND CHALLENGES	6

Women Issues and Challenges - female feticide, violence against women; Domestic violence- dowry related abuse and deaths, Physical violence, Emotional abuse; Sexual assault; Honour killing; Eve-teasing- Stalking, e-stalking (cyber-crime).

	TOTAL PERIODS	30

COURSE OUTCOMES		
At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	discuss the concept of human values and their significance in personal and societal development.	Understanding (K2)
CO2	demonstrate introspective skills to enhance personal growth and self-awareness.	Applying (K3)
CO3	recognize the importance of gender equality in promoting a just and equitable society.	Understanding (K2)
CO4	cultivate a sense of social responsibility and ethical conduct towards achieving national and global development.	Analyzing (K4)
CO5	analyse the challenges faced by women in various spheres and identify strategies for addressing them.	Analyzing (K4)

TEXT BOOKS

1. A Foundation Course in Human Values and Professional Ethics: Presenting a Universal Approach to Value Education - Through Self-exploration. New Delhi, 2016.
2. Aurther, John. Personality Development. Lotus Press, 2018.

REFERENCES

1. Joshi, Dhananjay. Value Education in Global Perspective. Lotus Press, 2014.
2. Mahrotra, Mamta. Gender Inequality in India: Challenging Social Norms. Prabhat Books, 2015.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												**PSO's**	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	-	1	-	1	1	1	2	3	2	1	1	3	1	1
CO2	-	1	-	1	1	1	3	3	2	2	1	1	1	1
CO3	-	1	-	1	1	1	2	3	1	1	1	3	1	1
CO4	-	1	-	1	1	1	2	3	2	2	1	2	1	1
CO5	-	1	-	1	1	1	1	3	2	2	1	3	1	1

PT23404	CELL AND MOLECULAR BIOLOGY	3	0	2	4

COURSE OBJECTIVES

To enable students to

1. understand basic principles of cell structure, cell division and its regulation.
2. impart a thorough understanding of the key events of transport across cell membrane.
3. provide a detailed knowledge of cell signaling pathway and cell receptors.
4. give a detailed explanation of replication and transcriptional regulation.
5. impart adequate information of the gene expression and its regulation.

UNIT I **CELL STRUCTURE AND CELL DIVISION** **9**

Structure and function of Prokaryotic and Eukaryotic cells. Structure and functions of cell organelles - Mitochondria, ER, Ribosome, Golgi bodies, Nucleus. Organization of Plasma membrane, Membrane models. Cell division-Mitosis and Meiosis, Cell cycle and its regulation.

UNIT II **TRANSPORT ACROSS CELL MEMBRANE** **9**

Passive and active transports, Permeases, Sodium -potassium pumps, Ca_2^+ ATPase pump, ATP dependent proton pumps, cotransport, symport, antiport, Endocytosis and Exocytosis.

UNIT III **CELL RECEPTORS AND CELL SIGNALING** **9**

Membrane bound, cytosolic and nuclear receptors, autocrine, paracrine and endocrine signaling, signal amplification, CAMP, role of IP3, CAMP and G-protein role in signal transduction, Ca2+ influx and its role in cell signaling.

UNIT IV **REPLICATION AND TRANSCRIPTION** **9**

Genetic material - Conservative, Semi-Conservative - DNA replication: Messelson & Stahl experiment. Fidelity of DNA replication, Inhibitors of DNA replication. Transcription in prokaryotes and Eukaryotes - Transcription factors - promoters and enhancers.

UNIT V **EXPRESSION OF GENE AND REGULATION** **9**

Genetic code - Translation and post translational modifications, Operon Concept - Lac, gal, trp operon – Mutation – Repair – Regulation of gene expression in prokaryotes and Eukaryotes.

LIST OF EXPERIMENTS

1. Microscope – Bright field, phase contrast and fluorescent microscopy.
2. Introduction to principles of sterile techniques and cell propagation
3. MTT Assay
4. Osmosis and Tonicity
5. Staining for different stages of mitosis in Allium Cepa (Onion).
6. Microbial medium and culture preparation.
7. Plating techniques.
8. Animal cell culture (demonstration)

TOTAL PERIODS: **75**

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand the composition, structure and characteristics of nucleic acids	Understanding (K2)
CO2	understand the central dogma of life and its significance	Analyzing (K4)
CO3	gain knowledge about cell signaling and role of receptors in signal transduction.	Applying (K3)
CO4	impart a thorough understanding of the mechanisms of DNA replication and transcription.	Understanding (K2)
CO5	comprehend the basic mechanisms of gene expression and their regulation.	Understanding (K2)

TEXT BOOKS

1. Ajoy Paul, A textbook of Cell and Molecular Biology, Books and Allied Publishers 2011.
2. David Freifelder, Molecular Biology-2nd Edition, Narosa publishing house, 2004

REFERENCES

1. Darnell J Lodish,H. Baltimore, Molecular cell biology, Free Man,2020
2. De Roberties and De Roberties.JR, Cell and Molecular Biology- BI publications ,2022
3. Stryer, L., Biochemsitry, 4th Edition, W.H. Freeman & Co., 2012
4. Nelson DL, Cox MM. Lehninger Principles of Biochemistry. 6th Edition, 2013.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	2	-	-	2	-	-	-	-	2	2	-
CO2	2	-	3	-	-	2	-	1	-	-	-	-	-	2
CO3	2	1	-	3	1	-	-	1	-	2	-	-	2	1
CO4	1	3	1	2	3	1	1	-	-	-	2	1	1	2
CO5	1	-	2	1	3	1	-	-	-	1	-	-	-	1

PT23405	PHARMACEUTICAL ANALYSIS LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1. carry out analytical experiments related to spectroscopic and chromatographic techniques.
2. gain the knowledge about separation process
3. acquire the concepts and titration methods for analysis
4. facilitate students to acquire knowledge about the principles and operations of various modern analytical instruments.

LIST OF EXPERIMENTS

1. Assay of the given compound by acid base titration.
2. Assay of the given compound by precipitation titration.
3. Determination of λ-max of compounds/drugs.
4. Determination of calibration curve for compounds/drugs by UV-Spectrophotometer.
5. Interpretation of any two absorption spectrum.
6. Assay of drugs by colorimetric method.
7. Determination of amino acid by thin layer chromatography.
8. Determination of plant metabolites by thin layer chromatography.
9. HPLC and GC-MS (Demonstration).

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand the standardization of various assay reagents with respect to chemical and drug analysis.	Understanding (K2)
CO2	quantification of drugs molecules by chromatographic and spectral techniques.	Applying (K4)
CO3	understand the modern tools in industry.	Analyzing (K4)
CO4	analyze the concentration of chemicals using chromatogram.	Applying (K3)

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	-	-	1	2	-	-	-	3	2
CO2	3	3	2	1	2	-	-	1	-	-	-	-	3	2
CO3	2	2	1	-	1					-	-	-	3	2
CO4	1	2	1	2							-	-	2	1

PT23406	TECHNOLOGY OF DOSAGE FORMS LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1. provide the knowledge on the principles of granulation techniques
2. gain the knowledge about various formulation and evaluation of different dosage forms.
3. acquire the concepts packaging of different dosage forms
4. facilitate students to acquire knowledge about the principles of dissolution studies

LIST OF EXPERIMENTS

1. Preparation and evaluation of granules by granulation technique (wet granulation method).
2. Formulation and evaluation of tablets.
3. Preparation, evaluation, and packaging of syrups.
4. Preparation, evaluation, and packaging of suspensions.
5. Preparation, evaluation, and packaging of emulsions.
6. Preparation, evaluation, and packaging of ointments.
7. Preparation, evaluation of Suppositories.
8. Filling and sealing of ampules.
9. Dissolution studies of solid dosage forms.
10. Preparation of microspheres.

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand the manufacturing process of solid using granulation technique.	Understanding (K2)
CO2	understand the formulation of different dosage forms.	Applying (K4)
CO3	understand the inhouse evaluation process of dosage forms.	Analyzing (K4)
CO4	analyze the importance of dissolution studies.	Applying (K3)

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	-	-	2	-	-	-	-	2	2	-
CO2	2	-	-	3	-	2	-	-	-	-	-	-	-	2
CO3	2	1	-	3	1	-	-	1	-	-	-	-	2	1
CO4	2	1	3	2	3	-	-	-	-	-	-	1	1	2

GE23401	PROFESSIONAL DEVELOPMENT II	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1. enhance their own behavioural skills to survive in corporate world.
2. evaluate their listening and speaking skills to face the interviews in a successful way.
3. solve advance level verbal aptitude tests to get placed in Tier I companies.
4. improve their reasoning skills to get placed in reputed companies.

UNIT I	WRITING SKILLS	7

Email writing; Fixing and cancelling appointments; Paper submission for seminars and conferences; Business communication; Stress management; Body language; Dress code; Self-introduction II; Update resume building II; JAM level -3.

UNIT II	PRESENTATION SKILLS	7

Presentation skills - Types and methods of delivering presentation, ways and methods to improve presentation skills; Mini presentation in smaller groups; Situational role play; Face to face interview; Group discussion level IL; JAM Level-4.

UNIT III	QUANTITATIVE APTITUDE - I	8

Simplification; Time, speed and distance; Trains; Boats and streams; Ratio and proportion; Partnership; Percentage.

UNIT IV	LOGICAL REASONING	8

Seating arrangement; Arithmetic reasoning; Character puzzle; Syllogisms; Matching definitions; Statements and arguments.

	TOTAL PERIODS	30

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	interpret the personality development through various activities.	Understanding (K2)
CO2	examine speaking and listening skills to excel in their jobs.	Analyzing (K4)
CO3	develop the quantitative skills and analytical skills to face the interview.	Applying (K3)
CO4	extend the reasoning abilities by scoring exceeded percentage to get placed in reputed companies.	Understanding (K2)

TEXT BOOKS

1. Agarwal, R.S. "Objective General English", S.Chand & Co.2021.
2. Agarwal, R.S. "Quantitative Aptitude", S.Chand & Co.2021.

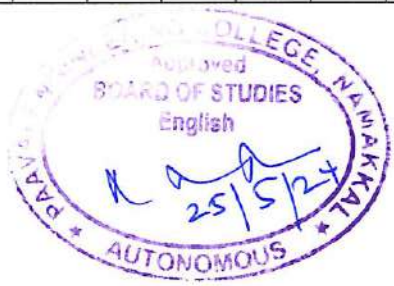
REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill, 2023.
2. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand & Co Ltd, New Delhi.2021.
3. Word Power Made Easy By Norman Lewis, Wr.Goyal Publications, 2021.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	3	3	2	3	-	3	1	2
CO2	-	-	-	-	-	-	2	3	2	3	-	3	1	2
CO3	3	2	2	-	-	1	-	-	-	-	2	-	2	2
CO4	2	3	3	2	-	3	3	1	-	1	2	-	2	2



PT23201	BIOCHEMISTRY AND MICROBIOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	understand the basic structure, properties, and functions of biomolecules
2.	emphasize the role of biomolecules by providing basic information on specific metabolic diseases.
3.	describe about the evolution of microorganisms and microscopy.
4.	interpret the effects of microbes in food and the clinical importance of microorganisms.
5.	outline the requirements of microbial nutrition for growth of microorganisms and the impact of environment on its growth.

UNIT I	INTRODUCTION OF BIOMOLECULES I	9

Carbohydrates: Introduction, Classification of carbohydrates– monosaccharides, disaccharides, polysaccharides; glycolysis, citric acid cycle and pentose pathway.

Lipids: Classification – structure and functions of lipids; Fatty acids – TAG structure and properties Phospholipids – functions; Derived lipids; Metabolism of Lipids - Fatty acid biosynthesis and degradation; Cholesterol biosynthesis and ketone bodies formation.

UNIT II	INTRODUCTION OF BIOMOLECULES II	9

Classification, Structure and function of amino acids – Properties; Proteins – Classification – hierarchy of proteins – primary, secondary, tertiary and quaternary structure; Biologically important peptides. Metabolism – synthesis and degradation of amino acids.

UNIT III	INTRODUCTION TO MICROBIOLOGY	9

Origin, scope and discovery of microbiological world, Classification and nomenclature of microorganisms; Characterization and identification of microorganisms; Structural organization and reproduction – bacteria, virus and fungi; Basics of microscope, Staining Techniques – simple, differential, fungal and special staining methods; Pharmaceutical significance of microorganisms.

UNIT IV	NUTRITION AND GROWTH OF MICROBES	9

Nutritional requirements for growth of microorganisms; Types of Nutrient media – bacteria and fungi; Nutritional types based on energy source; Bacterial growth curve, Methods for determining bacterial numbers, mass and cell constituents; Bacterial metabolites for drug discovery

UNIT V	CONTROL OF MICROORGANISMS	9

Physical and chemical control of microorganisms; Antibacterial drugs- Penicillin, Erythromycin, anti-fungal drugs- Nystatin, Griseofulvin, clinically important microorganisms- Mycobacterium Tuberculosis, HIV.

	TOTAL PERIODS:	45

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	relate the structure and functional role of carbohydrates and lipids in biological reactions.	Remember (K1)
CO2	understand the hierarchical organization of proteins and their metabolic pathways.	Understanding (K2)

CO3	identify the different types of microorganisms and various staining techniques.	Applying (K3)
CO4	analyse about the nutritional requirements of different microorganisms and their growth.	Analysing (K4)
CO5	identify various methods for controlling microorganisms and clinically important microorganisms.	Applying (K3)

TEXT BOOKS

1. David L. Nelson and Michael M Cox. Lehninger's Principles of Biochemistry, Macmillan Worth Publisher, 6th Edition, 2012.
2. Pelczar MJ, Chan ECS and Krein NR. Microbiology, Tata McGraw Hill Edition, New Delhi, India.

REFERENCES

1. Berg J. M., Tymoczko J. L., Stryer, L. Biochemistry, 7th Edition, Macmillon, 2012.
2. Rodwell V., Bender D., Botham K., Kennelly P., Anthony Weil P. Harpers Illustrated Biochemistry, McGraw Hill, 30th Edition 2015.
3. Tortora, G.J., Funke, B.R. and Case, C.L. Microbiology, An Introduction. 11th Edition. Pearson Education. 2012
4. Powar and Daginawala. General Microbiology, Volume-I Himalaya Publishing House.2010

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	2	-	-	2	-	-	-	-	2	2	-
CO2	2	-	-	2	-	2	-	-	-	-	-	-	-	2
CO3	2	1	-	3	1	-	-	1	-	-	-	-	2	1
CO4	3	1	3	2	3	1	1	-	-	-	-	1	1	2
CO5	-	-	2	1	3	1	-	-	-	1	-	-	-	1