SEMESTER III

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	BS	MA20301	Transforms and Boundary value problems	3	1	0	4
2	PC	PT20301	Stoichiometry and Chemical Process Calculations	3	0	0	3
3	PC	PT20302	Essential of Biochemistry & Microbiology	3	0	0	3
4	PC	PT20303	Pharmaceutical Chemistry	3	0	0	3
5	PC	PT20304	Physical Pharmaceutics	3	0	0	3
6	MC	MC20301	Value Education	2	0	0	0
PRACTICALS							
7	PC	PT20305	Physical Pharmaceutics Laboratory	0	0	4	2
8	PC	PT20306	Biochemistry & Microbiology Laboratory	0	0	4	2
9	HS	EN20301	English Proficiency course laboratory	0	0	2	1
			TOTAL	**17**	**1**	**10**	**21**

SEMESTER IV

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	BS	MA20403	Probability and Statistics	3	1	0	4
2	ES	PT20401	Fluid Flow Operations	3	0	0	3
3	ES	EE20409	Electrical Machine Drives and Sensors	3	0	0	3
4	PC	PT20402	Unit Operations in Pharma Industries	3	0	0	3
5	PC	PT20403	Pharmaceutical Analysis	3	0	0	3
PRACTICALS							
7	PC	PT20404	Analytical Methods and Instrumentation Laboratory	0	0	4	2
8	ES	CM20304	Fluid Mechanics Laboratory	0	0	4	2
9	ES	EE20410	Electrical Engineering Laboratory	0	0	4	2
			TOTAL	**18**	**1**	**12**	**22**

MA20301 TRANSFORMS AND BOUNDARY VALUE PROBLEMS 3 1 0 4

COURSE OBJECTIVES

To enable students to

- introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- acquaint the students with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic
- formulate Partial Differential Equations and use Mathematical tools for the solution of PDE that model several physical processes
- develop the modeling of one dimensional equation of heat conduction, wave equation and two dimensional Laplace equation
- develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform does for continuous systems, a valuable aid in analysis of continuous time systems

UNIT I FOURIER SERIES 12

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range series - Complex form of Fourier Series - Parseval's identity - Harmonic Analysis.

UNIT II FOURIER TRANSFORMS 12

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

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 - Convolution theorem - Formation of difference equations - Solution of difference equations using Z-transform.

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, the students will be able to

- derive Fourier series, their possible forms of representations of periodic functions

- identify and formulate a function in frequency domain whenever the function is defined in time domain
- formulate and solve partial differential equations that occur in many engineering applications
- model wave and heat equations, solve certain boundary value problems and use the solution methods in engineering applications.
- demonstrate the use of Z-transform to convert discrete functions into complex frequency domain representation

TEXT BOOKS

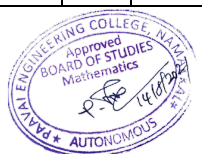
1. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi,(2011).

REFERENCES

1. Narayanan S., Manickavasagam Pillai.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" ,Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.
2. Larry C. Andrews, Bhimsen K. Shivamoggi, "Integral Transforms for Enginears", SPIE Optical Engineering press, Washington USA (1999).
3. Ramana. B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company limited, New Delhi (2010).
4. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education (2007).
5. Erwin Kreyszig., "Advanced Engineering Mathematics" 10th Edition,Wiley Publications.

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	-	-	-	-	-	-	-	1	3	2
CO2	3	3	2	1	-	-	-	-	-	-	-	1	3	2
CO3	3	2	3	2	-	-	-	-	-	-	-	1	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	1	3	2
CO5	3	3	2	2	-	-	-	-	-	-	-	1	3	2



PT20301	STOICHIOMETRY AND CHEMICAL PROCESS CALCULATIONS	3 0 0 3

COURSE OBJECTIVES

To enable students to

- use different systems of units and convert one system of unit to another system.
- learn what material balance are, how to formulate, apply and solve them.
- know how to use the psychometric chart for determining humidity.
- learn the basics of thermo chemistry and thermo physics calculations.
- relate the air requirement for combustion calculations of fuels.

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 ΔH_R 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

- have clear idea of various types of unit systems and they will be able to convert units from one form of the unit to other.

- have sound strategy for solving and developing mathematical relations for material and energy balance calculations for reaction and separation processes.
- experiment and solve material balance problems involving chemical reactions.
- learn what energy balances are, and how to apply them and finally, to learn how to deal with the complexity of larger problems.
- analyze the behaviour of recycle processes, performing approximate material balances by hand and setting up calculations for rigorous solution by computer.

TEXT BOOKS

1. Narayanan, K.V. and Lakshmikutty, B. Stoichiometry and Process Calculations, 2nd Edition., PHI Learning Pvt. Ltd, 2017
2. Bhatt, B.I. and Thakore, S.M. Stoichiometry, 5th Edition, Tata McGraw Hill Education Pvt. Ltd, 2011.

REFERENCES

1. Venkataramani, V, Anantharaman, N and MeeraSheriffaBegum K. M. Process Calculations, 2nded.PHI Learning Pvt. Ltd, 2011
2. Himmelblau, D. M. and Riggs,B.J. Basic Principles and Calculations in Chemical Engineering, 8thEdition, Prentice Hall International series, 2012.
3. Sikdar, C.D. Chemical Process Calculations, PHI Learning Pvt. Ltd, 2013.
4. Gavahane, K. A. Introduction to Process Calculations, Nirali Publication, 2016.

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	3	1	-	-	1	-	-	-	-	3	2
CO2	3	3	2	2	1	-	-	1	-	-	-	-	3	2
CO3	3	3	2	2	1	-	-	1	-	-	-	-	2	2
CO4	2	3	2	2	1	-	-	1	-	-	-	-	2	3
CO5	3	2	2	2	1	-	-	1	-	-	-	-	3	3

PT20302 FUNDAMENTALS OF BIOCHEMISTRY & MICROBIOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to

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

UNIT I INTRODUCTION OF BIOMOLECULES 9

Nomenclature; Structure, Classification, and Functions of Carbohydrates – Monosaccharides, Disaccharides, Polysaccharides and Metabolism Of Carbohydrates; Classification – Structure and Functions of Lipids; Fatty Acids – TAG Structure and Properties; Phospholipids – Functions; Derived Lipids – Cholesterol and Metabolism of Lipids

UNIT II AMINOACIDS AND PROTEINS 9

Classification, Structure and Function of Aminoacids – Properties; Proteins – Classification, Hierarchy of Proteins – Primary, Secondary, Tertiary and Quaternary Structure, Determination of Primary Structure; Biologically Important Peptides; Metabolism – Synthesis and Degradation of Aminoacids.

UNIT III FUNDAMENTAL CONCEPTS OF THE MICROBIAL STRUCTURE AND REPRODUCTION 9

Introduction, History and Scope of Microbiology, Classification and Nomenclature of Microorganisms; Basics of Microscopy, Staining - Simple, Differential (Gram Staining, Acid Fast Staining), Special Staining (Flagella, Capsule, Endospore); Structural Organization and Multiplication of Bacteria, Viruses (Virus - TMV, HIV & T4 Bacteriophage - Lytic, Lysogenic Cycle), Fungi - Fungal Morphology, Mycelial and Yeast Forms - Sexual and Asexual Reproduction.

UNIT IV MICROBIAL GROWTH AND MOLECULAR SYSTEMS 9

Microbial Nutrition and Growth- Types of Growth Media, Growth Phases, Various Culture Types, Types Of Fungal Growth Media, Microbial Metabolism - Aerobic & Anaerobic Respiration, Entner Duodruffs Pathway, Nitrogen Fixation; Molecular Systems- Polyphasic Approach 16s Rrna Gene Sequencing.

UNIT V CONTROL OF MICROORGANISMS 9

Physical and Chemical Control of Microorganisms; Host-Microbe Interactions; Anti-Bacterial, Anti-Fungal and Anti-Viral Agents; Mode of Action and Resistance to Antibiotics; Clinically Important Microorganisms.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- explain the structure and functional role of carbohydrates and lipids in biological reactions.
- gain knowledge in the hierarchical organization of proteins and their metabolic pathways.
- be able to obtain knowledge in morphology and staining techniques.
- obtain a significant knowledge in advanced aspects of molecular analysis.
- gain knowledge about microbe's interaction and therapeutic modalities.

TEXT BOOKS

1. David L. Nelson and Michael M Cox. Lehninger's Principles of Biochemistry, Macmillan Worth Publisher, 6th Edition, 2012.
2. Voet D., Prat W.C., Voet J. Principles of Biochemistry, John Wiley and Sons, 4th Edition 2012.
3. Pelczar MJ, Chan ECS and Krein NR. Microbiology, Tata McGraw Hill Edition, New Delhi, India.
4. Bernard R. Glick & Jack J. Pasternak. Molecular Biotechnology. Indian edition. Panima Publishing Corporation,2002

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

PT20303 PHARMACEUTICAL CHEMISTRY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- inculcate understanding of the properties and principles of medicinal agents that originates from organic and inorganic sources and their application in pharmaceutical industry.
- provide the basic functional group identification, molecular rearrangement, chemical bonding with their reaction mechanism.
- provide the fundamental principles involved in the identification, preparation of pharmaceutical aids and to apply the principle of coordination compounds in pharmaceutical substances
- acquire the knowledge of molecular biology
- gain the basic knowledge and fundamentals of various agents and its industrial application

UNIT I STRUCTURE AND PROPERTIES 9

Molecular Orbital Theory, Hybrid Orbitals, Polarity of Bonds and Molecules, Dipole Moment, Resonance, Inductive, Mesomeric and Electromeric Effects; Intramolecular and Intermolecular Hydrogen Bonding.

UNIT II CHEMISTRY OF ALIPHATIC, AROMATIC AND HETEROAROMATIC COMPOUNDS 9

Characteristics of Organic Compounds, Structure, Nomenclature, Preparation, and Reaction Mechanism of Alkyl and Aryl Halides (Mechanism of SN1, SN2, E1 And E2), Huckel's Rule, Structures, Synthesis, Properties and Chemical Reactions of Benzenoid and Non-benzenoid Compounds, Mechanism of Aromatic Electrophilic and Nucleophilic Substitution. General Principles of Heterocyclic Synthesis – Methods of Preparation and Reactions of Pyridines, Pyrroles, Thiophenes, Furans, Quinolines and Isoquinolines.

UNIT III PRINCIPLES OF TEST FOR PURITY IN PHARMACEUTICAL SUBSTANCES 9

Identification and Characterization of Impurities in Pharmaceutical Substances, Limit Tests - Definition, Importance, General Procedure for Limit Test for Chlorides

UNIT IV STUDY OF ORGANIC REACTIONS AND MOLECULAR REARRANGEMENTS 9

Hoesch Reaction, Formylation Reactions, Gattermann Reaction, Gattermann - Koch Reaction, Vilsmeier Reaction, Reimar-Tiemann Reaction, Wolff Rearrangement, Schmidt Reaction; Curtius Rearrangement, Catalytic Dehydrogenation, Meerwein – Ponndorf - Verley, Nabh4, Clemmenson, Sandmeyer, Ullmann, Azo Coupling, Deamination, Benzidine Rearrangement.

UNIT V PHARMACEUTICAL AIDS AND CO-ORDINATION COMPOUNDS 9

Preparation and Properties of Various agents such as – Sodium Bisulphate, Sodium Metabisulphate, Sulphur Dioxide, Bentonite, Magnesium Stearate, Zinc Stearate, Aluminium Sulphate, Sodium Carboxy Methyl Cellulose, Sodium Methylparaben - Theory of Co-ordination compounds with special

reference to Application in Pharmacy such as – EDTA, Dimercaprol, Penicillamine, 1, 10-Phenanthroline.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- identify the functional groups in pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.
- identify and estimate the purity of drugs and its application.
- apply the knowledge in the development and synthesis of new drug molecule with special reference to organic, inorganic and coordination chemistry.
- understand the knowledge about molecular biology.
- demonstrate the various reagents used in pharmaceutical industry.

TEXT BOOKS

1. Francis A. Carey (Author), Richard J. Sundberg. Advanced Organic Chemistry, Part A: Structure and Mechanisms 5th Edition, Springer Publishers, 2000.
2. N V Chenchu Lakshmi, Pharmaceutical Inorganic chemistry: Theory and practice, 1st Edition, Pearson Education India,2012.

REFERENCES

1. Michael B. Smith, Jerry March. March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 6th Edition, Wiley,2007
2. Lutz F. Tietze, TheophilEicher, Ulf Diederichsen, Andreas Speicher. Reactions and Syntheses in the Organic Chemistry Laboratory, 1st Edition, Wiley – VCH,2007
3. P. L. Soni, VandnaSoni. Coordination Chemistry: Metal Complexes, 1st Edition, CRC Press, 2013
4. R.K. Sharma. Textbook of Coordination Chemistry, 1st Edition, Discovery Publishing House Pvt. Ltd.2011.

CO/PO MAPPING:

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

PT20304 PHYSICAL PHARMACEUTICS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- acquire the fundamental principles and concepts involved in pharmaceutical powders, liquid flow, dispersions.
- acquire the fundamental knowledge of drug diffusion, dissolution, complexation, and protein binding.
- provide the knowledge about colloidal dispersion
- acquire the fundamental of complex and protein structure.
- acquire the fundamental reaction 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, 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 AND 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 of Flocculated Particles, 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

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

- understand the surface, interfacial phenomena, and the rheology of liquids.
- ability to understand the principles, characters, and applications of pharmaceutical dispersions.
- apply the concept of drug diffusion, dissolution, complexation, and protein binding.
- be familiar with the degradation pathways, stabilization of drugs and their expiry date calculation.
- understand the drug stability of the compounds

TEXT BOOKS

1. Manavalan, R. and Ramasamy. C. Physical Pharmaceutics 2nd Ed., Vignesh Publishers, 2015.
2. C.V.S. Subrahmanyam. Textbook of physical pharmaceutics, 3rd Edn., Vallabhprakashan, 2015.

REFERENCES

1. Alfred N. Martin, Patrick J. Sinko. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, sixth edition, Lippincott Williams & Wilkins, 2011.
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, NiraliPrakashan, 12th edition, 2017.

CO/PO MAPPING:

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

MC20301 VALUE EDUCATION 2 0 0 0

COURSE OBJECTIVES

To enable students to

- develop the individual multi-dimensionally in physical, intellectual, emotional, and spiritual dimensions.
- facilitateindividuals think about and reflect on different values.
- understandtheir responsibility in making choices and the practical implications of expressing them.
- Instigate to choose their personal, social, moral, and spiritual values.
- designand chisel the overall personality of an individual.

UNIT I PERSONAL VALUES 6

Value Education – Definition, Types of values; Human values - Respect, Acceptance, Consideration, Appreciation, Listening, Openness, Affection, Patience, Honesty, Forgiveness, Sacrifice, Authenticity, Self Control, Altruism, Tolerance and Understanding, Wisdom, Decision making, Self actualization, Character formation towards positive Personality,Contentment; -Religious Values -Humility, Sympathy and Compassion, Gratitude. Peace, Justice, Freedom, Equality.

UNIT II COMMUNAL VALUES 6

Social Values - Pity and probity - Self-control - Respect to - Age, Experience, Maturity, Family members, Neighbors- Universal Brotherhood - Flexibility -Peer pressure - Sensitization towards Gender Equality, Physically challenged, intellectuallychallenged - Reliability - Unity - Modern Challenges of Adolescent Emotions and behavior - Comparison and Competition- Positive and Negative thoughts- Arrogance, Anger and Selfishness.

UNIT III ENGINEERING ETHICS 6

Professional Values - Knowledge thirst - Sincerity in profession- Regularity, Responsibility, Punctuality and Faith - Perseverance - Courage - Competence - Co-operation- Curbing unethical practices - Integrity, Social Consciousness and Responsibility.Global Values - Computer Ethics – Moral Leadership - Code of Conduct - Corporate Social Responsibility.

UNIT IV SPIRITUAL VALUES 6

Developing Spirituality - Thinking process, Moralization of Desires - Health benefits- Physical exercises - Mental peace - Meditation - Objectives, Types, Effects on body, mind, and soul- Yoga - Objectives, Types, Asanas. Family values -family's structure, function, roles, beliefs, attitudes and ideals, Family Work Ethic, Family Time, Family Traditions.

UNIT V HUMAN RIGHTS

Classification of Human Rights - Right to Life, Liberty and Dignity- Right to Equality - Right against Exploitation - Cultural and Educational Rights- Physical assault and Sexual harassment - Domestic violence.

TOTAL PERIODS: 30

COURSE OUTCOMES

At the end of this course, the students will be able to

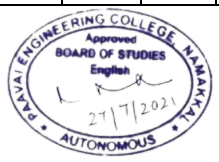
- cultivate the values needed for peaceful living in the existing society.
- comprehend humanistic values to develop peace in the world.
- foster ethics in profession and usage of technology.
- orient with the importance of value education towards personal, group and spiritual attributes.
- nurture physical, mental, spiritual growth to face the competitive world.

REFERENCES

1. Little, William, An introduction of Ethics. Allied publisher, Indian Reprint 1955.
2. Sharma, S.P. Moral and Value Education; Principles and Practices, Kanishka publishers, 2013.
3. "Values **(**Collection of Essays)". Sri Ramakrishna Math. Chennai. 1996

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	2	-	-	2	-	2
CO2	-	-	-	2	-	2	-	1	3	2	1	3	-	2
CO3	-	-	3	2	2	3	2	3	3	1	3	3	2	3
CO4	-	-	3	1	-	2	-	-	1	-	-	3	2	-
CO5	-	-	-	-	-	1	-	-	-	-	-	-	3	-



PT20305 BIOCHEMISTRY AND MICROBIOLOGY LABORATORY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the principles behind the qualitative estimation of biomolecules.
- understand the principles behind the quantitative estimation of biomolecules.
- impart the knowledge of extraction and analysis of biomolecules.
- identify the microbes and characterize its nature.
- understand the propagation of microorganisms.

LIST OF EXPERIMENTS

1. Preparation of buffer –titration of a weak acid and a weak base.
2. Qualitative tests for carbohydrates and amino acids.
3. Protein estimation by Biuret and Lowry's methods.
4. Protein estimation by Bradford and spectroscopic methods.
5. Extraction of lipids and analysis by TLC.
6. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect.
7. Estimation of glucose by GOD-POD method after hydrolysis of starch with acid and specificity of the enzymatic method.
8. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs.
9. Microscopic Methods in the Study of Microorganisms., Microscopic identification of yeast/mold
10. Staining Techniques Simple, Differential- Gram's Staining, spore /capsule staining.
11. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC.
12. Effect of Disinfectants- Phenol Coefficient.
13. Antibiotic Sensitivity Assay.
14. Growth Curve in Bacteria.
15. Effect of pH, Temperature, UV radiation on Growth Bacteria

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, the students will be able to

- estimate the concentration of various biomolecules.
- analyze the composition of biomolecules in various body fluids.
- know the various aseptic techniques and sterilization methods.
- develop the skills required for the study of microorganisms
- understand the importance of physical parameters for the optimum growth of bacteria.

REFERENCES

1. Introduction of Practical Biochemistry by David T. Phummer. (II Edition)
2. Introduction of Practical Biochemistry by David T. Phummer.
3. Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.

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	-	1	-	-	-	1	3	2
CO2	3	2	2	1	2	-	-	1	-	-	-	1	2	3
CO3	3	2	3	1	1	-	-	1	-	-	-	1	2	3
CO4	2	2	-	2	-	1	-	-	-	-	-	-	3	2
CO5	2	1	2	-	-	-	-	-	-	-	-	-	2	2

PT20306 PHYSICAL PHARMACEUTICS LABORATORY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- practice the determination of fundamental properties of dosage forms of powders and dispersions.
- study the kinetics and stability aspects of pharmaceuticals.
- study the compressibility and stability of drugs
- study the different types of colloids and emulsions

LIST OF EXPERIMENTS

1. Studies on 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

- characterize and evaluate the properties of powders by using suitable methods.
- plan and carryout the stability studies and determine the stability of various dosage forms.
- calculate the rate constants and determine the various order of reactions involved in pharmaceutical systems and process.
- understand the shelf life of the drugs

TEXT BOOKS

1. CVS Subrahmanyam, SG Vasantharaju. Laboratory Manual of Physical Pharmacy, 2nd Ed., Vallabh Prakashan, 2009.
2. Manavalan, R. and Ramasamy. C. Physical Pharmaceutics 2nd Ed., Vignesh Publishers, 2015.

REFERENCES

1. Eugene L. Parrott, WitoldSaski. Experimental Pharmaceutics, 4th edn., Burgess Pub. Co., 1977.
2. Howard C. Ansel. Pharmaceutical Calculations, 13th edn., LWW, 2009,
3. Dr. U. B. Hadkar. Practical Physical Pharmacy & Physical Pharmaceutics, Nirali Prakashan, Pune,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	2	1	3	2	-	-	2	-	-	-	3	3
CO2	3	3	2	1	-	-	-	-	2	-	-	-	2	3
CO3	3	3	2	1	-	-	-	-	2	-	-	-	2	2
CO4	2	2	3	2	-	1	-	-	-	-	-	--	3	2

EN20301 ENGLISH PROFICIENCY COURSE LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable students to

- Familiarize with the reading skills such as skimming and scanning.
- Practice writing tasks to the level expected.
- Develop listening strategies such as listening for key words, making inferences, and identifying main ideas.
- Speak well without inhibition and to assist the students in improving their vocabulary, pronunciation, and comprehension of grammar.
- Enrich their slew skills to crack on-line proficiency tests and to bring their career aspirations true

LIST OF EXPERIMENTS

1. Listening Exercises from TOEFL
    a) Conversations, Lectures
2. Listening Exercises from IELTS
    a) Places and directions
    b) Actions and processes
3. Reading Exercises from PTE
    a) Re-order paragraphs
4. Reading Exercises from IELTS
    a) Opinions and attitudes
    b) Locating and matching information
5. Reading Exercises from BEC Vantage
    a) Single informational text with lexical gaps
    b) Error identification
6. Writing Exercises from PTE
    a) Summarize written text
7. Writing Exercises from IELTS
    a) Describing maps
    b) Describing diagrams
8. Speaking IELTS format
    a) Talking about familiar topics
    b) Giving a talk
    c) Discussion on a Topic

TOTAL PERIODS: 30

COURSE OUTCOMES

At the end of this course, the students will be able to

- sakim, scan and infer the given texts and attend the tasks successfully.

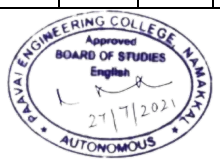
- write coherently using appropriate vocabulary and grammar.
- listen to speeches and conversations and answer the questions.
- communicate fluently and effectively on any given topics.
- appear with confidence for on-line tests.

TEXTBOOKS

1. Cambridge University Press India Pvt. Ltd, New Delhi.2016.
2. PTE Academic Test builder. Macmillan Education. London. 2012.
3. Cambridge IELTS 12 Academic Student's Book with Answers: Authentic Examination Papers (IELTS by Cambridge University Press. New Delhi.2016
4. TOEFL iBT Prep Plus 2018-2019 4 Practice Tests) Kaplan Publishing. Newyork.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	-	-	-	2	3	-	-	-	3	2	-	-		2
CO2	-	-	2	2	-	-	1	1	3	2	-	2	-	2
CO3	-	-	-	-	-	3	1	2	3	2	2	3	2	-
CO4	-	-	-	-	-	2	2	3	3	2	2	-	2	-
CO5	-	-	2	-	-	1	2	-	3	3	-	1	2	3



MA20403 PROBABILITY AND STATISTICS 3 1 0 4

COURSE OBJECTIVES

To enable students to

- analyse the concept of Random variables and probability distribution in designing processes.
- know and differentiate the discrete and continuous two dimensional random variables.
- determine the concepts of hypotheses testing, its need and applications.
- equip with statistical techniques for designing experiments, analyzing, interpreting and presenting research data.
- emphasize the aspects of statistical tools in engineering problems.

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

ANOVA - One way and Two way classifications - Completely randomized design - Randomized block design - 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.

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, the students will be able to

- demonstrate the fundamental concepts of probability and probability distributions of random variables in designing process
- identify the differences in two dimensional random variables
- implement the statistical techniques to hypotheses testing of engineering and management problems

- be aware of the principles to be adopted for designing the experiments.
- compare statistical date using control chart in quality control

TEXT BOOKS

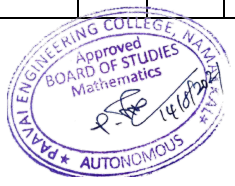
1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4thEdition, 2007.
2. Johnson. R.A. and Gupta. C.B., Miller and Freund's Probability and Statistics for Engineers", PearsonEducation, Asia, 7thEdition, 2007.
3. Papoulis. A andUnnikrishnapillai. S., "Probability, Random Variables and Stochastic Processes"McGraw Hill Education India,4thEdition, New Delhi, 2010.

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 ofProbability and Statistics", Tata McGraw Hill Edition, 2004.

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	3	-	-	-	-	-	-	-	3	3	3
CO2	3	2	3	3	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3



PT20401 FLUID FLOW OPERATIONS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- provide the basic fundamental knowledge about the flow properties of different types of fluids.
- have some knowledge on fundamental concepts, fluid properties and fluid statics.
- help the students to have knowledge on fluid properties characteristics while static, during flow through ducts, pipes, and other channels.
- provide the knowledge about the various transporting and metering devices of fluid flow in bulk pharmaceutical manufacturing and in chemical process.
- knowledge on several machineries used to transport the fluid and their performance are assessed.

UNIT I PROPERTIES OF FLUIDS AND CONCEPT OF PRESSURE 9

Introduction–Physical Properties of Fluids, Types of Fluids, Fluid Statics and its Applications; Pressure, Density, Height Relationships, Pressure Measurement; Units and Dimensions – Dimensional Analysis, Dimensionless Numbers.

UNIT II MOMEMTUM BALANCE AND ITS APPLICATIONS 9

Kinematics of Fluid Flow, Streamline, Stream Tube, Velocity Potential, Newtonian and Non-Newtonian Fluids, Time Dependent Fluids, Reynolds Number Experiment and Significance; Continuity Equation, Momentum Balance, Potential Flow, Bernoulli's Equation, Correction for Fluid Friction, Correction for Pump Work.

UNIT III FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS 9

Flow of Incompressible Fluids in Pipes – Laminar and Turbulent Flow through Closed Conduits; Velocity Profile and Friction Act or for Smooth and Rough Pipes; Heat Loss due to Friction in Pipes and Fittings.

UNIT IV FLOW OF FLUIDS THROUGH SOLIDS 9

Form drag, Skin drag, Drag Co-efficient, Flow around Solids and Packed Beds – Friction Factor for Packed Beds, Ergun's Equation– Motion of Particles through Fluids – Motion under Gravitational and Centrifugal Fields, Terminal Settling Velocity, Fluidization – Mechanism, Types, General properties, Applications

UNIT V TRANSPORTATION AND METERING 9

Measurement Of Fluid Flow – Orifice Meter, Venturi Meter, Pitot Tube, Rotameter, Weirs and Notches – Hot Wire Anemometers; Transportation of Fluids, Positive Displacement Pumps, Rotary and Reciprocating Pumps, Centrifugal Pumps, Performance and Characteristics– Airlift and Diaphragm Pumps.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- understand fundamental concepts in fluids, such as density, viscosity, pressure, and temperature.
- solving problems skill in the movement of fluids through all kinds of process equipment and use dimensional analysis for scaling experimental results
- apply the mass, energy, and momentum balance equations in fluid flow problems.
- analyse and solve the problems involving laminar and turbulent frictional flow, fluid dragon particles, packed beds and pumps involving Newtonian and non-Newtonian fluid flow in chemical engineering equipment's.
- analyse pipe flows as well as fluid machineries used to transport the fluid and their performance

TEXT BOOKS

1. W.L. McCabe, J.C. Smith, P. Harriott. "Unit operations of Chemical Engineering", 7th ed., McGraw-Hill, 2017.
2. W.M. Deen. "Introduction to Chemical Engineering Fluid Mechanics (Cambridge Series in Chemical Engineering)", Cambridge University Press, UK, 2016.

REFERENCES

1. Bansal,R.K. "Fluid Mechanics and Hydraulic machines", Laxmi Publications (P)Ltd., 2017.
2. Nevers,N.D. "Fluid Mechanics for Chemical Engineers", 3 r d ed., McGraw-Hill,2005
3. James Patrick Abulencia, Louis Theodore. "Fluid Flow for the Practicing Chemical Engineer", Wiley, 2009.

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	1	1	1	-	-	1	-	-	-	-	3	2
CO2	3	3	2	2	1	-	-	1	-	-	-	-	3	2
CO3	3	3	3	2	1	-	-	1	--	-	-	-	2	3
CO4	3	3	3	2	1	-	-	1	-	-	-	-	3	2
CO5	3	2	2	2	1	-	-	1	-	-	-	-	2	2

EE20409 ELECTRICAL MACHINE DRIVES AND SENSORS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- acquire knowledge on the fundamentals of DC machines, starters and braking methods
- understand the basic concepts of induction motors.
- know the fundamentals and power ratings of electric drives.
- analyze the speed control of DC and AC drives.
- familiarize knowledge about transducer and sensors.

UNIT I DC MACHINES **9**

DC Generator-Construction and principle of operation, EMF equation, types, OCC and external characteristics curves; DC Motors-Principle of operation, types, characteristics; Starters ,braking methods

UNIT II AC MOTOR **9**

Three phase Induction motors, construction, types, principle of operation, torque-slip characteristics and starting methods, Single phase induction motor-Construction and working principle of operation.

UNIT III FUNDAMENTALS OF ELECTRIC DRIVES **9**

Basic elements, types of electric drives, factors influencing the choice of electrical drives ,Heating and cooling curves ; Loading conditions and classes of duty , selection of power rating for drive motors ; Load variation factors.

UNIT IV SOLID STATE SPEED CONTROL OF D.C. AND A.C DRIVES USING CONVENTIONAL METHODS **9**

Speed control of DC series and shunt motors – Armature and field control, Ward- Leonard control system, solid state control using controlled rectifiers (Single phase Half and Full wave); Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme ; Inverters and AC voltage regulators ; Applications.

UNIT V TRANSDUCERS AND SENSORS **9**

Introduction to transducers – LVDT, piezoelectric transducer, temperature transducer, pressure transducers; Introduction to sensors-Signal conditioning of sensors, position sensors, inductive position sensors, inductive proximity sensors, rotary encoders, temperature sensors, light sensors, chemical sensors, level sensors and its types ; Applications.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- reproduce the concept of DC generator and implement it in practical applications.
- explain about AC motors and its working.

- formulate electric drives with various power rating.
- select DC and AC drives for industry and domestic application.
- analyze the concentration of chemicals using sensors.

TEXT BOOKS

1. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 2014.
2. VedamSubrahmaniam, "Electric Drives (concepts and applications)", Tata McGraw- Hill, 2016.
3. D. Patranabi, "Sensors and Transducers", PHI Learning Pvt. Ltd., 2016.

REFERENCES

1. Theraja B.L and Theraja A.K., "A Text book of Electrical Technology", Volume – II, S,Chand Co.,2016.
2. M.D.Singh, K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2014.
3. Ian.R.Sinclair, "Sensors and Transducers", BSP Publication, 2015.
4. Bimal K Bose, "Modern Power Electronics and AC Drives", Prentice-Hall of India Pvt. Ltd., 2013.
5. Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, 2014.

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

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

PT20402 UNIT OPERATIONS IN PHARMA INDUSTRIES 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the basic fundamentals of material composition.
- acquire knowledge of various unit operations such as size reduction, separation.
- understand the principle of crystallization and evaporation.
- gain knowledge about filtration, centrifugation,
- provide the basic fundamentals of mixing operations.

UNIT I MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION 9

Overview of Composition, Corrosion, Resistance, Properties and Applications of the materials of construction with special reference to Stainless Steel and Glass- Industrial Hazards and Safety Precautions – Mechanical, Chemical, Electrical, Fire and Dust hazards, etc.

UNIT II SIZE REDUCTION & SEPARATION 9

Properties and Characterization of Particulate Solids — Introduction to Storage and Conveying of Solids - Analysis and Technical methods for Size determination of Powders - Size reduction equipment – Screening equipment

UNIT III CRYSTALLIZATION 9

Characters of Crystals like Purity, Size, Shape, Geometry, Habit, Forms, Size and its factors - Solubility curves - Super saturation theory and its limitations; Nucleation mechanism and Crystal growth- Crystallisers- Swenson Walker crystalliser - Caking of Crystals and its Prevention and Numerical Problems on Yields.

UNIT IV FILTRATION AND CENTRIFUGATION 9

Theory of Filtration, Filter Aids, Filter Media, Factors affecting Filtration, Industrial Filters including Filter Press, Rotary Filter, Edge Filter, etc., Mathematical Problems on Filtration; Principles of Centrifugation- Industrial Centrifugal Filters - Sedimentation Centrifuges.

UNIT V MIXING 9

Mixing of Powdered Materials – Mechanism of Random Mixing and Interactive Mixing; Sampling techniques, Size and Mixing Indices. Factors affecting the Mixing Process; Types, Characteristics, and Operation of Mixers.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- understand the importance of various categories of materials used in pharmaceutical industry.
- apply the fundamental concepts of Size reduction, separation, filtration, centrifugation in pharmaceutical industry.
- implement the fundamental concepts of crystallization and evaporation in pharma industry

- understand about filtration and centrifugation in pharmaceutical industry
- understand the basic concepts of mixing process in pharmaceutical industry

TEXT BOOKS

1. McCabe WL, Smith J.C and Harriott. “Unit operations of Chemical Engineering” McGraw Hill International Book Co. London 2004.
2. Girish K. Jani, “Pharmaceutical Engineering I, Unit Operation I” B.S. Shah Prakashan, India, 2006.

REFERENCES

1. Badger, W.L and Banchero, J.T. “Introduction to Chemical Engineering” Tata McGraw Hill, 2002
2. Coulson, J.M. and Richardson.J.F. “Chemical Engineering” 3rd Edition, Butterworth Heinemann Publication, 2001.
3. K. Sambamurthy, Pharmaceutical Engineering New Age International (P) Ltd., Publishers, New Delhi, 1998.
4. Cooper and Gunn's Tutorial Pharmacy, Edited by S J Carter, CBS Publishers, New Delhi, 2005

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	3	2	-	1	-	-	-	1	3	2
CO2	3	3	2	2	-	-	-	1	-	-	-	-	3	3
CO3	3	3	2	2	1	-	-	1	-	-	-	-	2	2
CO4	2	2	-	1	-	1	-	-	-	-	-	-	3	2
CO5	1	1	2	-	-	-	-	-	-	-	-	-	2	2

PT20403 PHARMACEUTICAL ANALYSIS 3 0 0 3

COURSE OBJECTIVES

To enable students to

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

UNIT I UV-VISIBLE SPECTROSCOPY 9

Theory of Atomic and Molecular Spectra, Electronic Transitions, Beer and Lambert's law, Derivation and Deviations, Chromophores, Autochromes, Spectral Shifts, Solvent Effect on Absorption Spectra; Instrumentation - Sources of Radiation, Wavelength Selectors, Sample cells, Detectors- Barrier Layer Cell, Photo tube, PMT, PDA detectors; Applications in Pharmaceuticals.

UNIT II ATOMIC ABSORPTION SPECTROSCOPY 9

Principles, Instrumentation, Operation – Single and Double Beam Spectroscopy; Sampling Technique – Detection Limit, Difference between Atomic Absorption Spectroscopy and Flame Spectroscopy; Applications in Pharmaceuticals.

UNIT III INFRARED AND NMR SPECTROSCOPY 9

Principles of Vibrational Spectroscopy, Instrumentation and Sampling Techniques, Applications in Pharmaceutical Sciences; NMR principles, Instrumentation, Applications in Pharmaceuticals.

UNIT IV MASS SPECTROMETRY 9

Basic Principles, Instrumentation, and Ionization Methods; Atmospheric Pressure Ionization (API), Chemical Ionization (CI), Electron Impact Ionization (EI), Fast Atom Bombardment (FAB), Matrix Assisted Laser Desorption Ionization (MALDI), Time of Flight (TOF); Applications in Pharmaceuticals..

UNIT V CHROMATOGRAPHIC METHODS 9

History, Origin, and Classification of Chromatography; Column Chromatography - Principle, Theory, Column Operations, Instrumentation, Derivatization Methods and Applications; High Performance Liquid Chromatography - Principle, Instrumentation, Solvents System, Packing Materials and Applications; Thin Layer Chromatography - Principle, Instrumentation, Solvents, Packing Materials and Applications in Pharmaceuticals.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- understand the concepts of modern analytical instruments like UV/Vis, IR, NMR, Mass spectroscopy and HPLC.

- implement to involve in Qualitative and Quantitative analysis techniques of various pharmaceutical agents.
- understand the principles of ES-MS.
- understand the phytochemical and biological standardization of pharmaceutical products.
- understand the principles of different chromatographic methods.

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	3	2	3	3	2	-	1	-	-	-	-	2	3
CO2	3	3	3	2	3	1	-	1	-	-	-	-	2	3
CO3	3	3	3	2	2	-	-	1	-	-	-	-	3	2
CO4	2	2	-	-	1	-	-	-	-	-	-	-	2	3
CO5	1	2	1	2	-	1	-	-	-	-	-	-	2	2

PT20404	ANALYTICAL METHODS AND INSTRUMENTATION LABORATORY	0 0 4 2

COURSE OBJECTIVES

To enable students to

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

LIST OF EXPERIMENTS

1. Calibration of volumetric glass wares.
2. Establishing standard operating procedure (SOP) and Calibration records for analytical balance, pH meter and UV/Vis spectroscopy.
3. Determination of λmax.
4. Effect of change in physio-chemical parameters on absorbance spectrum of a drug molecule.
5. Quantitative and qualitative analysis of drug molecule using standard comparison method by UV/Vis spectroscopy and HPLC.
6. Quantitative analysis of drug molecule using E1%1cm method by UV/Vis spectroscopy.
7. Quantitative analysis of drug molecule using calibration graph method by UV/Vis spectroscopy and HPLC.
8. Separation and identification of mixtures of drugs by TLC.
9. Separation and identification of amino acids by paper chromatography.
10. Identification of functional group of a drug molecule by IR spectroscopy.
11. Determination of impurities by limit test.
12. Quantitative analysis by titrimetric methods.

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, the students will be able to

- understand the standardization of various assay reagents with respect to chemical and drug analysis.
- quantification of drugs molecules by chromatographic and spectral techniques.
- understand the modern tools in industry.
- analyze the concentration of chemicals using chromatographics.

REFERENCES

1. Atherden L.M, “Bentley and Driver’s Textbook of Pharmaceutical Chemistry”, 8th Edition, Oxford University Press, 2004.
2. Siddiqui, Anees A, “Pharmaceutical Analysis”. Vol.I& II, 3rd edition, CBS Publishers, 2014.

3. Takeru Higuchi, EinarBrochmann, HanffenHanssen, HamffenHanssen, “Pharmaceutical Analysis” 1st Edition, CBS Publishers, 2005.
4. Loyd V. Allen Jr, “Remington: The Science and Practice of Pharmacy”. Vol. I & II, 22nd Edition, Pharmaceutical Press, 2012.
5. Kenneth A. Connors, “Textbook of Pharmaceutical Analysis”, 3rd Edition, John wiley and sons, New York, 2007.

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	3	2	3	-	-	1	-	-	-	-	-	-	3	2
CO4	2	2	1	-	1	-	-	-	-	-	-	-	2	2
CO5	1	2	1	2	-	-	-	-	-	-	-	-	2	3

CM20304 **FLUID MECHANICS LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

To enable students to

- calibrate and study the working of flow meters and
- find pressure loss for flowing fluid
- determine characteristics of different pump.
- Measure the pressure drop studies

LIST OF EXPERIMENTS

1. Discharge coefficient of constant and variable head meters
2. Calibration of weirs and notches
3. Open drum orifice and draining time
4. Flow through straight pipe
5. Flow through annular pipe
6. Flow through helical coil and spiral coil
7. Losses in pipe fittings and valves
8. Characteristic curves of pumps (Centrifugal, Reciprocating)
9. Pressure drop studies in packed column
10. Pressure drop studies in Fluidized bed
11. Viscosity measurement
12. Calibration of Rotameter

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of the course, students will be able to

- understand the fundamental fluid flow properties and its measurements.
- apply the principles of dimensional analysis for Engineering applications.
- analyze the types of fluid flow in pipe
- analyze the performance of fluid moving machinery and appraise the types of valves and pipe fittings in process industries.

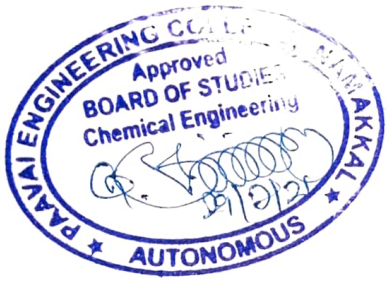
REFERENCES

1. McCabe, W.L, Smith J.C and Harriot, P., "Unit Operations in Chemical Engineering", McGraw-Hill, Fourth Edition, 1984.
2. J.M. Coulson and J.F. Richardson, "Chemical Engineering Vol - I &II", 6thEdition Butterworth –New Delhi, (2000).

3. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines", Revised Ninth Edition, Laxmi Publications(p) limited, (2014).
4. Noel De Nevers, "Fluid Mechanics for Chemical Engineers, "Second Edition, McGraw Hill (1991)

CO/PO MAPPING

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



EE20410 ELECTRICAL ENGINEERING LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to

- conduct test to examine the characteristics of DC motors under loaded and unloaded conditions.
- know about the speed control in DC shunt motor.
- demonstrate the working of various starters.
- conduct the relevant experiments for determining the performance characteristics of transducers.

LIST OF EXPERIMENTS

1. Load test on DC shunt motor and DC Series motor.
2. Open circuit characteristics and load characteristics of DC shunt
3. Speed Control of DC Shunt Motor (Armature and Field control)
4. Swinburne's test
5. Load test on three phase squirrel cage induction motor
6. Speed control of three phase squirrel cage induction motor.
7. Load test on single phase induction motor.
8. Study of DC and AC Starters.
9. Study of displacement transducer –LVDT
10. Study of pressure transducer

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, students will be able to

- examine the characteristics of DC motors under loaded and unloaded conditions.
- control the speed of DC shunt motor with appropriate circuit.
- employ practically various starters in engineering applications.
- analyze the performance characteristics of transducers.

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