

COURSE OBJECTIVES

To enable students

- study structural and functional properties of carbohydrates, proteins, lipids and nucleic acids
- emphasize the role of the biomolecules by providing basic information on metabolic diseases and disorders.
- recognize the importance of proteins for building blocks.
- describe the functions of fats and amino acids against germs.
- understand the enzymatic action against bacteria.

UNIT I INTRODUCTION TO BIOCHEMISTRY**9**

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Henderson-Hasselbalch equation, physiological buffers in living systems, Energy in living organism. Properties of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes.

UNIT II CARBOHYDRATES**9**

Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, physical and chemical properties of carbohydrates Isomerism, racemisation and mutarotation. Digestion and absorption of carbohydrates. Metabolic pathways and bioenergetics – Glycolysis, glycogenesis, glycogenolysis and its hormonal regulation. TCA cycle and electron transport chain. Oxidative phosphorylation. Biochemical aspect of Diabetes mellitus and Glycogen storage Disease.

UNIT III LIPIDS**9**

Classification of lipids- simple, compound and derived lipids. Nomenclature of fatty acid, physical and chemical properties of fat. Metabolic pathways: synthesis and degradation of fatty acid (beta oxidation), hormonal regulation of fatty acid metabolism, ketogenesis, Biosynthesis of Cholesterol. Disorders of lipid metabolism.

UNIT IV NUCLEIC ACID & PROTEIN**9**

Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as a genetic material, Chargaff's rule. Watson and Crick model of DNA. Structure of RNA and its type. Metabolism and Disorder of purines and pyrimidines nucleotide Classification, structure and properties of proteins, structural organization of proteins, classification and properties of amino acids. Separation of protein, Inborn Metabolic error of amino acid metabolism.

UNIT V ENZYME AND ITS CLINICAL APPLICATION

Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors. Kinetics of enzymes - Michaelis-Menten equation. Factors affecting enzymatic activity: temperature, pH, substrate concentration and enzyme concentration. Inhibitors of enzyme action: Competitive, non-competitive, irreversible. Enzyme: Mode of action, allosteric and covalent regulation. Clinical enzymology. Measurement of enzyme activity and interpretation of units.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon Completion of the Course the students will be able to

- Explain the fundamentals of biochemistry
- Clinical application of Biochemistry
- Evaluate the lipid compound and its synthesis.
- Evaluate the nucleic acid and its synthesis.
- Understand the enzyme reaction and its clinical application.

TEXT BOOKS:

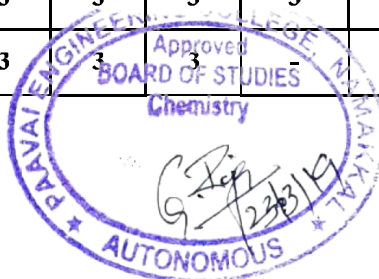
1. RAFIMD—Textbook of biochemistry for Medical Student Second Edition, University Press, 2014.
2. David.W.Martin, Peter.A.Mayes, Victor.W.Rodwell, —Harper's Review of Biochemistry, LANGE Medical Publications, 1981.

REFERENCES:

1. Keith Wilson & John Walker, —Practical Biochemistry - Principles & Techniques, Oxford University Press, 2009.
2. Pamela.C.Champe & Richard.A.Harvey, —Lippincott Biochemistry Lippincott's Illustrated Reviews, Raven publishers, 1994.

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



COURSE OBJECTIVES

To enable the students to,

- identify all the organelles of an animal cell and their function.
- explain physiological mechanism of various organ systems and to explain the pathophysiology of underlying common diseases.
- understand the structure and functions of the various types of systems of human body.
- provide the knowledge of structure and functioning of cardiovascular system, respiratory system, endocrine system and reproductive system
- provide the knowledge of physiological parameters of normal health and factors affecting various physiological processes in the body.

UNIT I HEAMATOLOGY **9**

Composition and functions of blood, functions of plasma proteins, reaction of blood, coagulation of blood, coagulation factors, functions of bone marrow, erythropoiesis, functions of haemoglobin, blood groups.

UNIT II PHYSIOLOGY OF MUSCLES **9**

Physiology and properties of skeletal muscle, smooth muscle, cardiac muscle, Physiology of muscular contraction, excitability and contractibility, isotonic and isometric contractions, refractory period, tonicity, electromyography.

UNIT III RESPIRATORY SYSTEM **9**

Functions of respiratory system, role of ciliated epithelium, pleural cavity and intra pleural pressure, mechanism of breathing, resistance to breathing, pulmonary volumes, mechanism of gaseous exchange, control of respiration.

UNIT IV CARDIOVASCULAR SYSTEM **9**

Introduction to circulation, functions of circulation, anatomical considerations of heart, cardiac impulse, cardiac cycle, heart sounds, electrocardiogram, heart rate, cardiac output, blood pressure, factors influencing blood pressure, blood velocity, functions of pulmonary circulation, coronary circulation, nervous control and reflex control of blood flow.

UNIT V ENDOCRINE AND REPRODUCTIVE SYSTEM **9**

Physiology of Pituitary, thyroid, parathyroid, adrenal and pancreatic hormones and disorders of these glands, endocrine control of growth and metabolism; pineal, thymus, testes, ovaries, physiology of reproductive systems, sex hormones, physiology of fertilization, menstruation, menopause, spermatogenesis and oogenesis, pregnancy and parturition and clinical disorders.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- explain basic structure and functions of human cell
- learn about the physiology of various systems of human body
- locate and have idea while dealing with images
- analyze and interpret physiological data to design of medical instruments used for diagnosis
- explain interconnect of various systems

TEXTBOOKS

1. Guyton, A.C. and Hall, J.E., “Textbook of Medical Physiology”, 11th Edition, Saunders, 2006.
2. CC Chatterjee. Human Physiology Volume I and II. Medical Allied Agency, Kolkata, Special Edition, 2011.
3. Stuart Ira Fox. Human physiology. 12th ed. Mac Graw Hill. 2011.
4. Dee Unglaub Silverthorn. Human physiology - An integrated approach. Fifth edition. Pearson Education, Inc., 2012.

REFERENCE BOOKS

1. Carola, R., Harley, J.P. and Noback, C.R., “Human Anatomy & Physiology”, 2nd Edition, McGraw-Hill, 1992.
2. Vander, A.J., Sherman, J.H., and Luciano, D.S., “Human Physiology: The Mechanisms of Body Function”, 5th Edition, McGraw-Hill, 1990
3. Waugh, Anne and Allison Grant, “Ross and Wilson Anatomy and Physiology in Health and Illness”, 10th Edition, Churchill - Livingstone / Elsevier, 2006

CO/PO MAPPING:

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(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO2	2	-	2	-	-	-	-	-	-	-	-	-	1	1
CO3	2	-	2	-	-	2	-	-	-	-	-	-	1	-
CO4	2	-	2	-	-	2	1	-	-	-	-	-	1	-
CO5	2	-	2	-	-	-	-	-	-	-	-	-	1	1



COURSE OBJECTIVES

To enable students to

- introduce Fourier series analysis which is central to many applications in engineering apart from solving boundary value problems.
- acquaint the student with Fourier transform techniques used in many engineering systems.
- familiarize effective application of mathematical tools for the solutions of partial differential equations that model several physical processes.
- apply one dimensional equation of heat conduction and study about wave equation.
- learn and apply Z transform techniques for discrete time systems.

UNIT I FOURIER SERIES **15**

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

UNIT II FOURIER TRANSFORMS **15**

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

UNIT III PARTIAL DIFFERENTIAL EQUATIONS **15**

Formation of partial differential equations – Lagrange's linear equation – Solutions of standard four types of first order partial differential equations - Linear partial differential equations of second and higher order with constant, coefficients.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **15**

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS **15**

Z-transforms – Elementary properties – Inverse Z-transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transform.

TOTAL PERIODS: 75

COURSE OUTCOMES

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

- comprehend Fourier series, their different possible forms and the frequently needed practical harmonic analysis from discrete data.
- describe the concept of a function as a double integral under certain conditions and apply in the Fourier transform pair and their properties.
- solve certain boundary value problems and apply the methods and results in engineering applications.

- employ partial differential equations to solve one dimensional wave and heat equations.
- comprehend Fourier series, their different possible forms and the frequently needed practical harmonic analysis from discrete data.

TEXT BOOKS

1. Veerarajan T., “Transforms and Partial Differential Equations”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Narayanan S., Manickavasagam Pillai.T.K and Ramanaiah.G “Advanced Mathematics for Engineering Students” ,Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.

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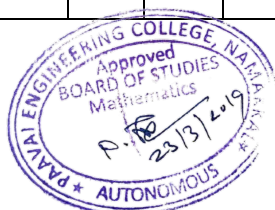
1. Larry C. Andrews, Bhimsen K. Shivamoggi, “Integral Transforms for Engineers”, SPIE Optical Engineering press, Washington USA (1999).
2. Ramana.B.V., “Higher Engineering Mathematics”, Tata Mc-GrawHill Publishing Company limited, New Delhi (2010).
3. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education (2007).
4. Erwin Kreyszig, “Advanced Engineering Mathematics” 10th Edition, Wiley Publications.

WEB LINKS

1. <https://www.youtube.com/watch?v=coe-UA5ONI0>
2. <https://www.youtube.com/watch?v=gZNm7L96pfY>
3. <http://172.16.100.200/NPTEL/displayweb.html?type1=111103021%2F35.pdf>
4. <https://www.youtube.com/watch?v=4GHY8sRKPuU>
5. <http://172.16.100.200/NPTEL/displayweb.html?type1=111104031%2Flectures.pdf%23page%3D101>.

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



COURSE OBJECTIVES

To enable students to

- learn basic laws about the basic calculation techniques.
- make the students understand the concept of laws about the behaviour of gases and vapour pressure.
- the students will gain knowledge on the Humidity and solubility concepts & calculations.
- learn what material balances are, how to formulate and apply them, how to solve them.
- learn what energy balances are, and how to apply them and finally, to learn how to deal with the complexity of big problems

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

- convert one system of unit to another system & Calculate process variables –mass, flow rate and composition etc.
- describe the fundamentals of stoichiometry
- evaluate humidity with/without the use of psychrometric chart
- apply material balances on unit operations and processes
- able to carry out detail energy balance of any chemical plant having different unit operations and unit processes

TEXT BOOKS

1. Bhatt, B.I. and Thakore, S.M., “Stoichiometry”, 5th Edition, Tata McGraw Hill Education Pvt. Ltd, 2011.
2. Himmelblau, D. M. and Riggs, B.J. “Basic Principles and Calculations in Chemical

REFERENCES

Venkataramani, V., Anantharaman, N. and Meera Sheriffa Begum K.M. “Process Calculations”, 2nd ed. PHI Learning Pvt. Ltd., 2011

1. Sikdar, C.D., "Chemical Process Calculations", PHI Learning Pvt. Ltd., 2013.
2. Narayanan, K.V. and Lakshmikutty, B. “Stoichiometry and Process Calculations”, 2nd Edition., PHI Learning Pvt. Ltd., 2017
3. Gavhane, K. A. “Introduction to Process Calculations”, Nirali Publication, 2016

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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



COURSE OBJECTIVES

To enable students to

- have knowledge on fundamental concepts & fluid properties.
- impart the student knowledge on dynamic characteristics for through pipes and porous medium, flow measurement
- have knowledge on fluid properties characteristics on solids such as packed bed
- have knowledge on fluid flow measuring equipments such as rotameter
- have knowledge on several machineries used to transport the fluid and their performance are assessed.

UNIT I FLUID PROPERTIES**9**

Physical properties of fluids – **Classification of fluids** – Pressure measurement – Manometers – Simple and Differential – **Concept of buoyancy** – Dimensional homogeneity, **Rayleigh and Buckingham- π method** – Significance of different dimensionless numbers.

UNIT II FLOW OF COMPRESSIBLE AND INCOMPRESSIBLE FLUIDS**9**

Types of fluid flow – Boundary layer concepts – **Navier-Stokes" equation** – Continuity Equation – Mass balance in a flowing fluid – **Bernoulli's equation** – Euler's equation of motion - Flow of incompressible fluids in pipes – Laminar and turbulent flow through closed conduits **-Hagen-Poiseuille equation**

UNIT III 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 – Terminal settling velocity – **Fluidization** – Types – Advantages – Applications.

UNIT IV TRANSPORTATION**9**

Measurement of fluid flow – construction, working and equation for variable head and variable area meters: **Orifice meter** – **Venturimeter** – **Pitot tube** – **Rotameter** – determination of discharge and discharge coefficient – **Weirs and notches** – Major and minor losses.

UNIT V METERING**9**

Transportation of fluids – Performance curves and characteristics – Efficiency of Centrifugal pump, working principle of Positive displacement, **Rotary and Reciprocating pumps** – Introduction to Fans, **blowers and Compressors**

TOTAL PERIODS: 45**COURSE OUTCOMES**

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

- fundamental concepts of physical properties of fluids and its importance in fluid flow operations.

- use dimensional analysis for scaling experimental results
- treat problems in the movement of fluids through all kinds of process equipment and
- understand the fluid flow through packed and fluidized beds
- deal with the important engineering tasks of moving fluid through process equipment and of measuring and controlling fluids in flow.

TEXT BOOKS

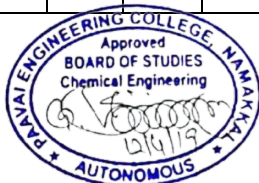
1. R.K. Bansal, “Fluid Mechanics and Hydraulic Machines”, Revised Ninth Edition, Laxmi Publications (p) limited, (2014).
2. A.P. Kulkarni, “Fluid Mechanics for Chemical Engineers” NiraliPrakshan Publication (2015).

REFERENCES

1. McCabe W.L, Smith, J C and Harriot. P “Unit operations in Chemical Engineering”, McGraw Hill, VII Edition, (2005).
2. Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Second Edition, McGraw-Hill, (1991).
3. James O Wilkes and Stacy G Bike, “Fluid Mechanics for Chemical Engineers’ Prentice Hall PTR (International series in Chemical Engineering) (1999).
4. Munson, B. R., Young, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 5th Edition“, John Wiley, 2006

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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



COURSE OBJECTIVES

To enable students to

- introduce students to the principles of Microbiology.
- emphasize structure and biochemical aspects of various microbes.
- help the students to have knowledge on fluid properties characteristics while static, during flow through ducts, pipes and other channels.
- emphasize structure and biochemical aspects of various microbes.
- impart the student knowledge on industrial application of microorganism.

UNIT I INTRODUCTION**9**

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, **microscopic examination of microorganisms**, light and electron microscopy; principles of different staining techniques like **gram staining, acid fast, capsular staining, flagellar staining**.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION**9**

Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM**9**

Nutritional requirements of bacteria; **different media used for bacterial culture**; growth curve and different methods to quantify bacterial growth; **aerobic and anaerobic bioenergetics** and utilization of energy for biosynthesis of important molecules.

UNIT IV 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.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY**9**

Primary metabolites; secondary metabolites and their applications; **preservation of food**; production of penicillin, alcohol, **vitamin B-12**; biogas; **bioremediation; leaching of ores** by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TOTAL PERIODS: 45**COURSE OUTCOMES**

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

- the fundamentals of microbiology
- identify the microbial structure and its multiplication.
- to acquire the knowledge about microbial nutrition, growth and metabolism □
- be familiar with the industrially important microorganism.

- the fundamentals of microbiology

TEXT BOOKS

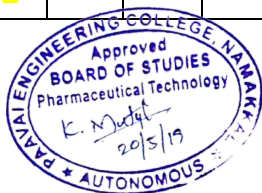
1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.
2. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.

REFERENCES

1. Tortora, G.J., Funke B.R, and Case C.L. (2009). Microbiology an Introduction, Benjamin Cummins, USA.
2. Dubey, R.C. and Maheswari, D.K. (2005). A Textbook of Microbiology, S.Chand and Company Ltd., New Delhi.
3. Stanier, R.Y., Ingraham, J.L., Wheels, M.L. and Painter, P.R. (1999). General Microbiology, Mac Millan Educational Limited, London.
4. Prescott L.M., Harley J.P., Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.

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



COURSE OBJECTIVES

To enable students to

- inculcate understanding of the properties and structure of chemical compounds.
- understand the concept of chemistry of aliphatic, aromatic and heteroaromatic compounds.
- help the students to have knowledge on principles of test for purity in pharmaceutical Substances
- provide the basic molecular rearrangement and study of organic reactions.
- apply the principle of coordination compounds in pharmaceutical substances and understand the concept of preparation of pharmaceutical aids.

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
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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 nonbenzenoid compounds, mechanism of aromatic electrophilic and nucleophilic substitution. General principles of heterocyclic synthesis – Methods of preparation and reactions of Pyridines – Pyrroles – Thiophenes – Furans – Quinolines – 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, sulphates**, iron, arsenic, heavy metals and lead with suitable examples.

UNIT IV STUDY OF ORGANIC REACTIONS AND MOLECULAR REARRANGEMENTS 9

Hoesch reaction, Formylation reactions, Gattermann Reaction, **Gattermann-Koch reaction**, Vilsmeier reaction, Reimer-Tiemann reaction, **Wolff rearrangement**, Schmidt reaction. Curtius rearrangement, Catalytic dehydrogenation, Meerwein-Ponndorf-Verley, NaBH_4 , 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

- the properties and structure of chemical compounds.
- the concept of chemistry of aliphatic, aromatic and heteroaromatic compounds.
- identify and estimate the purity of drugs and its application.
- identify the functional groups in pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.
- apply the knowledge in the development and synthesis of new drug molecule with special reference to organic, inorganic and coordination chemistry.

TEXT BOOKS

1. Francis A. Carey (Author), Richard J. Sundberg, Advanced Organic Chemistry, Part A: Structure and Mechanisms 5th Edition, Springer Publishers, 2000.
2. R.K. Sharma, Text Book of Coordination Chemistry, 1st Edition, Discovery Publishing House Pvt. Ltd. 2011.

REFERENCES

1. Michael B. Smith, Jerry March, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 6th Edition, Wiley, 2007
2. Lutz F. Tietze, Theophil Eicher, Ulf Diederichsen, Andreas Speicher, Reactions and Syntheses in the Organic Chemistry Laboratory, 1st Edition, Wiley – VCH, 2007
3. P. L. Soni, Vandana Soni, Coordination Chemistry: Metal Complexes, 1st Edition, CRC Press, 2013.
4. N V Chenchu Lakshmi, Pharmaceutical Inorganic chemistry: Theory and practice, 1st Edition, Pearson Education India, 2012.

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



COURSE OBJECTIVES

To enable students to

- acquire the fundamental principles and concepts involved in pharmaceutical powders.
- understand the concept of liquid flow.
- help the students to have knowledge on dispersions system.
- introduce students to drug diffusion, dissolution, complexation and protein binding.
- provide the knowledge about 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 solidliquid 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.

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

- know the fundamental properties of pharmaceutical solids
- understand the surface, interfacial phenomena and the rheology of liquids
- ability to understand the principles, characters and applications of pharmaceutical dispersions.
- acquire the knowledge about drug diffusion, dissolution, complexation and protein binding.
- be familiar with the degradation pathways, stabilization of drugs and their expiry date calculation.

TEXT BOOKS

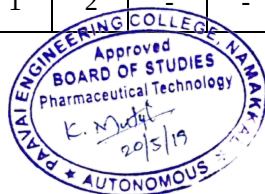
1. Manavalan, R. and Ramasamy. C. "Physical Pharmaceutics" 2nd Ed., Vignesh Publishers, 2015.
2. C.V.S. Subrahmanyam, Text book of physical pharmaceutics, 3rdEdn., Vallabhprakashan, 2015.

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1. Hadkar. U. B., Physical Pharmacy, NiraliPrakashan; 12th edition, 2017
2. Physical Pharmacy by Alfred Martin.
3. Eugene, Parott. Experimental Pharmaceutics.
4. Cooper and Gunn, Tutorial Pharmacy.

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	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



COURSE OBJECTIVES

To enable students to

- To practice the determination of fundamental properties of dosage forms of powders and dispersions.
- To study the kinetics and stability aspects of pharmaceuticals.
- implement the knowledge of various parameters involved in the formulation and development of various dosage forms
- demonstrate about the plant design, production techniques and process chemistry involved in the drug industry.

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 involved in pharmaceutical systems and process
- determine the various order of reactions involved in pharmaceutical systems and process

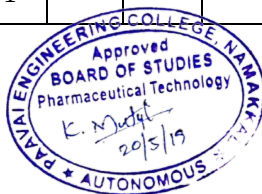
TEXT BOOKS

1. Manavalan, R. and Ramasamy. C. "Physical Pharmaceutics" 2nd Ed., Vignesh Publishers, 2015

2. Eugene L. Parrott, Witold Saski, Experimental Pharmaceutics, 4th edn., Burgess Pub. Co., 1977.

CO/PO MAPPING:

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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



COURSE OBJECTIVES

To enable students to

- Demonstrate various techniques to learn the morphology, identification, and propagation of microbes
- Acquire knowledge about microbes
- Gain the different microscopic principles involved in various industrial application
- study the growth characteristics of microbes

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
4. Microscopy – Working and care of Microscope
5. Microscopic Methods in the Study of Microorganisms., Microscopic identification of yeast/mould
6. Staining Techniques Simple, Differential- Gram's Staining, spore /capsule staining
7. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
8. Effect of Disinfectants- Phenol Coefficient
9. Antibiotic Sensitivity Assay
10. Growth Curve in Bacteria and Yeast
11. 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

- understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.
- know the various aseptic techniques and sterilization methods.
- develop the minimum skills to work on several important techniques for the study of microorganisms in the laboratory.
- Gain knowledge about different growth curve study

TEXT BOOKS

1. Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual", 4th Edition, AddisonWesley, 1999.
2. Collee, J.G. et al., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, Churchill Livingstone, 1996.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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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



TEXTBOOKS

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

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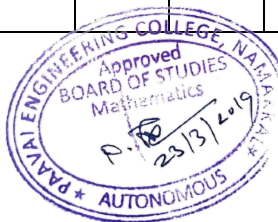
1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th Edition, 2007.
3. Ross, S.M., "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.

WEB LINKS

1. <https://www.youtube.com/watch?v=IYdiKeQ9xEI>
2. https://www.youtube.com/watch?v=J70dP_AECzQ
3. <https://www.youtube.com/watch?v=pvvoK4rlzqQ>
4. <https://www.youtube.com/watch?v=IEP3swFeauE>
5. <https://www.youtube.com/watch?v=SAfS56Ez0QY>

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	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



COURSE OBJECTIVES

To enable students to

- understand the concept pharmaceutical plant construction
- provide the basic fundamentals and various unit operations such as size reduction & separation.
- study the fundamentals crystallization and evaporation.
- realize the concept of filtration & centrifugation
- acquire knowledge on mixing

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

- recognise the various categories of materials used in pharmaceutical industry.
- recognise the various categories of materials used in pharmaceutical industry
- acquire the knowledge on filtration, centrifugation in Pharmaceutical industry.
- understand concept of mixing

- recognise the various categories of materials used in pharmaceutical industry.

TEXT BOOKS

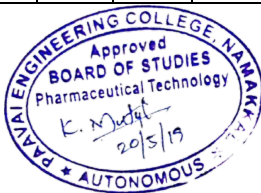
1. McCabe WL, Smith J.C and Harriott “Unit operations of Chemical Engineering” McGraw Hill International Book Co. London 2004.
2. Girish K.Jani, “Pharmaceutical Engineering I, Unit Operation I” B.S.ShahPrakashan,India, 2006.

REFERENCES

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

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



COURSE OBJECTIVES

To enable students to

- study various modes of heat transfer and heat transfer by conduction in detail..
- understand the concept of heat transfer by convection
- understand the working of Heat exchangers and to learn design of double pipe, shell and tube heat exchangers.
- understand the phenomenon of radiation, radiation shields and estimation of emissivity.
- understand the principles and applications of mass transfer operations.

UNIT I HEAT TRANSFER – CONDUCTION 9

Basic transfer processes – **heat, mass and momentum** – heat transfer process - conductors and insulators - conduction – Fourier’s fundamental equation – thermal conductivity and thermal resistance - linear heat flow – heat transfer through homogenous wall, **composite walls**, radial heat flow through cylinders and sphere – extended surfaces (fins) — solving problems in heat transfer by conduction.

UNIT II HEAT TRANSFER - CONVECTION 9

Newton Rikhman’s law – film coefficient of heat transfer - convection – free and forced convection dimensional analysis and its application – factors affecting the heat transfer coefficient in free and forced convection heat transfer – **overall heat transfer coefficient** - solving problems in heat transfer by convection

UNIT III HEAT TRANSFER – HEAT EXCHANGER 9

Heat exchangers – parallel, counter and cross flow – evaporator and condensers - Logarithmic Mean Temperature Difference – overall coefficient of heat transfer – **tube in tube heat exchanger**, shell and tube heat exchanger, plate heat exchanger – applications of heat exchangers - solving problems in heat exchangers.

UNIT IV HEAT TRANSFER: RADIATION 9

Radiation heat transfer – concept of black and grey body - **monochromatic total emissive power** – **Kirchoff’s law – Planck’s law - Stefan-Boltzman’s law** – heat exchange through non-absorbing media - solving problems in heat transfer by radiation.

UNIT V MASS TRANSFER: DIFFUSION 9

Mass transfer – introduction – **Fick’s law for molecular diffusion** - molecular diffusion in gases – equimolar counters diffusion in gases and diffusion of gas A through non diffusing or stagnant B - diffusion through a varying cross sectional area and diffusion coefficients for gases - **molecular diffusion in liquids, biological solutions and gels.**

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand and apply the principles in heat transfer phenomena and solving problems in heat transfer by conduction.
- application for various correlations of convective heat transfer to different problems explains radiation in different type of solids and estimate emissivity.
- Students gain knowledge in various heat transfer methodology in process engineering and to design heat transfer equipments heat exchangers.
- explains radiation in different type of solids and estimate emissivity.
- To understand and apply the principles in mass transfer phenomena.

TEXT BOOKS

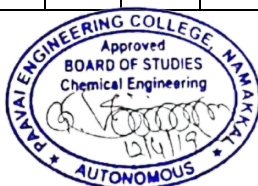
1. Bellaney, P.L. "Thermal Engineering". Khanna Publishers, New Delhi, 2001.
2. Geankoplis C.J. "Transport Process and Unit Operations". Prentice-Hall of India Private Limited, New Delhi, 1999.

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1. Jacob and Hawkins. "Elements of Heat Transfer". John Wiley and Sons Inc. New York, 1983.
2. Eckert, E.R.G. "Heat and Mass Transfer". McGraw Hill Book Co., New York, 1981
3. Holman, E.P. "Heat Transfer". McGraw-Hill Publishing Co. New Delhi, 2001
4. Coulson, J.M. and etal. "Coulson & Richardson's Chemical Engineering", 6th Edition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier), 2004.

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CO1	1	1	-	-	-	-	1	-	-	-	-	-	1	1
CO2	1	2	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	2	-	-	-	2	-	-	-	-	-	-	3	-
CO4	3	3	1	-	-	2	1	-	-	-	-	-	3	-
CO5	3	3	2	2	2	2	2	1	-	-	-	-	3	3



- develops ability to involve in phytochemical and biological standardization of pharmaceutical products.
- develops ability to handle the modern analytical instruments like Mass spectroscopy and HPLC
- develops ability to involve in quantitative analysis of various pharmaceutical agents.

TEXT BOOKS

1. Hobert H. Willard, "Instrumental Methods of Analysis", 7th Edition, CBS Publishers & Distributors, 2004.
2. B.K. Sharma, "Instrumental Method of Chemical Analysis", Krishna's Education Publishers, 2014

REFERENCES

1. Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, "Identification of Organic Compounds", 8th Edition, Wiley, 2014
2. Mendham J, "Vogel's Text Book 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.

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



COURSE OBJECTIVES

At the end of this course the student is expected

- To know the constituents of the environment and the precious resources in the environment.
- To conserve all biological resources.
- To understand the role of human being in maintaining a clean environment and useful

environment for the future generations

- To maintain the ecological balance and preserve bio-diversity.
- The role of government and non-government organizations in environment management.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

9

Environment: Definition- scope - importance – need for public awareness. Forest resources: Use –over exploitation- **deforestation** - case studies- mining - effects on forests and tribal people. Water resources: Use – **over utilization of surface and ground water**- floods – drought - conflicts over water. Mineral resources: Use – exploitation - environmental effects of extracting and using mineral resources – Food resources: **World food problems** - changes caused by agriculture and overgrazing – effects of modern agriculture - fertilizer-pesticide problems - water logging - salinity. Energy resources: Growing energy needs - renewable and non renewable energy sources. Role of an individual in conservation of natural resources.

UNIT II ECOSYSTEMS AND BIODIVERSITY

9

Concept of an ecosystem: **Structure and function of an ecosystem** – producers - consumers –decomposers – energy flow in the ecosystem – ecological succession – food chains - food webs and ecological pyramids. **Types of ecosystem**: Introduction - characteristic features - forest ecosystem – grassland ecosystem - desert ecosystem - aquatic ecosystems (lakes, rivers, oceans, estuaries). Biodiversity: Introduction– definition (genetic - species –ecosystem) diversity. **Value of biodiversity**: Consumptive use - productive use – social values – ethical values - aesthetic values. Biodiversity level: Global - national - local levels- **India as a mega diversity nation**- hotspots of biodiversity. Threats to biodiversity : Habitat loss - poaching of wildlife – **man wildlife conflicts** – endangered and endemic species of India. Conservation of biodiversity: **In-situ and ex-situ conservation of biodiversity**.

UNIT III POLLUTION

9

Pollution: Definition –air pollution - water pollution - soil pollution - marine pollution - noise pollution - thermal pollution – **nuclear hazards**. Solid waste management: Causes - effects - control measures of urban and industrial wastes. **Role of an individual in prevention of pollution** - pollution. Disaster management :Floods – earthquake - cyclone - landslides. **Electronic waste-Sources-Causes and its effects**.

UNIT IV SOCIAL ISSUES AND ENVIRONMENT

9

Sustainable development : Unsustainable to sustainable development – urban problems related to energy.

Water conservation - rain water harvesting - watershed management. Resettlement and rehabilitation of people. Environmental ethics: Issues - possible solutions – climate change - global warming and its effects on flora and fauna - acid rain - ozone layer depletion - nuclear accidents - nuclear holocaust - Environment protection act: Air (Prevention and Control of Pollution) act – water (Prevention and control of Pollution) act – wildlife protection act – forest conservation act – issues involved in enforcement of environmental legislation.

UNIT V HUMAN POPULATION AND ENVIRONMENT

9

Human population: Population growth - variation among nations – population explosion – family welfare programme and family planning – environment and human health – Human rights – value education – HIV/AIDS Swine flu – women and child welfare. Role of information technology in environment and human health.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- Know the relationship between the human population and environment.
- Understand the basic concepts of environment studies and natural resources.
- Gaining the knowledge about ecosystem and biodiversity.
- Have knowledge about causes, effects and control measures of various types of pollution.
- Understand the social issues and various environmental acts.

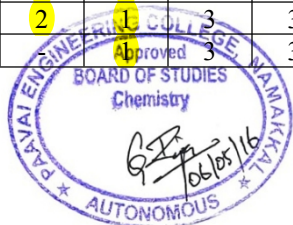
TEXT BOOKS

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1. S. Divan, Environmental Law and Policy in India, Oxford University Press, New Delhi, 2001.
2. A.K.De, Environmental Chemistry, VI edition, 2015 NewAge International (P) ltd Publication, New Delhi.
3. C.S.Rao, Environmental Pollution and Control engineering, V edition, NewAge International (P) ltd Publication, New Delhi 110002
4. Clair Nathan Sawyer, Perry L. McCarty, Gene F. Parkin, “Chemistry for Environmental Engineering and Sciences, V Edition, 2013, Tata McGraw Hill pub, New Delhi 110008

Mapping of course outcome with Programme Outcomes (S/M/W indicates strength of correlation) S-Strong-3, M-Medium=2, W-Weak=1.														
CO	Programmes Outcomes(POs)												PSO1 PSO2	
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CO1	-	-	-	-	-	1	3	3	2	-	-	3	1	-
CO2	-	-	2	-	-	1	-	3	-	2	-	3	1	-
CO3	2	-	2	-	2	1	-	3	-	2	-	3	1	-
CO4	2	2	2	-	2	1	3	3	-	2	-	3	1	-
CO5	-	2	-	-	-	3	3	3	2	2	-	2	1	-



COURSE OBJECTIVES

To enable students to

- understand the Standard operating procedures
- provide the basic fundamentals and concepts of absorption spectrum of a drug.
- study the Quantitative and qualitative analysis of drug molecule
- realize the concept Separation and identification of mixtures of drugs by TLC.
- acquire knowledge on Chromatographic Methods

LIST OF EXPERIMENTS

1. Calibration of volumetric glasswares.
2. Establishing standard operating procedure (SOP) and Calibration records for analytical balance, pH meter and UV/Vis spectroscopy.
3. Determination of λ_{max} .
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 amino acids by paper chromatography
9. Identification of functional group of a drug molecule by IR spectroscopy
10. Determination of impurities by limit test.
11. Quantitative analysis by titrimetric methods
12. Separation and identification of mixtures of drugs by TLC.

TOTAL PERIODS: 60

COURSE OUTCOMES

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

- develops ability to handle the modern analytical instruments like UV/Vis, IR, NMR, Mass spectroscopy and HPLC.
- develops ability to involve in Qualitative and Quantitative analysis of various pharmaceutical agents.
- develops ability to involve in phytochemical and biological standardization of pharmaceutical products.
- separation and quantification of drugs molecules by chromatographic and spectral techniques.

- preparation and standardization of various assay reagents with respect to chemical and drug analysis

TEXT BOOKS

1. Atherden L.M. “Bentley and driver’s Textbook of Pharmaceutical chemistry”, 8th Edition, Oxford University Press, 2004.
2. 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



COURSE OBJECTIVES

To enable students to

- enable the student to basic study of the phenomena of heat and mass transfer, to develop methodologies for solving food engineering problems.
- understand the information concerning the performance and design of Heat exchangers.
- develop processes with better heat efficiency and economics.
- provide knowledge on various flows measuring equipment's involved in food industries.

LIST OF EXPERIMENTS

1. Pressure drop across Fluidized bed columns.
2. Heat transfer studies of a shell and tube heat exchanger.
3. Separation factors of the experiments with liquid – liquid extraction.
4. Separation factors of the experiments with solid –liquid extraction.
5. Separation factors of the experiments with ion exchange.
6. Drying characteristics of Tray dryer
7. Drying characteristics of Rotary dryer
8. Water purification using ion exchange columns
9. Separation of binary mixture using Simple distillation
10. Separation of binary mixture using Steam distillation

TOTAL PERIODS: 60

COURSE OUTCOMES

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

- the basic laws of heat transfer and account for the consequence of heat transfer in thermal analyses of engineering systems.
- understand the importance of fluid flow in industrial applications.
- describe the use of flow measuring devices and demonstrate the loss of energy due to friction in pipes.
- calculate the losses of energy due to fittings in pipe flow systems.

TEXT BOOKS

1. McCabe, W.L, Smith J.C and Harriot, P., “Unit Operations in Chemical Engineering”, McGraw-Hill, Fourth Edition, 1984.
2. Geankoplis, Christie J. “Mass transport phenomena”. Holt, Rinehart and Winston, 1972.

REFERENCES

1. Ballaney, P.L. "Thermal Engineering", Khanna Publishers, New Delhi. 2002.
2. R.Palusingh, Dennis R. Heldman "Introduction to food engineering" 5th edition, Academic press 2014.

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



COURSE OBJECTIVES

To enable students to

- make the students conduct various experiments on electrical machines analyze their performance.
- 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 & AC Starters.
9. Study of displacement transducer –LVD
10. Study of pressure transducer

TOTAL PERIODS: 60

COURSE OUTCOMES

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

- Summarize the characteristics and speed control of electrical machines

TEXT BOOKS

1. Theraja B.L and therajaA.K., „A Text book of Electrical Technology „, volume – II, S,Chand& Co.,2007.
2. M.D.Singh, K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill,1998.

REFERENCES**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	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

