

COURSE OBJECTIVES

- To understand the basic of circuit theory
- To use the network elements and theorems for the analysis of complex circuits.
- To analyse the coupled circuits using the series & parallel resonance circuit terminologies.
- To compute the transient responses of RLC circuits and know the outline of two port networks.
- To construct and design the filters using software tools.

UNIT I BASICS OF CIRCUIT ELEMENTS AND ANALYSIS**9+3**

Basics of circuit elements – Power, Power Factor and Energy - Network reduction – voltage division – current division – Star – delta transformation - Ohm's Law – Kirchhoff's laws – DC and AC Circuits -Mesh current and node voltage method of analysis.

UNIT II NETWORK THEOREMS AND POWER MEASUREMENTS**9+3**

Thevenin's Theorem- Norton's Theorem- Superposition theorem- Maximum power transfer theorem, Reciprocity theorem, – Statement, illustration. Power measurement by 3 volt meter and 3 ammeter method - Solution of three phase balanced circuits & unbalanced circuits – Three phase power measurement using 2 wattmeter.

UNIT III RESONANCE AND COUPLED CIRCUITS**9+3**

Series resonance, parallel resonance – Q factor – Bandwidth. Self-Inductance – Mutual Inductance – Coefficient of coupling – dot rule – ideal transformer effective inductance of coupled coils in series & in parallel – Analysis of magnetic circuits.

UNIT IV TRANSIENTS CIRCUITS AND NETWORK PARAMETERS**9+3**

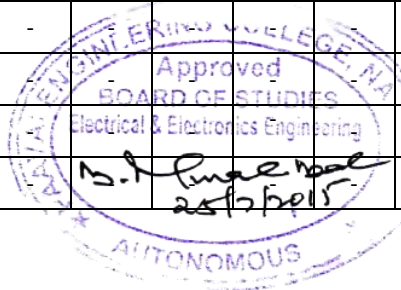
Transient response of RL, RC and RLC circuits using Laplace transform for DC input and AC with sinusoidal input. Characterization of two port network parameters-Z, Y and h parameters

UNIT V FILTERS**9+3**

Classification of filters-Filter networks – Characteristics Impedance - Design of filters –Constant K and M-derived-LPF,HPF and BPF. Introduction to PSpice-Application to electrical circuits

TOTAL(45+15)= 60 PERIODS**COURSE OUTCOMES**

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



COURSE OBJECTIVES

- Understand basic laws
- Know basic theorems
- develop the practical **knowledge through** the simulation of electrical circuits,
- design of filters and**verifying** circuit theorems.

LIST OF EXPERIMENTS

1. Verification of Ohms law
2. Verification of Kirchoff's laws
3. Verification of Thevenin's & Norton's Theorem
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
7. Power measurement in 3 phase circuits
8. Design and simulation of Resonance circuits
9. Circuit Analysis using CRO
10. Experimental determination of network parameters
11. Digital simulation of Circuit Transients using PSpice / PSIM
12. Digital simulation of Filter response using PSpice / PSIM
13. Digital simulation of Network theorems using PSpice / PSIM

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

- implement basic laws
- identify basic theorems
- develop the practical **knowledge through** the simulation of electrical circuits,
- design of filters and **verifying** circuit theorems

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

COURSE OBJECTIVES

To enable students to

- familiarize in the field of chemical kinetics.
- know the basic of catalysis and bio-catalysis reactions.
- understand the various types of photochemical reactions.
- acquire knowledge in the field of electrochemistry, solubility behaviour.
- understand the importance of physical chemistry towards different applications.

UNIT I CHEMICAL KINETICS**9**

Rate of a reaction-Order of a reaction – Examples and rate equations for Zero order, First order, Second order and Third order reactions –Molecularity of a reaction – Unimolecular and Bimolecular reactions – Half life period– Kinetics of parallel and opposing reactions – Activation energy – Arrhenius equation – Collision theory of reaction rates – Theory of absolute reaction rates – Michalis Menton kinetics of enzyme catalyzed reactions- Effect of temperature on enzyme catalysis

UNIT II CATALYSIS AND SURFACE CHEMISTRY**9**

General characteristics of catalytic reactions- Acid-Base catalysis-Heterogeneous catalysis-.Surface reactions- Kinetics of surface reactions-Unimolecular surface reactions-Bimolecular surface reactions- Effect of temperature on surface reactions-Auto catalysis and Oscillatory reactions.

UNIT III PHOTOCHEMISTRY**9**

Laws of Photochemistry, Beer–Lambert’s law- Grothus & Drapper’s law- Stark Einstein’s law- Quantum efficiency– Reason for difference in quantum efficiency –Method of determination of quantum yield. Photochemical reactions, Actinometry – Uranyl oxalate method only – Kinetics and mechanism of Hydrogen – Bromine reaction, Hydrogen – Chlorine reaction – Photosensitization- Photo inhibitor- Chemiluminescence.

UNIT IV COLLOIDS**9**

Introduction to colloids – properties of colloids – coagulation of solutions – Origin of charge on colloidal particles – Determination of size of colloidal particles – Donnan Membrane equilibrium – Emulsions – Gels – Applications of colloids – Nanoparticles (Au, Ag, Pt) – Preparation – Characterization – Properties – Application in catalysis and drug delivery systems.

UNIT V THE DISTRIBUTION LAW**9**

Distribution co-efficient - Distribution Law — Conditions for the validity of the Distribution law- I2– CCl₄ – H₂O System – Nature of interaction of the solute with one of the solvents Dissociation- Association – Applications of Distribution law – Process of Extraction.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- explain the chemical kinetics, electrochemical equilibria in different applications.
- demonstrate the catalysis and bio-catalysis reaction

- list the biochemical reactions equilibria towards different applications.
- comprehend the knowledge about industrial chemical reactions such as production of soaps, colloids.
- develop the basic concepts of chemical reaction and mechanism in large scale production

TEXT BOOKS

1. Kund and Jain, “Physical Chemistry”, S.Chand and Company, New Delhi (2011).
2. Puri B.H. Sharma L.R. and M.S.Prathama, “Principles of Physical Chemisry”, S.Chand and Company, New Delhi (2012).
3. B.S.Bahl, Arun Bahl and G.D.Tuli, “Essentials of Physical Chemistry”, S.Chand and Company, New Delhi (2015).

REFERENCES

1. Gordon M. Barrow, “Physical Chemistry”, Eight Edition, Tata McGraw Hill (2013).
2. Peter Atkins & Julio de Paula, Atkins, “Physical Chemistry”, 9th Edition, Oxford university press. (2012).
3. Gurudeep Raj (2011), “Advanced Physical chemistry”, 34th edition, Goel Publishing House, Krishna Prakashan Media (P) Ltd.
4. Laidler, J (2012): “Chemical Kinetics”, 4th edition, Harper & Row.
5. Glasstone, S (2014) : “An Introduction to Electrochemistry”, Affiliated East West press, New Delhi.

WEB LINKS

1. www.chemresources.com
2. www.library.njit.edu/research/helpdesk/subjectguides/chemistry.php

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
CO	Programmes Outcomes (POs)												PSO1 PSO2	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
CO1	2	2	2	2	2	2	2	2	-	-	2	2	2	2
CO2	2	2	2	1	2	2	2		2		1	2	2	1
CO3	2	1	2	2	1	2	1	2	-	3	1	2	2	2
CO4	2	1	3	2	2	1	2	-	2	-	1	2	1	2
CO5	2	2	3	1	2	2	2	2	2	3	2	2	2	2



COURSE OBJECTIVES

To enable students to

- have a knowledge on fundamental concepts, fluid properties and fluid statics.
- impart the student knowledge on dynamic characteristics for through pipes and porous medium, flow measurement
- have knowledge on fluid properties characteristics while static, during flow through ducts, pipes and other channels.
- Learn the working of different flowmeters
- Knowledge on several machineries used to transport the fluid and their performance are assessed.

UNIT I FLUID PROPERTIES AND STATICS**15**

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

UNIT II FLOW OF COMPRESSIBLE AND INCOMPRESSIBLE FLUIDS**15**

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 – Friction factor chart – Darcy weisbach Equation – Flow of incompressible fluids in pipes – Laminar and turbulent flow through closed conduits – Velocity profile and friction factor for smooth and rough pipes –Hagen-Poiseuille equation.

UNIT III FLOW OF FLUIDS THROUGH SOLIDS**15**

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**15**

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**15**

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 75**COURSE OUTCOMES**

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

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

- treat problems in the movement of fluids through all kinds of process equipment and use dimensional analysis for scaling experimental results
- 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.
- analyse pipe flows as well as fluid machineries used to transport the fluid and their performance

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” Nirali Prakshan 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).

WEB LINKS

1. [http:// www.nptel.ac.in](http://www.nptel.ac.in)
2. [http:// www.msubbu.in](http://www.msubbu.in)
3. <http://www.unitoperation.com>

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



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 psychrometric 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 BASIC CHEMICAL CALCULATIONS**15**

Units and Dimensions – Fundamental and derived units – conversions – Basis of calculations – Methods of gas expression – Compositions of mixture and solutions. Ideal and real gas laws – Gas constant – Calculations of pressure, volume and temperature using ideal gas law – Use of partial pressure and pure component volume in calculations – Applications of real gas relationship in gas calculation.

UNIT II MATERIAL BALANCE (Without chemical reaction)**15**

Law of conservation of mass – Application of material balance to unit operations like distillation, Evaporation– absorption, extraction, crystallisation, drying and mixing/blending. Psychrometry – Properties of atmospheric air – Humidity of air – Calculation of absolute, molal, relative and percentage humidity– Use of Psychrometric chart.

UNIT III MATERIAL BALANCE (With chemical reaction)**15**

Stoichiometric Principles - Material balance with chemical reaction – Limiting and excess reactants– percent excess– Conversion, yield and selectivity – Recycle – Bypass and purging.

UNIT IV ENERGY BALANCE**15****Thermo Physics**

Heat capacity of solids, liquids, gases and solutions – Use of mean heat capacity in heat calculations – Problems involving sensible heat and latent heats – Evaluation of enthalpy.

Thermo Chemistry

Standard heat of reaction, heats of formation, combustion, solution, mixing etc. – Calculation of standard heat of reaction – Effect of pressure and temperature on heat of reaction – Energy balance for systems with and without chemical reaction.

UNIT V FUELS AND COMBUSTION**15**

Combustion calculations Calorific value of solid, liquid and gas fuels – GCV and NCV. Analysis of coal – orsat, Proximate, Ultimate - Air requirement Theoretical oxygen and air– Calculation of excess air – Theoretical flame temperature.

TOTAL PERIODS 75**COURSE OUTCOMES**

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

- understand various types of units and dimensions, basic laws about behaviour of fluids and solid.

- formulate material and energy balances with or without chemical reactions and apply them for a given process.
- 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.
- calculate flue gas composition from fuel composition and vice versa.

TEXT BOOKS

1. K.A. Gavhane, "Stoichiometry" Nirali Prakashan Publications, (2015).
2. Himmelblau, D., "Basic Principles and Calculations in Chemical Engineering", 6th Edition, Prentice Hall of India (P) Ltd.,(2000).

REFERENCES

1. Venkataramani, V. and Anantharaman, N., "Process calculations", Prentice Hall of India (P) Ltd., 2003.
2. K.V.Narayanan, B.Lakshmipathy,"Stoichiometry and Process Calculation", PHI Learning Ltd.(2013).
3. Bhatt, B.I. and Vora, S. M., "Stoichiometry", 4th Edition, Tata McGraw Hill Publishers Ltd., (2005).

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



COURSE OBJECTIVES

To enable students to

- learn information on various material properties, selection for design and manufacture.
- understand heat treatment techniques for the materials related to ferrous materials.
- familiarize polymers, composites and ceramics based on specific application.
- introduce the structures using organic and inorganic materials.
- study detailed information on types of corrosion and its prevention

UNIT I INTRODUCTION**9**

Selection criteria and processes: General criteria of selection of materials in process industries. Environmental considerations and recycling Properties: Mechanical, Thermal, Chemical, Electrical, Magnetic and Technological properties. Processing of metals and alloys - Casting-hot and cold rolling – forging – extrusion - deep drawing. Plastic deformation of metal - Recovery and recrystallization of plastically deformed metals.

UNIT II FERROUS AND NON-FERROUS METALS**9**

Pure iron, cast iron, mild steel, stainless steels, special alloy steels- iron and iron carbide phase diagram- heat treatment of plain-carbon steels. Manufacturing methods of Lead, Tin and Magnesium. Properties and applications in process industries

UNIT III POLYMERS, CERAMICS, GLASSES**9**

Industrial polymerization methods, crystallinity and stereo isomers- Thermosetting and Thermo plastics. FRP- Fiber Reinforced Plastics (FRP), different types of manufacturing methods; Ceramic crystal and silicate structures - processing of ceramics-glasses-enamels-properties.

UNIT IV INORGANIC MATERIALS**9**

Manufacture of cement and its properties – Special cement – Cement concrete – Reinforced and prestressed concrete – Properties and applications – Mixing and curing. Flyash, Gypsum and Gypsum Plaster.

UNIT V CORROSION AND PREVENTION**9**

Definition of corrosion-Basic theories and mechanism of corrosion-Types of corrosion Anti-Corrosion methods- Organic paints and coatings metal, varnishes, distempers, ceramic coatings.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- choose appropriate material for process equipment with advanced properties and its processing method depending on type of application.
- gain knowledge on different types of materials, properties and applications in process industries
- acquire the knowledge about industrial polymerization methods, glass processing and properties of ceramics.
- understand and build reinforced structures by knowing the special properties of cement.

- gain knowledge about different types of corrossions and suggest preventive methods.

TEXT BOOKS

1. Khanna O P, “Material Science and metallurgy” Dhnapat Rai Publications (1995).
2. Er.R.K. Rajput “Engineering Materials” S.Chand Publications, 2014.

REFERENCES

1. Agarwal B.K., —Introduction to Engineering Materials, Tata McGraw Hill, 1988.
2. Budinsky K G and Budinsky K M “ Engineering materials- Properties and Selection” Prentice Hall of India (2002).

WEB LINKS

1. <https://www.youtube.com/watch?v=Y75IQksBb0M>
2. <https://www.youtube.com/watch?v=XTU0Z-FkhtU>
3. <https://www.youtube.com/watch?v=z-OP4EIhGWI>

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



COURSE OBJECTIVES

To enable students to

- improve the practical knowledge on the properties and characteristics of solvents and mixtures.
- understand the rate of reaction and its mechanism.
- analyse the physical nature of chemical reactions.
- Determine rate constant for reactions

LIST OF EXPERIMENTS

1. Determination of molecular weight of a polymer by viscosity method.
2. Determination of partition co-efficient of iodine between two immiscible solvents
3. Determination of partition co-efficient of benzoic acid between two immiscible solvents
4. Determination of K_a of the weak acid.
5. Conductometric experiments- Verification of Oswald's Dilution Law.
6. Titration of Strong Acid Vs Strong Base- Conductometric experiments.
7. Titration of mixture of Strong Acid & Weak Acid Vs Strong Base- Conductometric experiments.
8. Titration of Weak Acid Vs Weak Base- Conductometric experiments.
9. Determination of Rate Constant (K)-Ester Hydrolysis.
10. Determination of Activation Energy (ΔE).
11. Estimation of Ferrous ion concentration by Potentiometric Titration.
12. Determination of standard electrode potential (Zn).
13. Determination of pH metric titration of Strong Acid Vs Strong Base.
14. Enzyme catalytic reaction by varying pH.
15. Application of Phase Rule to Phenol-Water system.

TOTAL PERIODS 45

COURSE OUTCOMES

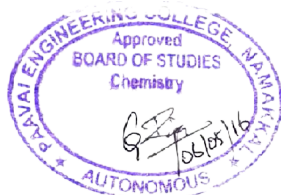
The student is able to

- determine the properties and characteristics of solvents and mixtures.
- analyse experimentally the various properties of acids & bases.
- determine the kinetics of various simple chemical reaction.
- Calculate the rate constants of a reaction

REFERENCES

1. Physical Chemistry experiments by Alexander Findley, McGraw-Hill IV Edition, (1976).
2. Shoemaker D.P., and Gardad C.W., Experiments in Physical Chemistry, McGraw-Hill, London, 2011.

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CO3	2	1	1	1	-	-	-	-	-	-	-	2	2	1
CO4	1	2	1	2	-	-	-	-	-	-	-	2	1	1



COURSE OBJECTIVES

To enable students to

- calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.
- Find discharge coefficients of fluid
- Understand the pump characteristics
- Calculate pressure drop

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
- Find discharge coefficients of fluid
- draw the pump characteristics
- Calculate pressure drop of fluids

REFERENCES

1. McCabe, W.L, Smith J.C and Harriot, P., "Unit Operations in Chemical Engineering", McGraw-Hill, Fourth Edition, 1984.

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CO4	1	2	2	-	-	-	-	-	-	-	-	-	1	1



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.

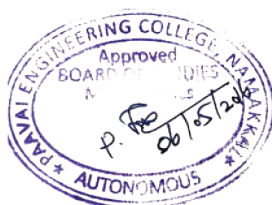
REFERENCES

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>
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CO5	3	3	2	2	-	-	-	-	-	-	-	1	2	2



COURSE OBJECTIVES

To enable students to

- learn the types of carbohydrates and their importance in daily usages.
- comprehend simple heterocyclic compounds and their properties.
- acquire the knowledge on the various types of dyes and their applications.
- know the fundamental and analysis of proteins.
- understand synthesis of important medicinal compounds and their applications.

UNIT I CARBOHYDRATES 9

Introduction – various definitions and classifications of carbohydrates –Preparation, Physical & Chemical properties, Structure and Uses of Monosaccharides (Glucose & Fructose) Interconversions – Aldo pentose to aldo hexose–Aldo hexose to aldo pentose- aldose to isomeric Ketose – Ketose to isomeric Aldose – Aldose to epimer.

UNIT II HETEROCYCLIC COMPOUNDS 9

Preparation, Physical & Chemical properties and Uses of Pyrrole, Furan, Furfural, TetrahydroFuran, Thiophene, Indole, Pyridine, Quinoline and Isoquinoline.

UNIT III DYES 9

Witt's theory and modern theory of colors – Synthesis, properties and uses of Methyl red, Methyl orange, Congo red, Malachite green, para-rosaniline, phenolphthalein, fluorescence, Eosin dyes

UNIT IV AMINOACIDS AND PROTEINS 9

Amino acids and proteins-Classification-synthesis of amino acids- reaction of carboxyl group and amino group-peptide linkage-structure of protein-end group analysis-colour reaction of proteins-denaturation.

UNIT V PHARMACEUTICAL CHEMISTRY 9

Synthesis, properties and uses of Antimalarial drugs – isopentaquine and chloroquine Synthesis, properties and uses of Antibacterial drugs – Sulphanilamide and Sulphapyridine, Pencillin and erythromycin.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain on various reaction preparations of organic compounds and their properties.
- comprehend synthesis of different type of organic compounds.
- understand synthesis of amino acids and proteins.
- develop the knowledge about organic reactions.
- study as a precursor on chemical reaction engineering.

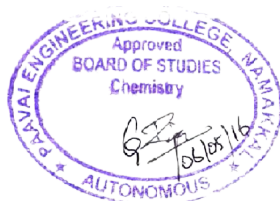
TEXT BOOKS

1. R.T. Morrison and R.N. Boyd "Organic Chemistry" VI Edition Prentice Hall Inc (1996) USA.
2. K.S. Tiwari, N.K. Vishnoi and S.N. Malhotra "A text book of Organic Chemistry" Second Edition, Vikas Publishing House Pvt. Ltd. (1998), New Delhi.
3. P.L.Soni, A text book of Organic Chemistry, S Chand Publishers, (2001), New Delhi.

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1. Chemistry in Engineering and Technology, Vol.2, TMH Publishing Co Ltd., New Delhi, 1994.
2. I L Finar "Organic Chemistry" ELBS (1994).
3. Rajbir Singh, "Physical Organic Chemistry", Mittal Publications, 2012.
4. Felix A. Carroll, "Perspective on Structure and Mechanism in Organic Chemistry", John Wiley and Sons, 2012.
5. Eric V. Anslyn and Dennis A. Dougherty, "Modern Physical Organic Chemistry", University Science Books, 2010.

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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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	1	-	-	1	-	3	-	3	1	2
CO2	3	2	-	2	1	-	-	1	-	3	-	3	1	2
CO3	3	2	-	2	1	-	-	1	-	3	-	3	2	1
CO4	3	2	-	2	1	-	-	1	-	3	-	3	2	1
CO5	3	2	-	2	1	-	-	1	-	3	-	3	2	2



COURSE OBJECTIVES

To enable students to

- understand the Fundamentals of energy conversion, construction and principle of operation.
- perform characterization of electrical machines and various drives.
- realize the concept of starting methods and speed control of electrical machines.
- study the fundamentals of Sensors application.
- acquire knowledge on the operation of solid state speed control of D.C. and A.C. drives

UNIT I DC MACHINES 9

DC Generator-Construction and Principle of operation, EMF Equation, types, OCC and External characteristics curves and Efficiency. DC Motors-Principle of operation, types, Characteristics of motor and Starters.

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 are 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 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.

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

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

TOTAL PERIODS 45

COURSE OUTCOMES

On Completion this course, the student will be able to

- select and utilize various of dc machines.
- employ effective control techniques to electrical motors.
- ability to understand concept applied in Electric drives.
- select appropriate Sensors for engineering applications.
- able to apply solid state speed control of D.C. and A.C. drives.

TEXT BOOKS

1. Nagrath .I.J. & Kothari .D.P, “Electrical Machines”, Tata McGraw-Hill, 2004.
2. VedamSubrahmaniam, “Electric Drives (concepts and applications)”, Tata McGraw- Hill, 2001.
3. D. Patranabi, “Sensors and Transducers”, PHI Learning Pvt. Ltd., 2003.

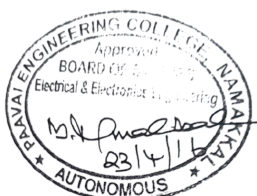
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1. Theraja B.L and therajaA.K., ‘A Text book of Electrical Technology ‘, volume – II, S,Chand& Co., 2007.
2. M.D.Singh, K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, 1998.
3. Ian.R.Sinclair, “Sensors and Transducers”, BSP Publication, 2001
4. Bimal K Bose, “Modern Power Electronics and AC Drives”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
5. Muhammad H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Pearson Education, Third Edition, 2004.

WEBLINKS

1. https://en.wikipedia.org/wiki/DC_motor
2. https://en.wikipedia.org/wiki/AC_motor

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



COURSE OBJECTIVES

To enable students to

- understand the Characteristics of particulate solids, and storage of solids.
- be in a position to decide the best suitable size reduction equipment needed for a particular process industry.
- acquire knowledge in separating solids from solids, solids from liquids.
- familiarize mechanism of filtration and equipment's involved in process.
- impact knowledge on mixing of solid-solid, liquid – liquid components.

UNIT I PROPERTIES AND STORAGE OF SOLIDS**9**

Characterization of solid particles: Particle size and shape, Mean particle sizes and number of particle in a mixture, Particle size measurement Methods - screen analysis Cumulative and Differential. Properties of particulate masses. Storage of solids - Bulk and Bin – Conveyors – Belt, Chain, Screw and Pneumatic conveying.

UNIT II SIZE REDUCTION**9**

Mechanism of size reduction – Choice of size reduction equipments – Energy and Power requirements in size Reduction – Laws of size reduction Size reduction equipments. Principles of comminution.

UNIT III MECHANICAL SEPARATIONS**9**

Screening and types of Screening equipment – material balance over the screen – screen capacity – effectiveness of screens – Concept of gravity settling – sedimentation – thickening – electrostatic and magnetic separator – Froth floatation – centrifugal separation - Cyclone separator.

UNIT IV FILTRATION**9**

Theory and mechanism of filtration- cake filter - principles – pressure drop – constant pressure and rate filtration – Batch and continuous filters Equipment for filtration – Filter media and aids – Fundamentals and introduction to membrane, bio, micro filtration.

UNIT V MIXING AND AGITATION**9**

Equipment for agitation – impeller and their characteristics – flow patterns - power for agitation – correlations. Mixing of solids and pastes: equipments for solid mixing, kneading and dispersions.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- explain the various types of mechanical operations and its importance in industries.
- decide the best type of operation needed for a specific industry by analyzing, interpreting and evaluating data.

- select and design various types of fluid-solid separation equipment based on the behaviour and properties of materials used in industries
- explain about filtration and their mechanism.
- evaluate their processing operation by effective agitation and mixing of fluids.

TEXT BOOKS

1. Kiran D Patil, “Mechanical Operations” 3rd Edition, Nirali Publication. (2015).
2. Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., “Principles of Unit Operations”, 2nd Edn., John Wiley & Sons, (1994).

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1. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, (1998).
2. Anup K Swain, Hemlata Patra, G K Roy, “Mechanical Operations”, Tata McGraw Hill Education Private Limited, (2011)
3. McCabe, W.L, Smith J.C and Harriot, P., “Unit Operations in Chemical Engineering”, McGraw-Hill, Fourth Edition, (1984).

WEB LINKS

1. [http:// www.nptel.ac.in](http://www.nptel.ac.in)
2. <http://www.msubbu.in/sp/mo/>
3. <http://www.unitoperation.com>

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



COURSE OBJECTIVES

To enable students to

- study various modes of heat transfer and their fundamental relations.
- understand properties of insulation and critical thickness of insulation.
- understand the phenomenon of radiation, radiation shields and estimation of emissivity.
- understand the working of heat exchangers and to learn design of double pipe, shell and tube heat exchangers.
- study the performance and types of evaporators.

UNIT I CONDUCTION 9

Modes of heat transfer – Steady state heat conduction – Fourier's law - heat conduction for flat plate, hollow Cylinder. Critical insulation thickness– Transient heat conduction – Lumped heat parameter model.

UNIT II CONVECTION 9

Concept of heat transfer by convection – Natural and forced convection — Application of dimensional analysis for natural and forced convection– Empirical Equations for natural and forced convection - Reynolds and Colburn analogy – jH factor — Local and Overall heat transfer coefficient

UNIT III RADIATION 9

Concept of thermal radiations – Black body concept – Stefan Boltzman's, Kirchhoff's, Planck's and Wien laws; Emissive power – Black body radiation – Emissivity – Planck's law – Radiation between black surfaces – Grey surfaces – Radiation shields.

UNIT IV HEAT EXCHANGERS 9

Heat exchanger types – Parallel and counter flow heat exchangers – Overall heat transfer coefficient – Log mean temperature difference for single pass – Correction factor for multi pass heat exchangers – Heat exchanger Effectiveness – Number of transfer units – Chart for different configurations – Dirt factor.

UNIT V EVAPORATORS 9

Introduction to Boiling and Condensation - Evaporation – Single effect and multiple effect evaporation – Boiling point elevation – Capacity, surface area and Economy of single and multiple effect evaporators - Evaporation equipments

TOTAL PERIODS 45

COURSE OUTCOMES

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

- derive equations for the calculation of heat flux and estimation of intermediate temperatures in multilayer systems.
- application for various correlations of convective heat transfer to different problems.

- explain 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 and evaporation
- design of single and multiple effect evaporators and can calculate the economy and capacity of evaporators.

TEXT BOOKS

1. Rajput “Process Heat Transfer “, McGraw-Hill, (1999).
2. K.A. Gavhane, “Heat Transfer”, Eighteenth Edition, Niralai Publication (2015).

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1. Coulson, J.M. and Richardson, J.F., “Chemical Engineering “ Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, (1998).
2. Yunus A. Cengel, “ Heat Transfer: A Practical Approach” 2nd Edition, Mcgraw Hill Education (2011).

WEB LINKS

1. [http:// www.nptel.ac.in](http://www.nptel.ac.in)
2. <http://www.msubbu.in/sp/mo/>
3. <http://www.unitoperation.com>

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



COURSE OBJECTIVES

To enable students to

- learn the basic concepts and properties of thermodynamics and its application to flow and non-flow process.
- study carnot principles and its application to heat engine and refrigerator.
- understand the clear concepts on P-V-T behavior, Equations of state, compressibility charts, equation of state and fugacity.
- have sound knowledge on entropy and enthalpy calculations in reversible and irreversible process.
- know the thermodynamic aspects of compression of fluids.

UNIT I BASIC CONCEPTS AND FIRST LAW 9

Definitions and Basic Concepts- State and Path functions- Thermodynamic systems – closed, open and isolated - Equilibrium, Energy, Work-modes of work - concept of Temperature and Heat- Zeroth Law- First law – application to closed and open systems- internal energy- specific heat capacities- enthalpy – steady flow process with reference to various thermal equipments.

UNIT II SECOND LAW OF THERMODYNAMICS 9

Statements of the second law – Kelvin, Planck and Clausius statements- Reversible and irreversible processes - heat engine and refrigerator -Criterion of reversibility, Carnot cycle and Carnot principles, Thermodynamic Temperature scale, Clausius inequality, Entropy and its calculation- Third law.

UNIT III THERMODYNAMIC PROPERTIES OF REAL GASES 9

The PVT behavior of fluids, laws of corresponding states and equation of states approaches to the PVT relationships of non ideal gas, problems; compressibility factors, generalized equations of state, property estimation via generalized equation of state; fugacity and fugacity coefficients of real gases.

UNIT IV THERMODYNAMIC FORMULATIONS 9

Measurable quantities, basic energy relations, Maxwell relations, thermodynamic formulations to calculate enthalpy, internal energy and entropy as function of pressure and temperature, other formulations involving C_p and C_v , complex thermodynamic formulations, thermodynamic properties of an ideal gas, entropy change in reversible and irreversible process.

UNIT V COMPRESSION OF FLUIDS 9

Thermodynamic aspects of compression process, classification of compression processes, basic equation for change of state of gases, the work expression for different situations, the effect of clearance volume, multistage compression, convergent divergent flow, Ejectors.

TOTAL PERIODS : 45

COURSE OUTCOMES

At the end of course, students will be able to

- calculate the heat and work requirements for the given flow or non-flow processes.
- evaluate the thermal performance of different heat engines and refrigeration cycles through the calculation of their thermal efficiency or coefficient of performance.
- experiment the thermodynamic properties and to assess the feasibility of any process.
- analyze and apply thermodynamic formulations and relations in solving problems related to complex thermodynamic systems as well as to meet environmental and societal needs
- to classify the compression process and its effects in various compression equipments.

TEXT BOOKS

1. Smith, J.M., Van Ness, H.C and Abbot M.M “Introduction to Chemical Engineering Thermodynamics “, McGraw Hill Publishers, VI edition, 2003
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004

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1. Kyle, B.G., “Chemical and Process Thermodynamics III Edition”, Prentice Hall of India Pvt. Ltd., 1999.
2. Elliott J.R., Lira, C.T., “Introductory chemical engineering thermodynamics”, Prentice Hall, 1998
3. Rao, Y.V.C., “Chemical Engineering Thermodynamics” Universities Press, 2005
4. Pradeep ahuja,” Chemical Engineering Thermodynamics”, PHI Learning Ltd (2009).
5. Gopinath Halder,” Introduction to Chemical Engineering Thermodynamics”, PHI Learning Ltd (2009).
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2. <http://web.mit.edu/16.unified/www/FALL/thermodynamics/notes/node5.html>
3. <http://www.nptelvideos.in/2012/12/basic-thermodynamics.html>
4. <http://www.msubbu.in/ln/td/>

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



COURSE OBJECTIVES

To enable students to

- identify what distinguishes a strong and weak nucleophile and recall the rules of reactions
- analyzes a list of compounds and determines their reactivity
- Know about synthesis of organic compounds
- identify and characterize various functional groups

1. Quantitative analysis of organic compounds – Identification of aliphatic/aromatic, saturated/unsaturated compounds.
2. Identification and characterization of various functional groups by their characteristic reactions:
a) alcohol, b) aldehyde, c) ketone, d) carboxylic acid, e) phenol, f) ester, g) primary, secondary and tertiary amines h) imide i) nitro compounds.
3. Analysis of an unknown organic compound and preparation of suitable solid derivatives.
4. Analysis of carbohydrates.
5. Analysis of proteins.
6. Methodology of filtration and recrystallization.
7. Introduction to organic synthetic procedures:
 - i. Acetylation – Preparation of acetanilide from aniline.
 - ii. Hydrolysis – Preparation of salicylic acid from methyl salicylate.
 - iii. Substitution – Conversion of acetone to iodoform.
 - iv. Nitration – Preparation of m-dinitrobenzene from nitrobenzene.
 - v. Oxidation – Preparation of benzoic acid from benzaldehyde/ benzyl alcohol.

TOTAL PERIODS 45

COURSE OUTCOMES

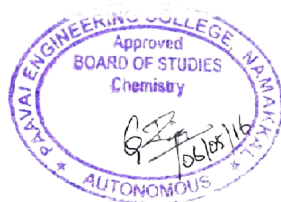
The student is able to

- identify what distinguishes a strong and weak nucleophile and recall the rules of reactions..
- shows their mastery of nomenclature.
- analyzes a list of compounds and determines their reactivity
- identify and characterize various functional groups.

REFERENCES

1. Vogels's Text Book of Practical Organic Chemistry, Fifth Edition, Longman, Singapore Publishers Pte. Ltd., Singapore (1989).
2. Organic Chemistry Lab Manual, Chemistry Division, Chemical Engineering Departemnt, A.C. Tech, Anna University (2007).

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



COURSE OBJECTIVES

To enable students to

- accuire a sound working knowledge on different types of crushing equipments
- learn separation characteristics of different mechanical operation separators.
- perform experiments to study the performance of various size reduction equipments
- determine mixing index

LIST OF EXPERIMENTS

1. Sieve analysis
2. Batch filtration studies using a Leaf filter
3. Batch filtration studies using a Plate and Frame Filter press
4. Characteristics of batch Sedimentation
5. Reduction ratio in Jaw Crusher
6. Reduction ratio in Ball mill
7. Reduction ratio of Roll Crusher
8. Separation characteristics of fine particles using Cyclone separator
9. Separation characteristics of Elutriator
10. Reduction ratio of Drop weight crusher
11. Mixing apparatus

TOTAL PERIODS 60

COURSE OUTCOMES

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

- carry out experiments as a team to study the performance of various size reduction equipments.
- analyze and interpret the experimental data for solid handling to provide valid results.
- select suitable equipment needed for a specific mechanical operation.
- calculate mixing index

REFERENCES

1. McCabe, W.L, Smith J.C and Harriot, P., “Unit Operations in Chemical Engineering”, McGraw-Hill, Fourth Edition, (1984).

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



COURSE OBJECTIVES

To enable students to

- conduct various experiments on electrical machines analyze their performance.
- determining the performance characteristics of transducers
- perform load tests
- know about the performance of starters

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 - LVDT
10. Study of pressure transducer

TOTAL PERIODS 60

COURSE OUTCOMES

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

- summarize the characteristics and speed control of electrical machines
- predict the performance characteristics of transducers
- conduct load tests
- Determine starter performance

CO/PO MAPPING:														
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CO3	2	3	2	-	-	-	-	-	-	-	-	-	1	-
CO4	2	1	2	-	-	-	-	-	-	-	-	-	1	-

