MAHATMA JYOTIBA PHULE ROHILKHAND UNIVERSITY, BAREILLY

NAAC A++ Accredited; UGC Category -1 University, World QS Ranking, NIRF 51+, ISO 9001:2015 & 14001:2001 Certified

CURRICULUM FOR DIPLOMA PROGRAMME

IN CHEMICAL ENGINEERING

(Second year; 3rd & 4th Semester)

चरैवेति चरैवेति

महात्मा ज्योतिबा फुले
रुहेलखण्ड विश्वविद्यालय, बरेली

(EFFECTIVE FROM YEAR 2025-26)

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN CHEMICAL ENGINEERING

Third Semester, Second Year

S. No	Category as per AICTE	Code of Course	Subject	Credits	Teaching Schedule Hrs. L T P	Marks
1.	Program core course	MAD-201T	APPLIED MATHEMATICS -III	4	3 1 0	100
2.	Program core course	DCE-301T	FLUID MECHANICS	4	3 1 0	100
3.	Program core course	DCE-303T	CHEMICAL PROCESS CALCULATIONS	4	3 1 0	100
4.	Program core course	DCE-305T	CHEMICAL ENGINEERING THERMODYNAMICS	4	3 1 0	100
5.	Program core course	DCE-307T	CHEMICAL TECHNOLOGY- I	4	3 1 0	100
			Total	**20**	**20**	**500**
6.	Program core course	DCE-303P	UNIT OPERATION LAB	**2**	**0 0 4**	**100**
			Total	**2**	**4**	**100**
			G. Total	**22**	**24**	**600**

Fourth Semester, Second Year

S. No	Category as per AICTE	Code of Course	Subject	Credits	Teaching Schedule Hrs. L T P	Marks
1.	Program core course	DCE-302T	HEAT TRANSFER OPERATIONS	4	3 1 0	100
2.	Program core course	DCE-304T	CHEMICAL REACTION ENGINEERING	4	3 1 0	100
3.	Program core course	DCE-306T	CHEMICAL TECHNOLOGY- II	4	3 1 0	100
4.	Program core course	DCE-308T	MASS TRANSFER OPERATIONS-I	4	3 1 0	100
5.	Program core course	DCE-310P	SUMMER INTERNSHIP (4 WEEKS)	4	0 0 4	100
			Total	**20**	**20**	**500**
6.	Program core course	DCE-302P	HEAT TRANSFER LAB	**2**	**0 0 4**	**100**
7.	Program core course	DCE-308P	MASS TRANSFER LAB	**2**	**0 0 4**	**100**
			Total	**4**	**8**	**200**
			G. Total	**24**	**28**	**700**

DETAILED CONTENTS OF VARIOUS SUBJECTS

Course Code: DCE-301T **L T P**
3 1 0

FLUID MECHANICS

COURSE OBJECTIVES

The subject gives knowledge of measurement of fluid flow and various fluid transportation machinery. The knowledge gained by this subject is directly used in different subjects studied in Chemical Engineering. The knowledge of this subject helps in installation of different fluid flow and transportation machinery.

LEARNING OUTCOMES

After studying this subject, the students will be able to:
• Distinguish between different types of fluids.
• Understand the concept of viscosity.
• Calculate flow rates.
• Calculate the power of pump required to do a certain pumping job.
• Understand the principles behind different flow meters.
• Install and calculate the flow rate of fluid with different flow meters in closed pipe line.
• Understand different flow control devices and to gain the knowledge of using different valves for different types of fluids and different flow situations.
• Understand the principle and working of different fluid flow machinery.
• Install the fluid flow machinery in closed pipelines.

COURSE CONTENTS

Unit-1: Introduction to fluids (08 Periods)

1. Properties of fluids- Density and viscosity, Vapor pressure and surface tension, cohesion and adhesion, Hydrostatic Pressure.
2. Types of Fluids- Ideal and Real fluids, Compressible and Incompressible Fluids (liquid), Newtonian and Non-Newtonian fluids and Newton's Law of Viscosity.
3. Types of Fluid flow: Streamline flow, steady and unsteady state flow, uniform and non- uniform flow, rotational and irrotational flow, Laminar flow and turbulent flow.

Unit-2: Pressure Measurements (04 Periods)

1. Pressure: Types of Pressure, Atmospheric, Gauge & Absolute Pressure, Barometric Leg
2. List of Pressure measuring devices: U-Tube Manometer –computation of Pressure difference using U-Tube manometer - Inclined Manometer –Simple Problems in U Tube manometer.

Unit-3: Flow of Incompressible Fluids (12 Periods)

1. Equation of continuity, Mass flow rate, volumetric flow rate, average velocity and mass velocity.
2. Introduction to Bernoulli's Theorem and its applications (derivation excluded).
3. Concept of Boundary layer, Form friction and skin friction.
4. Hagen-Poiseuille equation (derivation excluded).
5. Construction and Comparative Application of Venturi meter, Orifice meter, Rota meter, Pitot tube.

Unit-4: Pipe, fitting and valves (06 Periods)

1. Type of Pipes, Standard sizes of pipes on the basis of Wall thickness, Schedule number, BWG Number, Difference between Tube and Pipe.
2. Joints and fittings, Gate valve, Globe valve, Ball valve, Needle valve, Nonreturn value, Butterfly valve, Diaphragm valve, Control Valves, Solenoid Operating Valves.

Unit-5: Transportation of Fluids (10 Periods)

1. Pumps- Classification of Pumps, Centrifugal Pump: Parts of centrifugal pump, working of Centrifugal pump, Installation of Centrifugal Pump (Strainer, valves, NRV's explanation), priming, Cavitation, Net Positive Suction Head (NPSH).
2. Positive displacement Pump: Reciprocating pumps based on Fluid Handling and based on action of piston/plunger, Construction & working of Gear pump, Rotary Pump, Diaphragm pump, Screw pump.

INSTRUCTIONAL STRATEGY

Teacher should give small assignments to the student. Give industrial based practical problems for material and energy calculations.

RECOMMENDED BOOKS

1. Unit Operations of Chemical Engineering by McCabe, Smith; McGraw Hill
2. Introduction to Chemical Engineering by Badger & Banchero; McGraw Hill
3. Chemical Engineering Volume-1 by Richardson & Coulson; Pergamon Press

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Course Code: DCE-303T **L T P**
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CHEMICAL PROCESS CALCULATIONS

COURSE OBJECTIVES

This subject equips the students with basic chemical engineering calculations. It is one of the core subjects. In this subject, students learn the fundamental concepts on which chemical engineering design is based. This subject helps the student to prepare the material and enthalpy balance of a process. It also helps them to calculate the quantity of material input and output of a process plant.

LEARNING OUTCOMES

After studying this course, the students will be able to:
• Understand scope of material and balance in chemical industries.
• Carry out conversions of units and equations.
• Have knowledge of the solution concentrations, specific gravity, density, molarity, normality, molality in the chemical industries.
• Find the contents and properties of given analysed gas.
• Find out quantity of material input and outputs of various unit operations.
• Calculate material input and outputs of chemical reactions to identify excess and limiting reactants.
• Calculate the enthalpy associated with a reaction.
• Carry out combustion calculations, proximate analysis and ultimate analysis

COURSE CONTENTS

Unit-1: Introduction (04 Periods)

1. Introduction to material and energy balance in chemical industries
2. Unit conversion, S.I. system, M.K.S. system, C.G.S. system.

Unit-2: Gases and Gas Mixture (06 Periods)

1. Boyle's law, Charle's law, Ideal Gas law, value of universal gas constant, Amagat's Law
2. Average molecular weight, density and composition (by weight and by mole) of gas mixture.
3. Various units of concentration: PPM (parts per million), PPB (parts per billion) molarity, molality, normality.

Unit-3: Material Balance without Chemical Reaction (10 Periods)

1. Steps for solving simple material balance problems.
2. Solving simple problems on various unit operations like drying, evaporation, crystallization, distillation, mixing and absorption.

3. Concept of: By-pass streams, recycle and purge.

Unit-4: Material Balance with Chemical Reaction (08 Periods)

1. Limiting component, excess component, percent excess, yield, conversion and selectivity.
2. Combustion: proximate and ultimate analysis, air fuel ratio in Boiler/Furnaces, Theoretical oxygen/air required.
3. Basic numerical problems on Combustion.

Unit-5: Energy Balance (12 Periods)

1. Definitions of Specific heat (Cp & Cv)/sensible heat, latent heat.
2. Hess's law and associated basic problems.
3. Concept of Heat of reaction, heat of combustion & heat of formation.
4. Adiabatic reaction and adiabatic flame temperature
5. Calorific Value: Net and gross and its basic numerical problems.

INSTRUCTIONAL STRATEGY

Teacher should give small assignments to the student. Give industrial based practical problems for material and energy calculations

RECOMMENDED BOOKS

1. Stoichiometry by B. I. Bhatt &S. M. Vora; McGraw Hill Publication
2. Chemical Process Principles Part-1 by O.A. Hougen and K.M. Watson.
3. Chemical Process Principles Part-1 by R.A. Rastogi
4. Solved Examples in Chemical Engineering by G.K. Ray

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Course Code: DCE-305T **L T P**
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CHEMICAL ENGINEERING THERMODYNAMICS

COURSE OBJECTIVES

It is a core subject of Chemical Engineering and is essential for understanding basic concepts, thermodynamic properties of fluid and performance of thermal systems used in industry.

LEARNING OUTCOMES

After the completion of this course, the students will be able to:
• Know about basic concepts of thermodynamics.
• Understands laws of thermodynamics.
• Understand the application of laws of thermodynamics.
• Understand about the phase equilibrium.

COURSE CONTENTS

Unit-1: Introduction and Basic Concepts (06 Periods)

Thermodynamic systems: closed, open, isolated, homogenous, heterogeneous and surroundings, Thermodynamic properties: intensive, and extensive properties, State and path functions. Concept of internal energy, enthalpy, entropy, free energy and equilibrium, Ideal gas law, Amagat's law, Dalton's law, Zeroth law of thermodynamics

Unit-2: First Law of Thermodynamics for Open and Closed System (10 Periods)

Statement of first law of thermodynamics, expression and application of first law of thermodynamics for isothermal, isobaric, isochoric, adiabatic and polytropic processes. Properties of pure substances, phase change process of pure substance, property diagram for phase change processes- T-V, P-V and P-T diagrams, property tables- use of steam tables.

Unit-3: Second Law of Thermodynamics (04 Periods)

Statement of second law of thermodynamics: Kelvin Plank and Clausius, Heat engine, Heat Pump and Refrigerators- coefficient of performance and efficiency, Reversible and irreversible process, Carnot cycle and its efficiency.

Unit-4: Applications of Second law of Thermodynamics (10 Periods)

Concept of refrigeration, Thermodynamic cycles: vapor compression and absorption refrigeration and air refrigeration. Compressors- Piston, Rotary Screw, Centrifugal and Reciprocating. Liquefaction process, Properties and applications of refrigerants and their naming

Unit-5: Entropy (02 Periods)

Concept of entropy and Statement of third law of thermodynamics

Unit-6: Chemical Reaction Equilibrium and Vapor Liquid Equilibrium (08 Periods)

Composition of Gas Mixtures- Mass and Mole fraction, Concept of chemical potential, Henry's law, Raoult's law, Gibb's phase rule, vapor liquid equilibrium (VLE); P-v-T behaviour. Dew point and bubble point, fugacity, fugacity coefficient, activity and activity coefficient. Introduction to Applications of Thermodynamics in Industries: Power Generation-Steam Turbine & Gas Turbine, Refrigeration and Air Conditioning.

INSTRUCTIONAL STRATEGY

Teacher should give small assignments to the students related to subject and transfer industrial knowledge to students.

LIST OF RECOMMENDED BOOKS

1. Introduction to Chemical Engineering Thermodynamics by Smith and Vanness; McGraw Hill.
2. Chemical Engineering Thermodynamics by K.V. Narayanan; Prentice Hall India.
3. Chemical Engineering Thermodynamics by Dodge; McGraw Hill.
4. Chemical Engineering Thermodynamics by YVC Rao
5. Engineering Thermodynamics by PK Nag
6. Thermal Engineering by Ballaney
7. Chemical Engineering Thermodynamics by K.A. Gavhane, Nirali Publication.

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Course Code: DCE-307T **L T P**
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CHEMICAL TECHNOLOGY- I

COURSE OBJECTIVES

A comprehensive knowledge of various chemical industries involving process technology, availability of raw materials, production trend, preparation of flow sheet, engineering problems involving material of construction and uses, is required for diploma holders in Chemical Engineering.

COURSE OUTCOMES

After studying this course, the students will be able to:
- State basic principles of chemical process industry.
- Understand various processes used for manufacturing different compounds.
- Draw different types of flow sheet used in process industry.
- Describe engineering problems of various chemical industries.
- Understand use of various equipment/instruments used in process industry.

COURSE CONTENTS

Unit-1: Introduction (08 Periods)

1. Introduction to Major chemical process industries (such as fertilizer industries, fermentation industries, Oil refineries etc.) with reference to Indian resources, trade and export potential.
2. Process symbols used for various equipment and their uses.
3. Introduction to Good Manufacturing practices (GMP) and Good Laboratory Practices (GLP)

Unit-2: Sugar Industry (04 Periods)

1. Manufacturing of crystal sugar using cane sugar.
2. Various engineering problems encountered in sugar industry
3. Pollution abatement in sugar industry.

Unit-3: Fermentation Industry (06 Periods)

1. Introduction of fermentation industry and classification of fermentation processes
2. Production of ethyl alcohol by fermentation
3. Various engineering problems encountered in fermentation industry
4. Pollution abatement in fermentation industry

Unit-4: Soaps and Detergent Industry (10 Periods)

1. Manufacturing of soap and glycerin as by products from soap.
2. Manufacturing of detergents (including raw material and manufacturing process)
3. Hydrogenation of vegetable oils
4. Manufacturing of House disinfectants
5. Various engineering problems encountered in soaps and detergent industry.

Unit-5: Pulp and Paper Industry (08 Periods)

1. Different pulping process
2. Manufacturing of paper
3. Role of additives
4. Various engineering problems encountered in paper industry.
5. Pollution abatement in pulp and paper industry.

Unit-6: Polymer and Paint Industry (04 Periods)

1. Types of polymer, polymerization process, manufacture of polyethylene, styrene, nylon 6, Nylon 66, rayon. Manufacture of rubber.
2. Introduction to Paint, Varnishes and dyes.

INSTRUCTIONAL STRATEGY

Teacher should explain each process industry and use of each and every equipment used. An industrial visit can be organized in various chemical and process industries. Audio-visuals should be used to teach.

RECOMMENDED BOOKS

1. Dryden's Outlines of Chemical Technology by M. Gopal Rao and Marshal Sitting; Affliated Press Pvt. Ltd.
2. Shreve's Chemical Process Industries by Jorge Austin; Tata McGraw Hill
3. Unit Process in Organic Synthesis by P.H. Groggins; Tata McGraw Hill
4. Dryden's Outlines of Chemical Technology by M. Gopal Rao and Marshal Sitting; Affliated Press Pvt. Ltd.
5. Shreve's Chemical Process Industries by Jorge Austin; Tata McGraw Hill
6. Unit Process in Organic Synthesis by P.H. Groggins; Tata McGraw Hill
7. Chemical Technology Vol I and II by G. N. Pandey

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Course Code: MAD-201T **L T P**
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APPLIED MATHEMATICS-III

COURSE OBJECTIVES

Contents of this course provide understanding of some elementary and advanced mathematics algorithms and their applications of solving engineering problems. Content of this course will enable students to use some advanced techniques like Beta-Gamma function, Fourier series, Laplace transform and probability distributions in solving complex engineering problems.

COURSE OUTCOMES

After completing this unit, students will be able to:

- Understand matrix operations and uses of matrix in different problems.
- Apply elementary row and column operations in finding inverse of a matrix.
- Find Eigen values, Eigen vectors of a matrix and their different properties.
- Understand concept of probability distribution and their applications.

COURSE CONTENTS

Unit 1: Matrices (20 Periods)

Algebra of Matrices, Addition, Multiplication of matrices, Null matrix and a unit matrix, Square matrix, Symmetric, skew symmetric, Hermitian, Skew Hermitian, Orthogonal, Unitary, diagonal and Triangular matrix, Determinant of a matrix, Definition and Computation of inverse of a matrix., Elementary Row/Column Transformation, Meaning and use in computing inverse and rank of a matrix., Linear Dependence, Linear dependence/independence of vectors, Definition and computation of rank of matrix. Computing rank through determinants, Elementary row transformation and through the concept of a set of independent vectors, Consistency of equations. Definition and evaluation of eigen values and eigen vectors of a matrix of order two and three, Cayley-Hamilton theorem (without Proof) and its verification, use in finding inverse and powers of a matrix.

Unit 2: Vector Calculus and Multivariable Calculus (15 Periods)

Vector Calculus: Vector function, Differentiation and integration of vector functions, Gradient, Divergence and Curl, Directional derivatives, Vector Identities.
Multivariable Calculus: Function of two variables, Partial Differentiation: Partial derivatives, Chain rule, Higher order derivatives, Euler's theorem for homogeneous functions, Jacobians

Unit 3: Probability and Statistics (05 Periods)

Probability: Introduction, Addition and Multiplication theorem and simple problems. Distribution: Discrete and Continuous distribution, Binomial distribution, Poisson distribution, Normal distribution

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I &II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3. Applied Mathematics-II by Chauhan and Chauhan, Krishna Publications, Meerut.
4. Applied Mathematics-III by Chauhan and Chauhan, Krishna Publication, Meerut.

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Course Code: DCE-303P **L T P**
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UNIT OPERATION LAB

COURSE OBJECTIVES

To impart knowledge on
1. The fluid properties and understand conservation of mass, momentum and energy in fluid flows.

2. The internal flows and dimensional analysis
3. The working of Pumps, Turbines and construct the velocity triangles.

COURSE OUTCOMES

After completing the course, the students will be able to
1. Recognize the important fluid properties and determine forces acting on immersed bodies.
2. Solve fluid flow problems using Conservation principles.
3. Analyze the characteristics of boundary layer and relationship between different physical quantities of fluid flow.
4. Determine rate of flow and calculate flow losses through pipes.
5. Evaluate the performance of pumps.
6. Determine friction factor and coefficient of discharge

LIST OF EXPERIMENTS

1. AIM: To determine the head loss in a pipe transition in relation to the velocity head of the fluid
2. AIM: To determine Darcy `s co-efficient of friction in the given pipe line
3. AIM: To verify Bernoulli`s theorem
4. AIM: To determine the coefficient of V-notches to find the coefficient of discharge Cd
5. AIM: To determine the coefficient of discharge for venturi meter

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Course Code: DCE-302T **L T P**
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HEAT TRANSFER OPERATIONS

COURSE OBJECTIVES

Most of the Chemical Engineering operations will involve either heat addition or heat removal in one way or the other. It is, therefore, extremely necessary to have good understanding about the heat transfer mechanisms. This subject enables the students to apply this knowledge for understanding the performances of various heat transfer equipment such as heat

exchangers, condensers, evaporators etc. used in almost all chemical and related industries.

LEARNING OUTCOMES

After the completion of this course, the students will be able to:
• Understand basic laws of heat transfer
• Analyze problems involving steady heat conduction in simple geometries.
• Understand the concept of convective heat transfer and to analyze the problems involving heat transfer coefficients for natural and forced convection
• Analyze heat exchanger performance using LMTD and use it for parallel or counter flow
• Recognizer various type of heat exchanger working principle, and basic geometries of heat exchanger.
• Determine the overall heat transfer coefficient for a heat exchanger.
• Understand the concept of boiling and condenser
• Analyze the performance of evaporator

COURSE CONTENTS

Unit-1: Modes of Heat Transfer: (02 Periods)

Conduction, Convection, Radiation. Concept of steady state and unsteady state heat transfer

Unit-2: Conduction (06 Periods)

1. Fourier's law of heat conduction, thermal conductivity of materials – solids, liquids and gases and effect of temperature on thermal conductivity. One dimensional steady state heat conduction through a plane wall, composite wall and cylinder, multi-layer cylinder.

2. Insulation and insulating materials, critical thickness of insulation, physical properties of insulating materials

Unit-3: Convection (08 Periods)

1. Natural and forced convection, Dimensionless numbers: Reynold, Prandtl, Nusselt and Grashoff, empirical correlations for free and forced convection (Significance Only & Derivation Excluded).
2. Simple numerical problems using Fourier's law of heat conduction, Significance of Dittus BoelterandSieder-Tate Equation, Convective heat transfer coefficient (Derivation Excluded).

Unit-4: Radiation (08 Periods)

Reflection, absorption and transmission of thermal radiation, Definitions of: Transmissivity, reflectivity and absorptivity. Emissive power, Wein's displacement law, Stefan Boltzmann Law, Planck's law, Kirchhoff's law, Concept of black body, Grey body, solar radiation

Unit-5: Heat Exchanger (08 Periods)

Introduction and classification: Local/individual and overall heat transfer coefficient, fouling factor, roughness of surfaces and their effect, LMTD for parallel and counter current heat exchangers. Construction and description of:- Concentric double pipe, Shell and tube (1-1heat exchanger and 1-2 heat exchanger), Compact heat exchanger-Plate type heat exchanger, Extended

surface equipment-finned tube heat exchanger.

Unit-6: Boiling and condensation (03 Periods)

Introduction to Boiling and Boiling Curves; Condensation – Drop wise and Film wise

Unit-7: Evaporators (05 Periods)

Evaporation, Capacity & Economy of Evaporators, construction and description of open pan, long type vertical evaporator, falling film evaporator and agitated thin film evaporator, Multiple effect evaporator.

INSTRUCTIONAL STRATEGY

A field visit may be conducted to expose the students to various types of heat transfer equipment. Practical should be conducted to give an idea about modes of heat transfer, effect of insulation on heat transfer.

RECOMMENDED BOOKS

1. Heat Transfer by Chapman, MacMillan Publication.
2. Principles of Heat Transfer by Kreith, Harper and Row Publication.
3. Process Heat Transfer by Kern, McGraw Hill Publication.
4. Heat Transfer by McAdams, McGraw Hill Publication.
5. Heat Transfer by KA Gavahane, NiraliPublications.
6. Process Heat Transfer by Kern DQ, McGraw Hill Book, New York
7. Heat Transfer 7th Ed. By Holman JP; McGraw Hill, New York
8. Applied Process Design for Chemical and Petrochemical Plants, Volume III by Ludwig, E; Gulf Publishing Co., Houston, Texas
9. Heat Transfer Principles and Applications by K Dutta; Prentice Hall, India.
10. Unit Operation of Chemical Engineering by McCabe and Smith.

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Course Code: DCE-304T

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CHEMICAL REACTION ENGINEERING

COURSE OBJECTIVES

This subject outlines the basic principles of Kinetics. These principles are useful in developing new concept and operating the plant. It enables the students to have an idea about the different types of rectors and its design also gives knowledge about the importance of catalyst in various chemical processes in the industries.

LEARNING OUTCOMES

After completion this course, the students will be able to:
• Know about rate of chemical reaction.
• Understand various types of reactors.
• Know the fundamentals of reactor design.
• Know the fundamentals of heterogeneous reacting system
• Understand the concept of catalysis

COURSE CONTENTS

Unit-1: Introduction to Chemical Kinetics (08 Periods)

1. Concept of rate of reaction, rate equation, rate constant, order of reaction, Molecularity of reaction.
2. Elementary and non-elementary reaction.
3. Activation Energy, Theories of reaction rates constant- Arrhenius law, Collision theory & Transition state theory.

Unit-2: Interpretation of batch reactor data. (12 Periods)

1. Concept of batch reactor, semi batch reactor, constant and variable volume reactions.
2. Integral and Differential method of analysis of batch reactor data.
3. Integral method of analysis of irreversible unimolecular first order reaction, bimolecular second order reaction, nth order, zero order and auto catalytic reaction.
4. Half-life concept for the overall order of irreversible reactions.

Unit-3: Introduction to Reactor Design (12 Periods)

1. Type of Reactors: Batch reactor & Continuous reactor (Plug flow reactor, Mixed flow reactor)
2. Concept of space-time, space velocity and holding time.
3. Performance equation for ideal batch reactor, mixed flow reactor and plug flow reactor for constant volume irreversible first order reaction.
4. Size comparison of the Reactor-PFR vs CSTR (For first order irreversible reactions).

Unit-4: Catalysis (08 Periods)

1. Definition, types and classification of catalyst
2. Preparation of catalyst, ingredients (Promoter, inhibitor, accelerator)
3. Catalyst Poisoning & Regeneration.
4. Desired properties of catalyst.

INSTRUCTIONAL STRATEGY

Stress should be given on interpretation and designing of the different reactors. Industrial visit during the semester should be planned and audio-visual aids should be used for making student understand. This will make subject interesting and improve student's performance in the subject.

RECOMMENDED BOOKS

1. Chemical Reaction Engineering by Octave Levenspiel; Wiley Eastern Ltd.
2. Chemical Engineering Kinetics by J.M Smith; McGraw Hill Publication
3. Chemical Engineering Thermodynamics by J.M Smith, H.C. Vanness; McGraw Hill
4. Thermodynamics for Chemists by Samuel Glasstone; Krieger Publication Company.

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Course Code: DCE-306T

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CHEMICAL TECHNOLOGY- II

COURSE OBJECTIVES:

This subject will cover essential features of Chemical process industries regarding manufacture of various types of chemicals. The subject gives ideas to about various parameters like temperature, pressure, concentration and catalyst which affect the yield of the product. The subject will also give the knowledge about the sources of Raw Materials used in the Manufacturing of certain Inorganic Chemicals.

LEARNING OUTCOMES

After studying this course, the students will be able to:
• State basic principles of chemical industry.
• Understand various processes used for manufacturing different chemicals
• Draw different types of flow sheet used in process industry.
• Describe engineering problems of various chemical industries
• Describe pollution abatement methods in various chemical industries.

COURSE CONTENTS

Unit-1: Sulphuric Acid Industry (04 Periods)

1. Manufacturing process of Sulphuric Acid by Double Contact Double Absorption Method.
2. Manufacturing of oleum
3. Pollution abatement in Sulphuric Acid Industry

Unit-2: Fertilizer Industry (14 Periods)

1. N-P-K, Types of Fertilizers
2. Manufacturing of Ammonia
3. Manufacturing of Nitric acid
4. Manufacturing of Urea
5. Manufacturing of Single Super Phosphate
6. Manufacturing of Triple Super Phosphate
7. Engineering Problems and Pollution abatement in fertilizer industry

Unit-3: Chlor-alkali Industry (06 Periods)

1. Manufacturing process of Caustic Soda

2. Manufacturing process of Soda ash.
3. Engineering Problems in Chlor-alkali Industry Experiments:

Unit-4: Flue and Industrial Gases (06 Periods)

1. Classification of Flue and Industrial Gases
2. Manufacturing process of Oxygen and Nitrogen from Air
3. Manufacturing process of Water Gas
4. Manufacturing process of Producer Gas

Unit-5: Cement Industry (10 Periods)

1. Classification of cement based on application
2. Constituents of cement and Gypsum
3. Manufacturing of Cement &Portland cement
4. Manufacturing of Plaster of Paris
5. Pollution abatement in cement industry

INSTRUCTIONAL STRATEGY

Teacher should explain each process industry and use of each and every equipment used. An industrial visit can be organized in various chemical and process industries. Audio-visuals should be used to teach.

RECOMMENDED BOOKS

1. Dryden's Outlines of Chemical Technology by M. Gopal Rao and Marshal Sitting; Affiliated Press Pvt. Ltd.
2. Shreve's Chemical Process Industries by Jorge Austin; Tata McGraw Hill
3. Unit Process in Organic Synthesis by P.H. Groggins; Tata McGraw Hill
4. Chemical Technology Vol I and II by G. N. Pandey

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Course Code: DCE-308T

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MASS TRANSFER OPERATIONS- I

COURSE OBJECTIVES

In this subject the basic concepts of mass transfer are covered to enable the students to understand working of various mass transfer equipment like distillation columns, gas absorption columns, dryers, cooling towers and extraction columns etc. which are used in industries for purification of products

LEARNING OUTCOMES:

After completion of this course, the students will be able to:
• Understand the fundamentals of mass transfer operations.
• Estimate the diffusivity for molecular diffusion in gases and liquids.
• Find out local and overall mass transfer coefficient for interphase mass transfer.
• Understand various mass transfer processes like diffusion, adsorption, stripping, humidification and drying.

COURSE CONTENTS

Unit-1: Introduction and Classification of Mass Transfer Operations **(01 Periods)**

Unit-2: Diffusion (07 Periods)

1. Definition of diffusion and its classification: Molecular &Eddy diffusion, Knudsen diffusion, Role of diffusion in mass transfer
2. Molar Flux, Fick's law of Diffusion, Diffusion in Gas phase: equimolecular counter diffusion, diffusion through stationary gas.
3. Mass transfer coefficient, Interface mass transfer, relation between film and overall mass transfer coefficient.

Unit-3: Gas Absorption and Desorption (12 Periods)

1. Absorption and Desorption, absorption material balance and design equation of operating line (for Dilute system only), choice of solvent, Raoult's law and Henry's law, Absorption factor.
2. Concept of HTU and NTU, HETP for packed column of distillation (Derivation excluded)
3. Introduction to Packed Column and Tray Column (differences and applications), their internals, Random and Structured packings, properties of tower packings, flooding, channelling, weeping and loading.

Unit-4: Humidification and Dehumidification (08 Periods)

1. Definition: Saturated and Unsaturated gas, Dry bulb and wet bulb Temperature, dew point, Adiabatic saturation temperature, Humidity, relative humidity, percentage humidity, humid heat, humid volume, use of humidity chart.
2. Gas liquid contact operation (Description, construction, Working, advantage and disadvantage): Cooling towers- natural,

Induced and Forced draft, humidifier and dehumidifier, spray chambers, spray ponds.

Unit-5: Drying (12 Periods)

1. Definition: moisture content (wet and dry basis), equilibrium moisture content, bound moisture content, unbound moisture content, free and critical moisture content, constant and falling rate periods, rate of drying curve, time of drying (Derivation excluded).
2. Drying equipment (Description, construction, Working, advantage and disadvantage) – tray dryer, rotary dryer, spray dryer, fluidized bed dryer and application.

INSTRUCTIONAL STRATEGY

Field visit will make the students familiar with different types of column (packed/tray) and different types of packing's/trays used in the column. This will also make the students aware of auxiliary equipment/models/supports used for the columns. Along with the theoretical part, emphasis should be given to problem solving and practices especially for distillation column, absorption and humidification.

RECOMMENDED BOOKS

1. Mass Transfer Operations by Treybal, Kogakusha Publication
2. Introduction to Chemical Engineering by Badger and Banchero, McGraw Hill Publication
3. Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication
4. Mass Transfer by Sherwood Pigford and Wilke, McGraw Hill Publication
5. Chemical Engineers Handbook by Perry and Chilton, McGraw Hill Publication
6. Mass Transfer Operations by Kiran D. Patil, Nirali Publication

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SUMMER INTERNSHIP (4 WEEKS)

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of 4 weeks duration to be organized during the semester break starting after second year i.e. after 4th semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested thata training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An external assessment of 50 marks has been provided in the study and evaluation scheme of 5th Semester. Evaluation of professional industrial training report through viva- voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

Teachers and students are requested to see the footnote below the study and evaluation scheme of 4th semester for further details.

The teacher along with field supervisors will conduct performance assessment of students. The components of evaluation will include the following:

a) Punctuality and regularity 15%
b) Initiative in learning new things 15%
c) Presentation and VIVA 15%
d) Industrial training report 55%

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HEAT TRANSFER LAB

COURSE OBJECTIVES

To impart knowledge on

1. The heat transfer characteristics of various heat transfer apparatus
2. The design calculations of different modes of heat transfer
3. Conducting the heat transfer experiments and practically learn how to find heat transfer coefficients

COURSE OUTCOMES

After completing the course, the students will be able to

1. Calculate and compare the thermal conductivity of different materials.
2. Predict the convective heat transfer coefficient by free convection.
3. Analyze the performance of forced convective heat transfer coefficient through pin-fin.
4. Evaluate the performance of radiation through black and gray bodies.
5. Analyze the performance parameters of parallel flow heat exchanger.
6. Analyze the performance parameters of counter flow heat exchanger.

LIST OF EXPERIMENTS

1. AIM: To determine the thermal conductivity of brass
2. AIM: To study shell and tube heat exchangers and its classification
3. AIM: To determine the Stefan Boltzmann constant for radiation heat transfer
4. AIM: To determine the effectiveness and overall heat transfer in for parallel and counter flow heat exchanger
5. AIM: To study the rate of heat transfer for different materials and geometries

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Course Code: DCE-308P **L T P**
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MASS TRANSFER LAB

COURSE OBJECTIVES

To impart knowledge on
1. The purpose of this course is to introduce the undergraduate students with the most important separation equipment's in the process industry, and provide proper understanding of unit operations.
2. The mass transfer and separation processes and to provide knowledge and abilities to calculate mass transfer flux using diffusion coefficients and using mass transfer coefficients and to carry out basic design of mass transfer equipment used in absorption and distillation.
3. To apply principal of Chemical Engineering for designing various types of separation equipment such as filtration, distillation, chromatography etc.

COURSE OUTCOMES

After completing the course, the students will be able to
1. Students will learn about the diffusional mass transfer
2. Operation of cooling tower will be clearly understood
3. Operation of Dryer will be understood
4. Student will understand the mechanism of crystallization and absorption
5. Conduct experiments in teams to collect data for different mass transfer operations

LIST OF EXPERIMENTS

1. AIM: To find out the crystal yield in a batch crystallizer
2. AIM: To study the performance of rotary dryer
3. AIM: To determine the temperature of distillation and vaporization efficiency in steam distillation operation
4. AIM: To study the performance of extraction column and perform the experiment with given chemicals
5. AIM: To study the performance of cooling tower.

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