

BE IV SEMESTER CHEMICAL ENGINEERING							
COURSE CONTENTS							
CM4301	Particle and Fluid Particle Processing	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	0	4	5	70	22

Course Objective: The objective of this course is to familiarize students with various industrial operations involving particulate solids and its handling in various unit operations, where fluid-particle interactions are of paramount importance. Upon completion of this course, the students will be able to: apply the fundamental of fluid-particle mechanics, which are essential for the Handling of particulate solids and understanding of numerous industrial fluid-solid processes like packed bed operation, fluidization, sedimentation, filtration, separation of solids from fluids, etc.

Unit I

Crushing and Grinding: Handling of particulate solids, Evaluation of size & shape, surface and population of particles, standard industrial screens and screen analysis of solids, Effectiveness of screen. Principles of comminution, size reduction; crushing, grinding, pulverizing and ultra fining size reduction equipment, power requirement in comminution.

Unit II

Principles of Mixing: Mixing of solids, Mixing equipment's, Design, selection factors & Power requirement of mixers, Mixer effectiveness and mixing index.

Unit III

Principles of Separation: Principles of Separation techniques for system involving solids, liquids & gases, classification, sedimentation and filtration Principles of flow through filter cakes and medium, filtration practice, selection of filtration equipment, Separation equipments.

Unit IV

Selection of conveying devices for solids: Belt, Chain, Screw – conveyors, Elevators and pneumatic conveying devices. Elementary design aspect of the conveying devices. Visit to Chemical Engg. Industry engaged mainly with Mechanical Operation.

Unit V

Fluidization: Particulate & aggregative fluidization, Characteristic of fluidized bed due to particle size, size distribution, shape and density. Pressure drop through a fluidized bed, Character of dense phase fluidization as revealed by pressure drop fluctuations. Up flow and down flow fluidization, Applications of Fluidization in Fluid Catalytic process, bed drying, Mass transfer in fluidized beds.

List of Experiments:

1. To analyse the given sample by differential, cumulative methods using standard screen.
2. Determination of size and surface area of irregular particles using a measuring gauge.

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3. To study the crushing behaviour and to determine the Rittinger's and Bond's constant of the given solid in a Jaw crusher
4. To study the crushing behaviour and to determine the Rittinger's and Bond's constant of the given solid in a ball mill.

Suggested Readings:

Text Books:

1. Coulson and Richardson's CHEMICAL ENGINEERING VOLUME 2 FIFTH EDITION
2. McCabe, Smith, and Harriott: Unit Operations of Chemical Engineering FIFTH EDITION
3. Badger and Banchero, "Introduction to Chemical Engg.", 1st Edn., McGraw Hill, New York, 1954
4. M. Leva, Fluidization.

Reference Books:

1. Perry RH & Don WG; PERRY'S CHEMICAL Engineering HAND BOOK; Mc Graw Hill.
2. *Introduction to Particle Technology SECOND EDITION* Martin Rhodes Monash University, Australia
3. Murthy; Structures and properties of Engg Materials; TMH
4. J.K. Beddow, Particulate Science and Technology.

Course Outcomes:

After completion of course student will be able to

CO1: Understand, analyze and apply basic methods of characterization of solid particle, verification of empirical law of physical size separation and size reduction
CO2: Understand and apply basic methods of mixing of solids, liquids and pastes and evaluating power requirement for various mixing equipments
CO3: Understand and apply basic principles for separation of fluids and calculating and designing equipments for the operation.
CO4: Understand, design and select various conveying devices for transportation of solid material.
CO5: Understand, analyze and apply the phenomenon of fluidization.

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BE IV SEMESTER CHEMICAL ENGINEERING							
<u>CM4302</u>		COURSE CONTENTS					
<u>CM4302</u>	Heat Transfer	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	0	4	5	70	22

Unit I

Conduction: Modes of heat transfer one dimensional and two dimensional, Heat rate equations, Theory of insulation, critical radius calculations, types of insulation material, conduction through slab, cylinder and sphere.

Unit II

Convection: Convective heat transfer, heat transfer in boundary layer and in films, natural and forced convection, co/counter/cross current contacting for heat transfer, individual and overall heat transfer coefficient, fouling factor.

Unit III

Radiation: Radiative heat transfer, Black body radiation, concept of shape factor, methods of determination of shape factor, radiation exchange in enclosure with black surfaces.

Unit IV

Heat Transfer with Phase Change: Heat transfer under phase change conditions, boiling and condensation of pure components, heat flux temperature diagram for boiling and condensation under vertical and horizontal surfaces, nucleate & pool boiling, effect of surface condition on condensation, correlation for heat transfer under condensation.

Evaporation: Type of evaporators and their applications single and multiple effect evaporators, design and operation of forward – backward and mixed feed operations, effect of boiling point elevation and hydrostatic head, vapour recompression.

Unit V

Heat Exchange Equipment: General design of shell and tube exchangers, condensers, extended surface equipments, heat exchanger equation – coil to fluid, jacket to fluid, double pipe, shell & tube & finned tube heat exchanger.

Suggested Readings:

1. Donald Q. Kern - PROCESS HEAT TRANSFER – Tata McGraw Hill.
2. Alan J. Chapman – HEAT TRANSFER – IV Ed. – Collier McMillan.
3. Heat Transfer by Y.V.C. Rao.

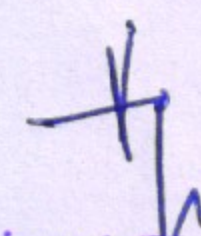
Course Outcomes:

After completion of course student will be able to

CO1: Understand and solve conduction through slab, cylinder and sphere, theory of insulation and critical radius calculations.
CO2: Understand and solve natural and forced convection heat transfer in boundary layer and in films.
CO3: Understand and solve radiation problems and concept of shape factor.
CO4: Understand and analyze the performance of heat exchangers and evaporators under phase change conditions.
CO5: Understand general design considerations and analysis of various heat exchange equipment.

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BE IV SEMESTER CHEMICAL ENGINEERING							
COURSE CONTENTS							
CM4303	Material Technology	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	0	0	3	70	22

Unit I

Engineering Materials: Classes of engineering materials, Mechanical, Thermal & Electrical properties of materials and their measurement. Engineering requirement of materials, selection of materials, structure of atoms and molecules, Bonding in solids - types of bonds and comparison of bonds.

Unit II

Crystallinity: Atomic structure, Inter atomic attraction, Molecular structure, Crystallinity, Solid solutions, Crystal imperfections, Electronic structure and Electromagnetic properties.

Unit III

Phase Deformation: Single phase metal deformation, Failure of metals, Theories of alloying, Phase relationship, Iron-carbon diagram, Nomenclature of steels, Utilization of cast iron, mild steel, stainless steel, lead and graphite in chemical engineering system.

Unit IV

Corrosion: Theories of Corrosion and corrosion control, Stability of materials in service: Chemical, Thermal and Radiolytic stability.

Unit V

Composite materials: Semiconductors, Superconductors, Surface modifications using linings of plastics, rubber, glass, ceramics with special reference to the applications in chemical Industries.

Suggested Readings:

1. VAMLACK, MATERIAL SCIENCE WOOLEF, VOL. 1,2,3,4.
2. Robert H. Perry & Don W. Green - PERRY'S CHEMICAL Engineering HAND BOOK - VII Ed. - Mc Graw Hill.
3. O.P. Khanna - MATERIAL SCIENCE & METALLURGY - Dhanpat Rai Publication.
4. S.K. Hajra Chhoushury - MATERIALS SCIENCE & PROCESSES - Indian Book Distributing Co.
5. V. Raghavan, Materials Science and Engineering, Prentice Hall

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Course Outcomes:

After completion of course student will be able to

CO1: Understand fundamental properties and its measurement of various engineering materials
CO2: Understand and analyze the Atomic structure and Electromagnetic properties of materials
CO3: Understand phase diagrams and phase transformations of metals
CO4: Understand the theories of Corrosion and Stability of materials in service
CO5: Understand and analyze Semiconductors, rubber, glass, ceramics with special reference to the applications in chemical industries.

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BE IV Semester Chemical Engineering							
COURSE CONTENTS							
CM4304	Organic Process Technology	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	0	4	5	70	22

Unit I**Industrial Microbial Processes and Edible Oils:**

Fermentation processes for the production of ethyl alcohol, alcohol derivatives like acetic acid, acetic anhydride, vinyl acetate, ethylene glycol, pyridine, citric acid and antibiotics, Refining of edible oils and fats, fatty acids, Soaps and detergents.

Unit II**Cellulosic Processes:**

Pulp and paper, pulping process chemical recovery pulp preparation and paper making.

Unit III**Petrochemicals:**

Intermediates for petrochemical from petroleum based stocks, phenol, methanol, ethylene, propylene, benzene, toluene and xylene, acrylonitrile, styrene, butadiene.

Unit IV**Fine Chemicals and Fibers:**

Dyes and Dye intermediates, carbohydrates and sugar, man-made fibers; rayon, polyester, polyamides and acrylics, cellulose acetate, insecticides and pesticides,

Unit V**Unit Processes:**

Nitration: nitrating agents, equipments for nitration, mixed acid preparation, sulfonation and sulfation agents.

Suggested Readings:

1. V.B. Gupta & V. K. Kathari – MANUFACTURING FIBRE TECHNOLOGY – Chapman Hall, Newyork I Edition 1997
2. V.K. Kathari- PROGRESS IN TEXTILE, SCIENCES TECHNOLOGY, VOL I & II – IAFL Publications, S-351 Greater Kailash part I New Delhi – 48 I Ed.
3. Austin, G.T. SHREEVES CHEMICAL PROGRESS INDUSTRIES – 5th Ed. Mc. Graw Hill New York 1984
4. Dryden C.E. –OUTLINES OF CHEMICAL TECHNOLOGY – 3rd Ed. Affiliated. East West press, New Delhi, 1997

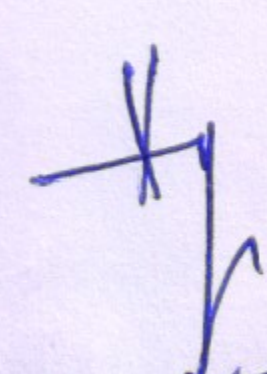
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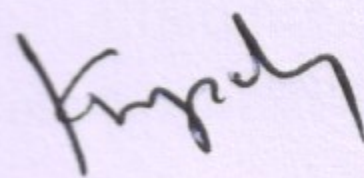
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Course Outcomes:

After completion of course student will be able to

CO1: Familiarity with the commercial processes of alcohol, edible oils, soap and detergent industry.
CO2: Understanding of pulp and paper industry with energy conservation and environmental pollution control.
CO3: Gain basic exposure of petrochemical sector with special reference to some specific products
CO4: Knowledge of theoretical fundamentals and working of dyes, sugar and fiber industries.
CO5: Exposure to nitration and sulfonation in organic synthesis.


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CM4305	Numerical Methods in Chemical Engineering	L	T	P	C	Max. Marks	Min. Marks	
Duration	3 Hours	3	0	4	5	70	22	

Unit I

Treatment of Engineering Data:

Graphical representation. Empirical equations, Interpolation, Newton's formula, Lagrange's Interpolation formula, extrapolation, Integration, graphical Integration, Graphical Construction of Integral curves, Numerical Integration.

Unit II

Interpretation of Engineering Data:

Significant figure, Classification of Measurements, Propagation of Errors, Variation and Distribution of Random Errors, Properties of Variance, Confidence limits for small samples.

Unit III

Ordinary Differential Equations:

Formulation, Application of Law of Conservation of Mass – Mixing in flow process. Classification of ordinary Differential Equations and its applications to common Chemical Engineering problems.

Unit IV

Numerical Solutions of Ordinary Differential Equations:

Linear Second – order Equations with variable coefficients, Numerical solution by Runge Kutta Method. Its application to higher – order equations.

Unit V

Formulation of Partial Differential Equations:

Finite difference, linear finite difference equations, non – linear difference equations. Optimization, types of methods, its application relating to chemical processes.

Suggested Readings:

1. Mickley, H. S. Sherwood, T. S. Reed – APPLIED MATHEMATICS IN CHEMICAL ENGINEERING- Tata McGraw Hill pub.
2. Jenson & Jeffrey's – MATHEMATICAL METHODS IN CHEMICAL ENGINEERING.

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Course Outcome:

After the course student should be able to:

CO1: Ability to apply Interpolation, extrapolation and Numerical Integration techniques to solve physical problems.

CO2: Able to know classification of Measurements, Errors, Variance and Confidence limits for small samples.

CO3: Mathematical formulation of chemical engineering problems and apply numerical techniques to solve physical problems.

CO4: Able to solve differential equations through various numerical solution computational methods.

CO5: Able to solve partial differential equations by various numerical solution computational methods.

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