

BE IV SEMESTER CHEMICAL ENGINEERING							
COURSE CONTENTS							
CM-4001	Material Science & Technology	L	T	P	C	Max. Marks	Min. Marks
<i>Duration</i>	<b>3 Hours</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>70</b>	<b>22</b>

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

BE IV SEMESTER CHEMICAL ENGINEERING							
COURSE CONTENTS							
CM-4002	Chemical Engineering Thermodynamics	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	1	0	4	70	22

### Unit I

**First law:** First law of thermodynamics and its application, batch flow processes, steady and unsteady flow, reversibility. Critical properties corresponding state. Compressibility. P- V – T- behavior of pure fluids, virial equations, cubic equations, generalized correlations and eccentric factor, behavior of liquids.

### Unit II

**Second law:** Second law of thermodynamics and its applications entropy of various systems. Thermodynamics equations. Effect of pressure on specific heat. Joule – Thompson effect. Third law of thermodynamics.

### Unit III

**Homogenous Mixtures:** Thermodynamics properties of homogenous mixtures. Property relationships for systems of variable compositions. Partial molal properties. Fugacity and fugacity coefficient, fugacity in ideal solutions, Properties changes of mixing, activity. Heat effects in mixing process. Excess properties, activity co-efficient gaseous mixtures.

### Unit IV

**Refrigeration:** Compression and expansion of fluids – single stage, multistage – power requirements and efficiency along with the effect and efficiency along with the effect clearance, compression of real gas, Refrigeration – Ideal reversed Carnot Cycle. Vapor compression refrigeration. Binary fluid cycle & Cascade system. Dry ice.

### Unit V

**Chemical Equilibria:** Chemical potential effect of pressure and temperature on heat of reaction and on free energy. Vant Hoff's equation, Clausius – Calpeyron equation. Gibbs Duhem equation. Equilibria and its applications.

### Suggested Readings:

1. Smith J. M. & Van Ness – INTRODUCTION TO CHEMICAL ENGINEERING THERMODYNAMICS –2<sup>nd</sup> Edition.
2. Dodge B. F. CHEMICAL ENGINEERING THERMODYNAMICS – McGraw Hill
3. Balzhiser, Samuels and Eliassen – CHEMICAL ENGG. THERMODYNAMICS – Prentice Hall
4. Sandler, S.I. – CHEMICAL ENGINEERING THERMODYNAMICS – John Wiley & Sons.
5. Rastogi and Mishra – CHEMICAL ENGG. THERMODYNAMICS.

BE IV SEMESTER CHEMICAL ENGINEERING							
COURSE CONTENTS							
CM-4003	Fluid Particle Mechanics	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	1	2	6	70	22

#### Unit I

**Crushing and Grinding:** Handling of particulate solids, Evaluation of size & shape, surface and population of particles, standard screens and screen analysis of solids. 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 & 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, Separation equipments.

#### Unit IV

**Selection of conveying devices for solids:** Belt, Chain, Screw – conveyors, Elevators and pneumatic conveying devices. Elementary design aspects of the 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, 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.
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:

1. J.K. Beddow, Particulate Science and Technology.
2. Perry RH & Don WG; PERRY'S CHEMICAL Engineering HAND BOOK; Mc Graw Hill.
3. Murthy; Structures and properties of Engg Materials; TMH
4. Badger and Banchemo, "Introduction to Chemical Engg.", 1st Edn., McGraw Hill, NewYork, 1954
5. M. Leva, Fluidization.

BE IV SEMESTER CHEMICAL ENGINEERING							
COURSE CONTENTS							
CM-4004	Inorganic Process Technology	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	1	2	6	70	22

#### Unit I

**Chlor-Alkalies:** Salts and Sodium compounds, soda ash, Caustic Soda, Chlorine and potassium salts.

#### Unit II

**Acids and Phosphates:** Hydrochloric acid, Sulphur and sulfuric acid, Phosphoric acid and phosphates.

#### Unit III

**Nitrogenous Fertilizers:** Nitrogenous Industries, Ammonia and Nitric acid, Nitrogenous Fertilizer, mixed fertilizers, N-P-K Fertilizers and micronutrients.

#### Unit IV

**Cement and Ceramics:** Types and Manufacture of Portland cement, Manufacture of glasses and special glasses, Ceramics: Refractories and its classification. Industrial gases: Nitrogen, Oxygen, Hydrogen, carbon dioxide and Acetylene.

#### Unit V

**Inorganic chemicals and Paints:** Inorganic chemicals namely Bromine, Iodine and Fluorine, Alumina and Aluminum chloride, Manufacture of paints - Pigments

#### List of Experiments:

1. Determination of iron content in a given salt solution.
2. Determination of lime% in a Portland cement.
3. Determination of N-P-K and micronutrients in Fertilizers sample.
4. Determination of dye concentrates using spectrophotometric analysis.
5. Available fluorine in bleaching powder.
6. Preparation of acetic acid from ethyl alcohol.
7. To determine % of formaldehyde in the formalene.
8. To prepare standard azodye and finding the yield.
9. To prepare urea formaldehyde resin and report % conversion.
10. To determine the acetic acid, ethanol concentration in aqueous solutions.

#### Suggested Readings:

1. Austine G.T. – SHREEVES CHEMICALS PROCESS INDUSTRIES – 5<sup>th</sup> Ed., Mc GrawHill 1984
2. Dryden C.E., M. Gopala Rao – OUTLINES OF CHEMICAL TECHNOLOGY – 3<sup>rd</sup> Ed. Affiliated East – West Press, New Delhi.
3. Pandey G.N. – CHEMICAL TECHNOLOGY VOLUME – I – Lion Press, Kanpur.

BE IV SEMESTER CHEMICAL ENGINEERING							
COURSE CONTENTS							
CM-4005	Heat Transfer	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	1	2	6	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.

### List of experiments:

1. To determine the thermal conductivity of metal rod.
2. To determine the equivalent thermal conductivity of composite wall.
3. To determine heat transfer coefficient in force convection.
4. To determine heat transfer coefficient in Natural convection.
5. To determine heat transfer coefficient with the help of Stefan Boltzman Apparatus.
6. To calculate emissivity of the test plate by emissivity measurement apparatus.
7. To determine heat transfer coefficient in double pipe heat exchanger.
8. To study the heat transfer characteristics of a shell and tube heat exchanger (heating/cooling) of water.
9. To determine heat transfer coefficient in parallel and counter flow heat exchanger.
10. To measure the rate of evaporation using an open pan evaporator.
11. To measure the rate of condensation of pure water vapour and to determine the heat transfer coefficient.
12. Demonstrate the film-wise drop-wise condensation and determination of the heat transfer coefficient.
13. To study the single effect evaporator and find out the heat transfer coefficient.

**Note: Each student should perform at least eight experiments out of the above list.**

### 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.

## BE IV SEMESTER CHEMICAL ENGINEERING

### COURSE CONTENTS

CM-4006	Computer Aided Process Calculations	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	0	0	4	0	60	19

1. Introduction to Microsoft Excel.
2. Basic Operations
3. Using functions
4. Unit conversions of chemical process.
5. Material Balance solution using Excel.
6. Energy balance solution using Excel