Engineering and Management Institute of India

Diploma in Engineering

CHEMICAL ENGINEERING SYLLABUS

Third Year		
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Department of Chemical Engineering

Vision:-

To strengthen the region through imparting superior quality technical education and research; which enables the fulfillment of industrial challenge and establish itself as a Centre of Excellence in the field of Chemical Engineering.

Strength of Material (CME-2.1)

UNIT-I

Simple Stresses & Strains : - Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT –II

Shear Force and Bending Moment Diagrams: - Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l., uniformly varying loads and combination of these loads – Point of contra flexure.

UNIT – III

Flexural Stresses: -Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, sections. Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T sections.

UNIT – IV

Thin Shells:- Definition – Thin and thick cylindrical shell Failure of thin cylindrical shell subjected to internal pressure Derivation of Hoop and longitudinal stress causes in a thin cylindrical shell subjected to internal pressure simple problems change in dimensions of a thin cylindrical shell subjected to internal pressure -problems Derivation of tensile stress induced in a thin spherical shell subjected to internal pressure simple problems change in diameter and volume of a thin spherical shell due to internal pressure.

UNIT –V

Torsion of Circular Shafts: -Theory of pure torsion, Derivation of torsion equations: T/J=q/r=Nθ/LAssumptions made in theory of pure torsion-Torsional moment of resistance – Polar section modulus – Power transmitted by shafts. Thin Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in dia, and volume of thin cylinders.

Reference Book:-

1.Strength of Materials by (R.K. Bansal ,Laxmi Publications 2010).

2. Strength of materials by (Sadhu Singh.Khanna Publications).

3. Strength of Materials by (S.Timshenko)

Technology of Inorganic Chemical (CME-2.2)

UNIT-I

WATER TREATMENT:- Sources of water - quality of water -Hardness of watermerits `and demerits of hard water in process industries- - water softening - cold lime and hot lime soda process - Ion exchange - Sodium cation and hydrogen c a tion exchange processes -Regeneration - demineralizaon of water –Double bed and Mixed bed Ion exchange process- Boiler feed water treatment - Municipal waste water d industrial waste water treatment – tertiary Treatment-aeration-chemical purification - coagulation - water desalination by reverse osmosis and electro dialysis.

UNIT –II

ALKALIES AND INDUSTRIAL GASES:- Manufacture of soda ash by Solvay process manufacture of chlorine and Caustic Soda - membrane cells Manufacture of carbon dioxide, dry ice uses of CO_2 - Manufacture of hydrogen by steam hydrocarbon reforming process - Oxygen manufacture by Linde Process – Uses of industrialgases.

UNIT – III

FERTILIZERS:- Fertilizer industries : Introduction- growth in Indiaclassification of fertilizers- nutrient content of fertilizersIntermediate products of fertilizers-Manufacture of ammonia– various methods of production- uses; Nitrogenous fertilizers: Manufacture of urea Phosphatic fertilizers: Manufacture of super phosphate complex fertilizers: Manufacture of NPK Potassic fertilizers: Manufacture of Potassium chloride and potassium sulphate.- Properties and use of these fertilizers.

UNIT – IV

GLASS, CEMENT AND PAINT:- Classes of commerical glasses - raw materials - methods of manufacture - melting - forming - annealing - finishing - manufacture of cement by wet and dry processes - constituents of paints, manufacture of titanium dioxide and.

UNIT –V

ACID INDUSTRIES:- Sulphuric acid manufacture by double absorption, contact process raw materials and industrial uses of sulphuric acid – Hydrochloric acid industrial uses-raw materials and manufacture process–Phosphoric acid industrial uses-raw materials and manufacture process – Nitric acid-industrial uses-raw materials and manufacture process.

Reference Book :-

1. Technology of Inorganic Chemical By P. George T.Austin.

2. Technology of Inorganic Chemical By John Griffiths.

PETROLEUM REFINING AND PETROCHEMICALS (CME-2.3)

UNIT-I

Basics of Petroleum: -Role of Crude Oil in Global Economy, Present Scenario of Crude Oil Refinery, Origin(Formation), Composition, Classification and Evaluation of Crude Oil, Crude Assay Analysis, Distillation Characteristics such as TBP,ASTM & EFV etc.

Processing of Petroleum: -Pretreatment of Crude (Dehydration & Desalting), Pumping of Waxy Crude, Heating of Crude , Distillation of Petroleum & Types of Reflux , ADU & VDU etc.

UNIT –II

Properties of Petroleum Products: - Types of Gases and their Composition, Types of Gasoline & it's Important Properties and Tests such as ASTM Distillation , RVP, Octane number , Oxidation stability , Sulphur Content etc., Various types of Naphtha and their Important Properties and Application, Important tests and Properties of Kerosene such as Flash & Fire Point , Smoke Point , Aniline Point etc., Types of Diesel & its Important Properties and Tests such as Pour Point, Diesel Index , Cetane Number etc. , Heavy Fractions Like Lube Oil, Bitumen ,Asphalt etc. and their Important Properties Such as Viscosity Index, Carbon Residue, Penetration Index, Softening Point etc.

UNIT – III

Treatment Techniques: - Physical Impurities Found in Crude & their Removal, Sweetening Techniques, Production and Treatment of LPG, Gasoline Treatment Such as Lead Doctoring, Merox Sweetening, Catalytic Desulphurization etc. Various Methods of Treatment of Lubes Such as Phenol Extraction , Furfural Extraction, etc.

Thermal & Catalytic Cracking: - Necessity and types of cracking.

Thermal cracking: - Mechanism of Thermal Cracking, Properties of Cracked Materials, Visbreaking, Dubb's Two Coil Process, Delayed Coking, Naphtha Cracking etc.

UNIT – IV

Catalytic cracking: - Advantages & Theory of Catalytic Cracking, Fixed Bed, Moving Bed & Fluidized Bed Technology, FCC, Hydrocracking, Catalytic Reforming, Platforming, Continuous Catalyst Regeneration Reforming, Catalytic Polymerization, Catalytic Alkylation, Catalytic Isomerization etc.

UNIT –V

C1 and C2 Petrochemicals: - Methanol, Formaldehyde, Chlorome thane etc. Ethylene, Ethylene Dichloride, Vinyl Chloride, Ethylene Oxide, Ethylene Glycol, Ethanol amines etc.

C3, C4, Aromatics and Polymers: - Propylene, Butadiene, etc. BTX Separation, p-xylene, Styrene, p-terephthalic acid, etc. PVC, LDPE, LLDPE, HDPE, Polypropylene , Polypropylene Co-polymers , Polystyrene , SBR ,PBR, Polyesters etc.

Reference Book:-

1 B. K.Bhaskar Rao, Modern Petroleum Refining Processes, Oxford and IBH 2007.

2. B.K.Bhaskar Rao, A Text on Petrochemicals, 2ndEdition, Khanna Publishers, Delhi, 1998

POLYMER CHEMISTRY (CME-2.4)

UNIT-I

INTRODUCTION: - Introduction, & historical background macromolecular concept monomer, & polymers Nomenclature of polymers, Characteristic features of a polymer, Definition of polymerization, Polymerization and functionality, High polymers and oligopolymers, Scope of elastomeric, Fabre forming and plastic materials.

CLASSIFICATION OF POLYMERS: -Classification of polymers on the basis of A. Origin - natural, semisynthetic & synthetic. B. Thermal response - Thermoplastic & Thermosetting. C. Mode of formation - Addition & Condensation. D. Line structure - Linear, branched, Cross linked. E. Application & Physical Properties - Rubber, Plastic and fibers. F. Tacticity - Isotactic, syndiotactic and atactic. G. Crystallinity - Non crystalline (amorphous), Semi-crystalline and crystalline.

UNIT –II

TYPES OF POLYMERISATION: - Addition (chain) polymerization,• Condensation polymerization,• Comparison between addition and condensation polymerization,• Copolymerization,• Types of co-polymer - Random, Alternate and Block.

CHEMISTRY OF POLYMERISATION: -Mechanism of addition polymerization - Initiation step, propagation step and termination step, chain transfer, Rate of polymerization, Average degree of polymerization Types of initiations, inhibitors, types of polymerization reactions as - free radical polymerization, anionic and cant ionic polymerization reactions co-ordination polymerization or Ziegler - Natta polymerization, polycondensation polyaddition polymerization, ring opening polymerization, miscellaneous polymerization reactions.

UNIT – III

POLYMERISATION TECHNIQUES: -Suspension, Bulk and Emulsion & Solution polymerization, Mini Emulsion and Mini Suspension polymerization. Interfacial Polymerization.

CHEMICAL & GEOMETRIAL STRUCTIRE OF POLYMER MOLECULES: -General remarks on polymer microstructure, microstructure based on chemical structure (a) Organic and inorganic polymers (b) homochain and hetero chain polymers (c) homopolymers and copolymers. Microstructure based on the geometrical structure i.e. linear, branched and cross-linked polymers, random, alternating, block and graft copolymers, stereo regular polymers.

UNIT –V

POLYMER REACTIONS: -A- Hydrolysis, Acidolysis, Aminolysis, Hydrogenation, addition and substitution reactions of various specific groups, cyclisation reaction, cross linking reaction, miscellaneous reactions. B- Polymer Degradation: What is polymer degradation, types of degradation.

Reference Book:-

1. Fluid Flow and Heat Transfer By K.S. Raju.

2. Fluid Flow and Heat Transfer By Suhas Patankar.

Mechanical Operation (CME-2.5)

UNIT-I

Introduction of Mechanical Operation:- Definition of Unit Operation and Unit Process, Difference between Unit operation and Unit Process, Examples of Unit Operation & Unit Process.

Properties of particulate solids:- Specific properties of solids, Density & Bulk density. Definition and calculation of particle diameter, Sphericity, equivalent diameter, specific surface area, volume surface mean diameter, mass mean diameter, shape factor, Calculation of no. of particles.

UNIT –II

Screen Analysis:- Need of screen analysis, Types of screen analysis, Application of screen analysis, Types of screens, trommel, grizzlies, Vibrating screen etc. Ideal & actual screen, Capacity & effectiveness of screen (With derivation). Calculation of capacity and effectiveness of screen, faults in screening.

UNIT – III

Size Reduction:- Definition and need of size reduction, Principles of size reduction, characteristics of comminuted products, Energy & power requirements in communition, laws of size reduction, work index, Types of size reduction equipment with their principle, construction & working, derivation of equation of angle of nip and critical speed. Calculation of angle of nip,capacity & Ribbon factors. Open & close circuit grinding.

UNIT – IV

Sedimentation:- Definition of sedimentation, theory of bath sedimentation, Interphase height and time curve, Flocculation principle, Gravity thickener. Explanation of free and hindered settling, cyclone separator, efficiency of cyclone separator. Definition of Stoke's law and Newton's law for terminal settling velocity.

UNIT –V

Filtration:- Definition and applications of filtration, Equipments for liquid – solid separation., Filter press, Rotary vacuum filter, filter media and its required characteristics, filter aids and method of application, calculation of special cake resistance, filter media resistance, porosity for constant rate, constant pressure system and vacuum drum, constant rate filtration and constant pressure filtration, classification of centrifugal equipment, batch centrifuge, Advantages and disadvantages of centrifuge over filter press.

Reference Book :-

1.Chemical Operation by Warren L. McCabe.

2. Chemical Operation by Jack T. Ballinger.

MATERIAL AND ENERGY BALANCE (CME-2.6)

UNIT-I

Scope: -Scope of material and energy balance in chemical industries.

Unit conversion: - Unit conversion of units, conversions of equations, S.I. system, M.K.S. system, C.G.S. system.

UNIT –II

Gases and Gas Mixture: -Ideal gas law, Boyle's law, Charle's law, value of universal gas constant, Amagats Law, partial pressure 3.2 Vander Waal's equation. 3.3 Average molecular weight, density and composition (by weight and by mole) of gas mixture. 3.4 Transform of material from one measure of concentration to another, including mass/volume, PPM, molality, normality and molarity.

UNIT – III

Material Balance without Chemical Reaction: -1 Steps for solving material balance problems. 4.2 Solving problems on various unit operations like drying, evaporation, crystallization, distillation, mixing, blending, absorption, extraction. 4.3 By pass, streams, recycle and purge simple problems.

Material Balance with Chemical reaction: -Limiting component, excess component, percent conversion, percent yield, percent excess 5.2 By pass, recycle and purge stream related simple problems.
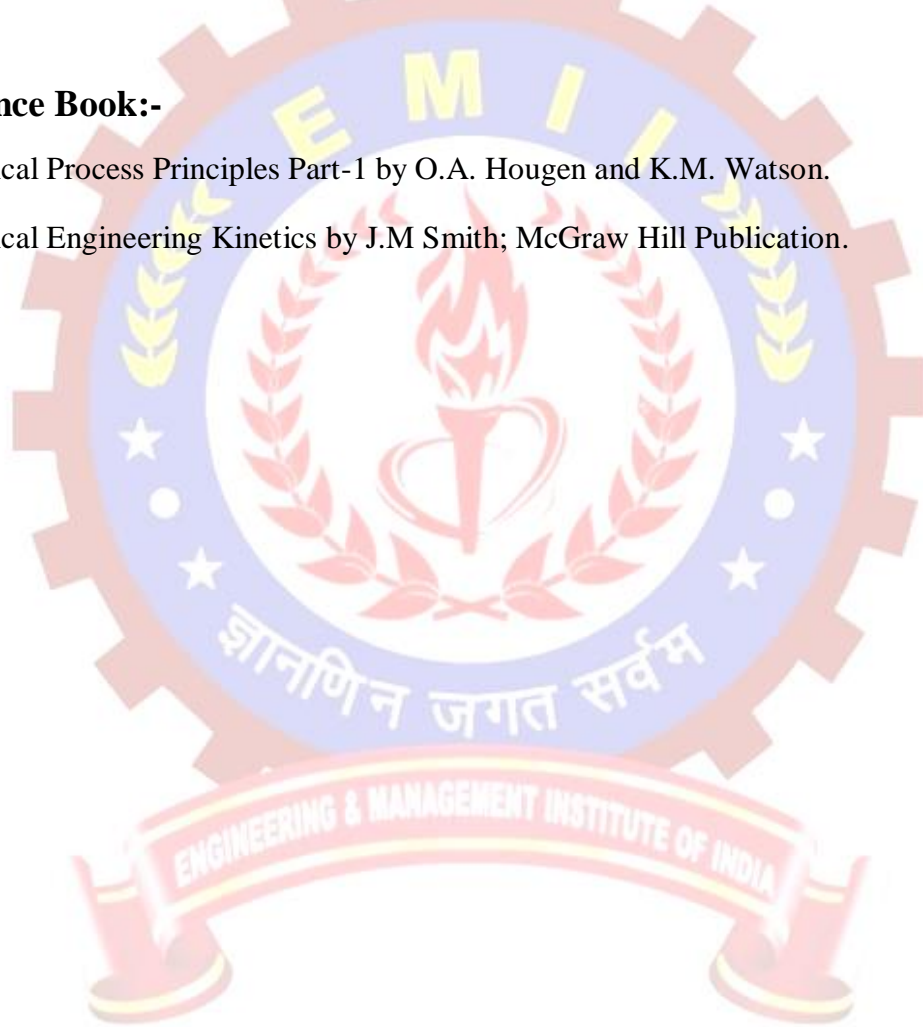
UNIT – IV

Energy Balance: -Units of heat, sensible heat, latent heat calculations. 6.2 Heat of formation by Hess's law, problems on the same. 6.3 Heat of reaction from specific heat data, heat of combustion, heat of formation data problems. 6.4 Adiabatic reaction and adiabatic reaction temperature 6.5 Net and gross heating value and its problems.

UNIT –V

Combustion Process: -1 Analysis of products of combustion: proximate and ultimate analysis. 7.2 Problems of fuel analysis, air fuel ratio, theoretical oxygen/air required. Problems of fuel analysis 7.4 Oxidation of sulphur and its compounds

Reference Book:-

1. Chemical Process Principles Part-1 by O.A. Hougen and K.M. Watson.

2. Chemical Engineering Kinetics by J.M Smith; McGraw Hill Publication.

Fluid Flow and Heat Transfer (CME-2.7)

UNIT-I

Fluid Statics:- Definition of fluid, fluid mechanics, static pressure, head, gauge pressure, absolute pressure, dynamic pressure, vacuum. Pressure measuring devices, Simple U tube manometer, differential U tube manometer, inclined tube manometer, measurement of absolute and gauge pressure by manometer, manometric liquids, purpose of pressure measurement. Mechanical pressure gauges, Bourdon tube, diaphragm & bellow gauges. Derivation & Calculation of pressure drop.

UNIT –II

Fluid dynamics :- Purpose of flow measurement, definition of average mass & volumetric flow rates, Classification of flow meters, orifice meter, venturimeter, pitot tube, flow nozzle, rotameter, open weirs. Comparison & merits-demerits of flow meters. . Calculation of flow rates by direct use of formulas.

UNIT – III

Fundamentals of Heat Transfer:- Introduction, Engineering heat transfer and analogies between various transport processes, modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzmann law, Thermal conductance and resistance, Convective and radiative conduction, Combined heat transfer process.

UNIT – IV

Steady State Heat Transfer by conduction:- Concept of heat conduction, Linear one-dimensional Heat conduction through wall, through cylinder and through sphere, Conduction through composite plane wall, conduction through composite cylinder, conduction through composite sphere, critical insulation thickness for pipes.

Heat Transfer by Convection:- The nature of heat convection, The Nusselt Number, Determination of Nusselt Number, Forced convection (No derivation), Free convection (No derivation)

UNIT –V

Fluidization :- Aggregative & particulate types. Mechanism, applications, calculation of pressure drops through fluidized bed. Comparison of packed & fluidized beds, their merits, demerits & applications.

Level measurement :- Direct level measurement – tape, sight glass & float methods. Indirect level measurement – Air trap box, diaphragm box, bulbar system, differential U tube manometer methods.

Reference Book :-

1. Fluid Flow and Heat Transfer By K.S. Raju.

2. Fluid Flow and Heat Transfer By Suhas Patankar.

BASIC Electronics (CME-2.8)

UNIT-I

Introduction of Number System & Codes: - Distinction between analog and digital signal. Applications and advantages of digital signals. Need and process of A/D and D/A conversion, Binary and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice- versa. Binary addition, subtraction, multiplication and division including binary points. 1's and 2's complement method of addition/subtraction, sign magnitude method of representation, floating point representation, Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and Gray code. Concept of parity, single and double parity and error detection Alpha numeric codes: ASCII and EBCDIC.

UNIT –II

Logic Gates and Simplification: - Concept of negative and positive logic, Definition, symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND and NOR as universal gates. Postulates of Boolean algebra, DE Morgan's Theorems. Various identities. Formulation of truth table and Boolean equation for simple problem. Implementation of Boolean (logic) equation with gates, Karnaugh map (upto 4 variables) and simple application in developing combinational logic circuits Logic Families: Logic family classification: Definition of SSI, MSI, LSI, VLSI- TTL and C MOS families and their sub classification- Characteristics of TTL and C MOS digital gates. Delay, speed, noise margin, logic levels, power dissipation, fan-in, power supply requirement and comparison between TTL and C MOS families Logic Circuits:-Open collector, wired OR and totem pole output circuit operation (qualitative) for a TTL NAND gate- C MOS circuit operation for a standard gate (NOR).

UNIT – III

Arithmetic Circuits, Coders and Decoders: - Half adder and Full adder circuit, design and implementation. Half and Full subtracter circuit, design and implementation.4 bit adder/subtracter.Adder and Subtract or IC (7484), Encoders and Decoders: Four bit decoder circuits for 7 segment display and decoder/driver

ICs.Multiplexers and De- Multiplexers Basic functions and block diagram of MUX and DEMUX. Different types and ICs.

Latches and flip flops and Counters: - Concept and types of latch with their working and applications, Operation using waveforms and truth tables of RS, T, D, JK, and Master/Slave JK flip flops. Difference between a latch and a flip flop, IC flip flops Counters: Binary counters, Divide by N ripple counters (including design), Decade counter. Pre settable and programmable counters, Down counter, up/down counter, Synchronous counters(only introduction). Difference between Asynchronous and Synchronous counters, Ring counter with timing diagram, Counter Ics.

Shift Register and Memories: - Introduction and basic concepts including shift left and shift right. Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out. Universal shift register, Buffer register, Tristate Buffer register IC 7495. Memories: Basic RAM cell, N × M bit RAM, Expansion of word length and capacity, static and dynamic RAM, basic idea of ROM, PROM, EPROM and EEPROM.

Reference Book: -

1. BASIC Electronics by RP Jain.

2. BASIC Electronics by KS Jamwal.

PRINCIPAL OF STOICHIOMETRY (CME-2.9)

UNIT-I

STOICHIOMETRY: -Stoichiometry. 3.2 Basis of Calculation 3.3 Concept of limiting reactants. 3.4 Atomic weight, molecular weight, molecular formula, empirical formula and solve some problems on it 3.5 Solve problems on chemical reaction on mass-mass, mass-volume basis.

UNIT –II

GASES AND GASEOUS MIXTURES: -Applications of ideal gas . 4.2 Average molecular weight, density and composition (by weight and volume) of gas mixture and solve problems on it . 4.3 Partial pressure, vapour, Amagat's law, Dalton's law and solve problems on it . 4.4 State Roult's law and Henry's law and solve problems.

UNIT – III

MATERIAL BALANCE WITHOUT CHEMICAL REACTION: -State Law of conservation of mass 5.2 Concept of material balance 5.3 Solve problems on material balance based on Unit operations like mixing, evaporation, distillation, drying, humidification, extraction, absorption.
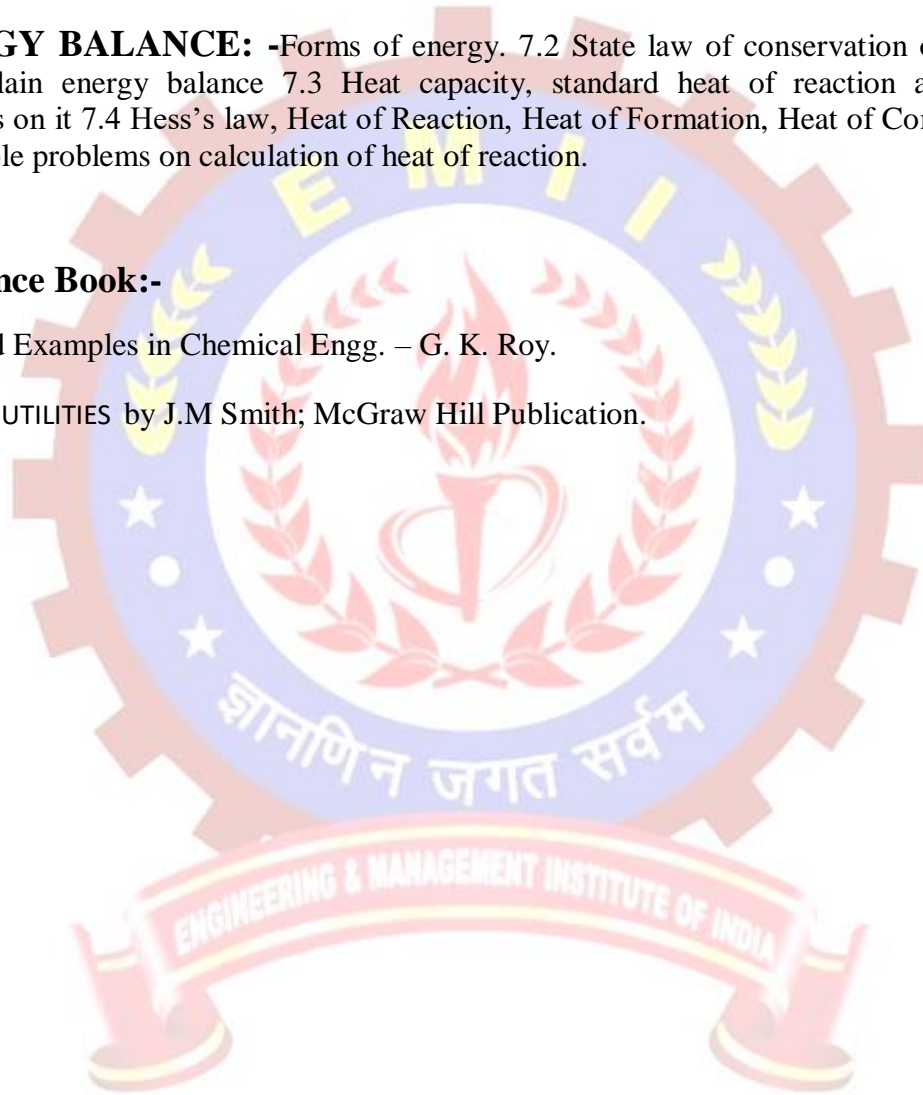
UNIT – IV

MATERIAL BALANCE INVOLVING CHEMICAL REACTION: - Stoichiometric ratio, stoichiometric proportions, excess reactants, percentage excess, conversion, yield, selectivity. 6.2 Concept and reaction mechanism in combustion. 6.3 Solve problems on material balance with chemical reaction and combustion. 6.4 Concept of recycle and by pass.

UNIT –V

ENERGY BALANCE: -Forms of energy. 7.2 State law of conservation of energy and explain energy balance 7.3 Heat capacity, standard heat of reaction and solve problems on it 7.4 Hess's law, Heat of Reaction, Heat of Formation, Heat of Combustion. 7.5 Simple problems on calculation of heat of reaction.

Reference Book:-

1. Solved Examples in Chemical Engg. – G. K. Roy.

2. PLANT UTILITIES by J.M Smith; McGraw Hill Publication.

Technology of Plastics (CME-2.10)

UNIT-I

INTRODUCTION:- Introduction of General parts of polymerization plants. Batch & continuous production processes. Advance polymer material such as Liquid crystal polymer, Conducting polymer, High energy absorbing material, Smart material, Nano polymer, etc.

UNIT –II

Industrial Manufacturing processes of common thermo: - plastic such as polyethylene's polypropylenes and polystyrenes and its co-polymers i.e.: ABS & SAN polyvinylchloride acrylic polymers along with their properties and applications. Introduction to new polymers such as polycarbonates, polypsulphones, polyimide, PET (Polyethylene terephthalate, PTFE (Poly Tetra Fluro Ethylene). Chemistry and Production of nylon 6 and nylon 6.6.

UNIT – III

Manufacturing process: - properties and application of synthetic condensation polymers (Themro-setting Plastic of synthetic such as phenol formaldehyde, urea formaldehyde, melamine formaldehyde polyester (saturated and unsaturated) epoxy resins, vinyl esters).
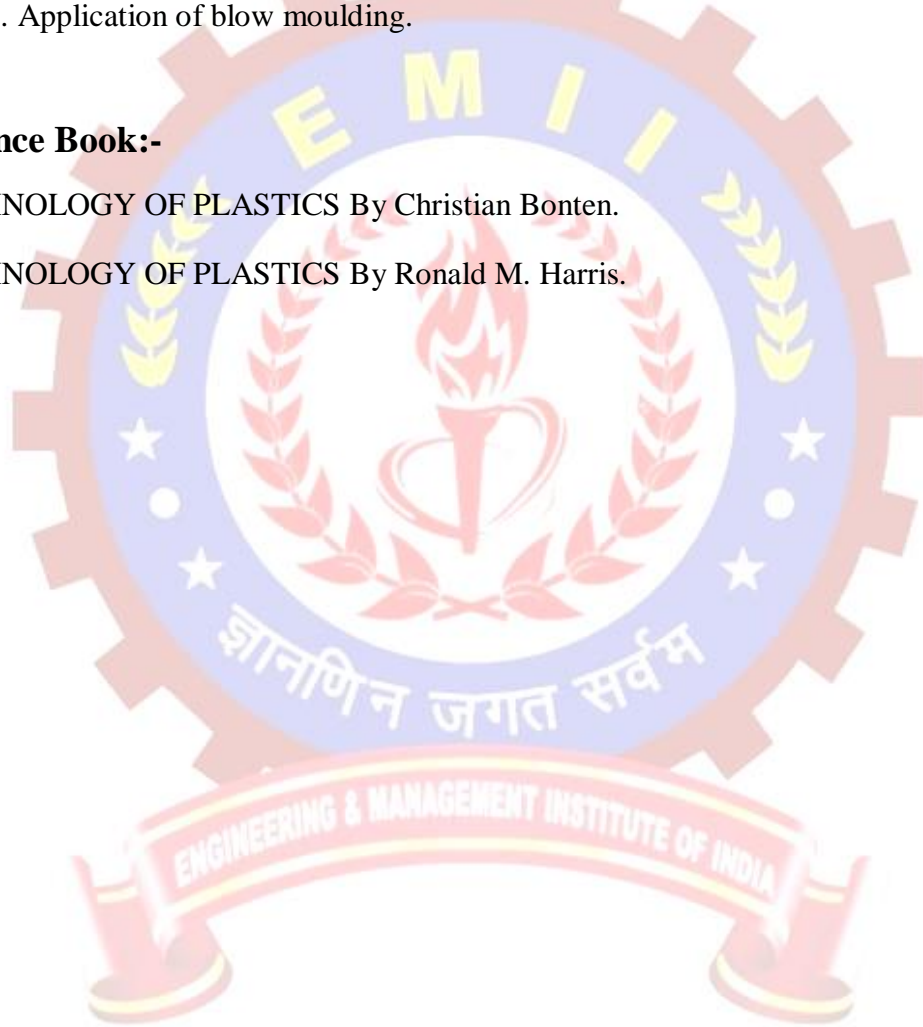
UNIT – IV

COMPRESSION MOULDING & TRANSFER MOULDING:- Basic Process and materials, Moulding cycles, Advantages and limitations for compression moulding, Application of compression moulding, Defects and their remedies in compression molding . Basic processes and materials, Types of transfer moulding, Advantage and limitation of Transfer moulding, Defects and their remedies Transfer moulding.

UNIT –V

BLOW MOULDING: - Basic Process and Materials, Types of Blow moulding i.e. Hand operated and Power operated, Extrusion blow moulding, Injection blow moulding machine, Stretch blow moulding, Finishing operation, Moulding defects and their remedies. Application of blow moulding.

Reference Book:-

1. TECHNOLOGY OF PLASTICS By Christian Bonten.

2. TECHNOLOGY OF PLASTICS By Ronald M. Harris.

Technology of Organic Chemical (CME-2.11)

UNIT-I

OILS FATS AND DETERGENTS: - Industrial uses of oils and fats important vegetable oils and animal fats. Distinguish between oils and fats. Manufacture of oil from soya bean, rice bran and pea nuts. Their unit process and unit operation. Soap and detergents-use of them and difference between them unit process and unit operation of soaps and detergents making. LABand surfactants.

UNIT –II

PETROLEUM PROCESSING: - Constitution of petroleum-crude oil distillation-unit process and unit operation of FCC, polymerization, alkylation, hydrogenation, hydrocracking, isomerization, reforming, sweetening and hydrodesulphurization.

UNIT – III

PETROCHEMICAL TECHNOLOGY:- Manufacture of petrol chemical such as ethylene glycol, pthalic anhydride, terephthalic acid, isopropyl alcohol, propylene oxide, methanol, ethanol and formaldehyde. With Unit process and Unitoperation.
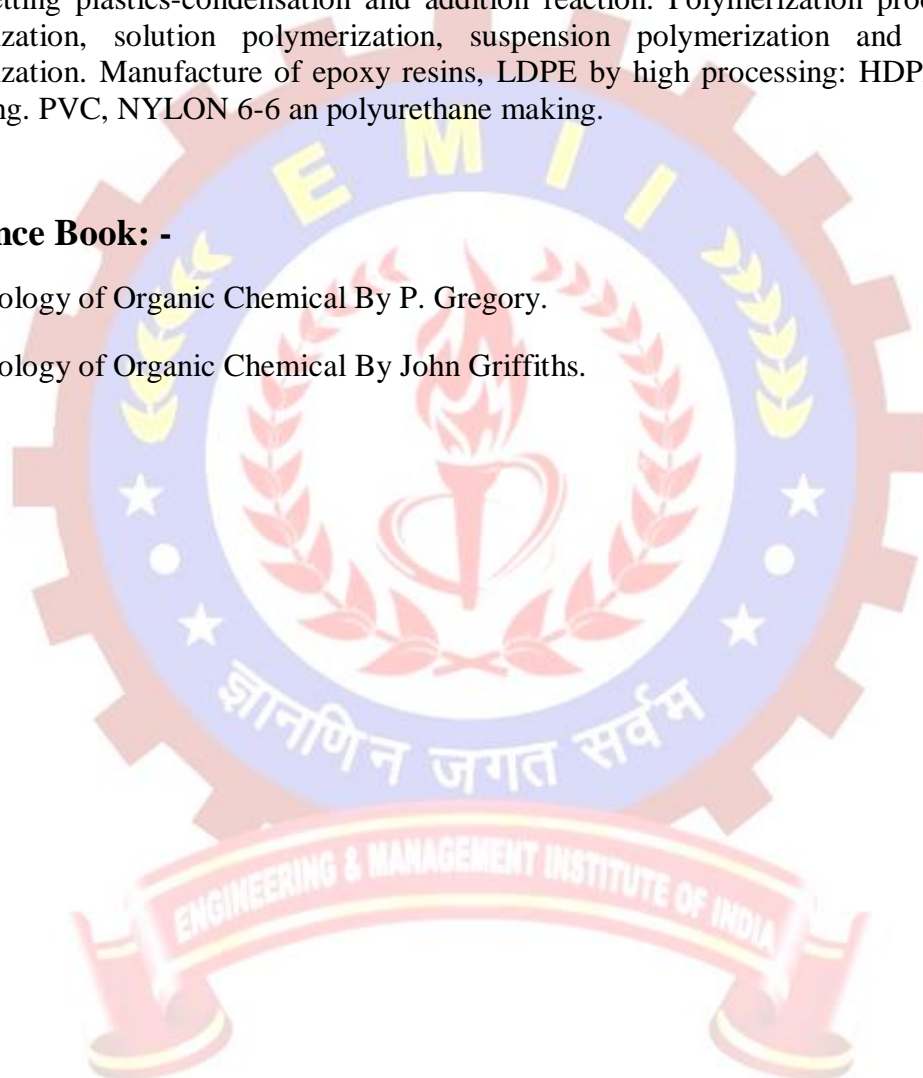
UNIT – IV

BIO-TECHNOLOGY AND FERMENTATION: - Bio-technology and Bio-process. Application bio-Technology in chemical Industries. Bio-process application in fermentation and pharmaceuticals Industries. Enzymes a pplication (Brief Discussion only) Kinetics of Bacterial Growth. Fermentation-important fermentation product, microorganism Nutrients-Enzymes-Manufacture of industrial Al ho citric acidAcetic ac d and lactic acid with all unit process and unit operation. Application of fermentation. Types preservatives.

UNIT –V

POLYMER PROCESSING: - Definition of polymer, thermoplastic and thermosetting plastics-condensation and addition reaction. Polymerization process-Bulk polymerization, solution polymerization, suspension polymerization and emulsion polymerization. Manufacture of epoxy resins, LDPE by high processing: HDPE by low processing. PVC, NYLON 6-6 an polyurethane making.

Reference Book: -

1. Technology of Organic Chemical By P. Gregory.

2. Technology of Organic Chemical By John Griffiths.

PLANT UTILITIES (CME-2.12)

UNIT-I

Water as Basic Utility: - List and use of various utilities in chemical plant. Sources of water.Types of Water. Hard & Soft water. Boiler Feed water and demineralized water. Methods of water softening processes, Lime soda process (Hot & Cold) Zeolite process, Ion exchange process, Phosphate process. Purification of water. Screening, Sedimentation, Coagulation, Filtration, Sterilization.

UNIT –II

Steam, Air & Inert Gases: - Utilities: Use of Steam, Air & Inert Gases as utilities. Properties of steam- Enthalpy, Wet steam, Saturated Steam, Superheated steam, Specific volume of steam. Steam Generator: Classification ,comparison , components, Factors affecting selection of Boiler ,Construction and working of (a) Locomotive Fire tube boiler (b) Lancashire boiler. Utility air- Compressed Air, Blower Air, Fan Air, Instrumental Air. Types of Air compressors -Reciprocating Air compressors, Multistage compressors, Rotary compressors.

UNIT – III

Refrigeration: -Concept of refrigeration.Methods of Refrigeration- Ice Refrigeration, Evaporative Refrigeration, Vapor Refrigeration System. COP and TOR of refrigeration . Types of Primary Refrigerants – Ammonia, Halo Carbons (Freon of Different type), HFC (Hydro Fluorocarbon). Types of secondary Refrigerants- Water, Brine. Selection of Refrigerants.

UNIT – IV

Basics of Instrumentation: -Importance of instrumentation in chemical plant 4.2 Classification of instruments 4b. Describe Basic elements of instruments 4.3 Basic elements of instruments 4c. Compare Static and Dynamic Characteristics of instruments

4.4 Static and Dynamic Characteristics of instruments 4d. Differentiate First and second order system 4.5 First order system and second order system.

UNIT –V

Measuring Devices: -Different Temperature scale 5b. Compare thermometers 5b.1Explain Principle, Construction & Working of : Mercury in glass, Bi-metallic , pressure spring , resistance thermometers 5.2 Definition of thermometer 5.3 Principle, Construction & Working of : Mercury in glass thermometer, Bi-metallic thermometer, pressure spring thermometer, resistance thermometer, 5c. Describe Principles of thermoelectricity and Seeback effect, Peltier effect and Thomson effect 5.4 Principles of thermoelectricity 5.5 See-back effect, Peltier effect and Thomson effect 5d. Describe principle, construction, working range, lead wires of thermocouple and Thermowells 5.6 Industrial thermocouple: their principle, construction, working range, lead wires 5.7 Thermowells in details 5e. Explain principle, construction, and working of Radiation and optical Pyrometers 5.8 Radiation and optical Pyrometers.

Reference Book:-

1. PLANT UTILITIES by Shukla R S.

2. PLANT UTILITIES by J.M Smith; McGraw Hill Publication.

POLLUTION CONTROL AND INDUSTRIAL SAFETY (CME-2.13)

UNIT-I

Introduction: -Environment and Pollution, Classification of pollution e.g. Land, Water, Air, Noise.Environment Impact assessment Studies, Character and origin of industrial wastes.

Air Pollution: - i) Definition of air pollution, Types of Air pollutants and their sources like SPM, SOX, NOX, NH3, F, C1, CFC, CO2 etc. ii) Air Pollution control equipment in industries. a) Settling chamber b) Cyclone c) Scrubber (dry & wet) d) Multi cyclone e) Electrostatic precipitator f) Bag Filter iii) Ambient air quality measurement & their standards iv) Vehicular Pollution and its control v) Noise Pollution and its control mechanism .

UNIT –II

Water Pollution: -Water pollution, standards for drinking water, domestic waste water and industrial waste water. Methods of measurement of various parameter like BOD, SS, pH, COD, TDS etc. Methods of treatment of industrial waste water like a) Chemical treatment b) Physio-Chemical treatment c) Bio-chemical treatment d) Any other advance treatment.

UNIT – III

Environment Protection: -Environmental protection from hazardous chemicals waste: Terminology relating to chemical hazards and air pollution, classification of chemical hazards and hazardous chemicals, codes of safety for operational hazards in laboratories, industries etc.

Radio Active Pollution: -Sources and effect on human, animal, plant and material. Measurement, means to control, preventive measures.

UNIT – IV

Solid Waste Management: -Municipal solid waste, biomedical waste, Plastic waste and its management, solid waste disposal methods such as open dumping, sanitary landfilling composting, incineration.

Pollution Acts: -A water pollution prevention control Act 1974, Air Pollution Act 1981, Environment protection Act 1986, Hazardous chemical manufacturing, storage and impact rules 1989 and hazardous waste and management and handling rules 1989, Regulation and control Rules 2000.

UNIT –V

Safety in Chemical Industry: -Receiving and storing chemicals- transporting and moving chemicals- Safety in chemical reactions, pipe-lines with color coding in chemical factories. Precautions in the case of processes in operations involving explosive or inflammable dusts, gases, vapours etc. Maintenance of chemical plants-corrosion health hazards in common chemical processes, Fire hazards and their prevention. specification for safety equipment (Reference should be made from I.S. Codes), case study of major chemical process industries disasters/accidents.

Reference Book:-

1. Safety in Process Plant Design by Wells.

2. Chemical Engineering Kinetics by J.M Smith; McGraw Hill Publication.

CHEMICAL REACTION ENGINEERING (CME-2.14)

Introduction to Chemical Kinetics: - Concept of rate of reaction, rate equation, rate constant, order of reaction, Molecularity of reaction, Chain reaction, Non chain reaction. 1.2 Type of intermediate form in non-chain reaction. 1.3 Single reaction multiple reaction, non-elementary reaction. 1.4 Theories of reaction rates constant- Arrhenius law and problems based on it, from Thermodynamic, from Collision theory, from Transition state theory. 1.5 Activation Energy.

Interpretation of batch reactor data: -Concept of batch reactor, semi Batch reactor, constant and variable volume reactions.Type of intermediate form in non-chain reaction. 2.2 Integral and Differential method of analysis of batch reactor data. 2.3 Integral method of analysis of irreversible unimolecular first order reaction, bimolecular second order reaction, nth order, zero order and auto catalytic reaction. Problem based on zero order, first order and second order reactions. 2.4 Half-life concept for the overall order of irreversible reactions and problem based on that.

Introduction to Reactor Design: -Type of reactor (Batch reactor, Continuous reactor, Plug flow reactor, Mixed flow reactor, Biological reactor, Fixed (packed) bed reactor, fluidized bed reactor. 3.2. Concept of space-time, space velocity and holding time. 3.3. Performance equation for ideal batch reactor, mixed flow reactor and plug flow reactor for constant volume and variable volume irreversible first order reaction. Problems based on the above topic. 3.4. Size comparison of the reactor-Batch reactors vs PFR (For first order reactions), PFR vs MFR (For first order irreversible reactions) and problems based on the above topics.

UNIT – IV

Introduction to Heterogeneous Reacting System: -Rate Equation for Heterogeneous Reaction 4.2. Contacting pattern for two phase system 4.3. Factor affecting heterogeneous reaction.

UNIT –V

Catalysis: -Definition, types and classification of catalyst 5.2. Preparation of catalyst, ingredients (Promoter, inhibitor, accelerator) 5.3. Catalyst Poisoning, regenerator. 5.4. Theories of catalysis-Adsorption, Intermediate compound formation theory. 5.5. Desired properties of catalyst.

Reference Book:-

1. Chemical Reaction Engineering by Octave Levenspiel; Wiley Eastern Ltd.

2. Chemical Engineering Kinetics by J.M Smith; McGraw Hill Publication.

CHEMICAL ENGINEERING THERMODYNAMICS (CME-2.15)

UNIT-I

Introduction and Basic Concepts: - Systems, processes and surroundings, homogenous and heterogeneous systems, closed, open and isolated, intensive and extensive properties, state and path functions. Concept of internal energy, enthalpy, entropy, free energy and equilibrium equation of state, ideal gas law, Vander Waals equation. Amagat's law, Dalton's law, Henry's law, Zeroth law of thermodynamics.

UNIT –II

First Law of Thermodynamics for Open and Closed System: -Statement of first law of thermodynamics, use of steam tables, calculation of internal energy, enthalpy, heat and work for ideal gas undergoing reversible, isothermal, Isobaric, adiabatic and polytrophic process. T-V, P-V and P-T diagram.

Second Law of Thermodynamics: -Statement of second law of thermodynamics: Kelvin Plank statement and Classius statement, Carnot cycle and its efficiency, concept of entropy and entropy change for closed and open system.

Heat pump and heat engine (coefficient of performance and efficiency). Reversible and irreversible process .Thermodynamic temperature scale, Thermal thermodynamic equation,Maxwell relation. 4. Third Law of Thermodynamics (Statement only)

UNIT – III

Entropy: -Inequality of Classius, entropy-a property of a system entropy change in reversible process, entropy change for an open system, principle of increase of entropy, efficiency, irreversibility.

UNIT – IV

Applications of Second law of Thermodynamics: -Refrigeration, vapor compression and absorption refrigeration cycle, air refrigeration cycle, types of compressors, reciprocating air compressor, single stage compressor, and isentropic efficiency of compressor, coefficient of performance(COP), liquefaction process, latest refrigerants - their qualities and applications.

UNIT –V

Chemical Reaction Equilibrium and Vapor Liquid Equilibrium: -Concept of chemical potential, Gibb's Duhen Equation, Raoul's law, Gibb's phase rule, vapor liquid equilibrium, dew point and bubble point, calculations for two component systems, fugacity, fugacity, fugacity coefficient, activity and activity coefficient.

Reference Book :-

1. Chemical Engineering Thermodynamics by K.V. Narayanan; Prentice Hall India.

2. Chemical Engineering Thermodynamics by YVC Rao.

Entrepreneurship Development & Management(CME-2.16)

Introduction:- Meaning and Importance, Evolution of term 'Entrepreneurship, Factors influencing entrepreneurship, Psychological factors, Social factors, Economic factor, Environmental factors, Characteristics of an entrepreneur, Entrepreneur and Entrepreneur, Barriers to entrepreneurship.

Types of entrepreneur: - According to Type of Business, According to Use of Technology, According to Motivation, According to Growth, According to Stages, New generations of entrepreneurship viz. social entrepreneurship, Edupreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship etc.

Entrepreneurial Motivation:- Motivation, Maslow's theory, Herjburg's theory, McGragor's Theory, McClelland's Need – Achievement Theory, Culture & Society , Values / Ethics , Risk taking behavior.

Creativity:- Creativity and entrepreneurship, Steps in Creativity, Innovation and inventions, Using left brain skills to harvest right brain ideas, Legal Protection of innovation, Skills of an entrepreneur, Decision making and Problem Solving (steps indecision making).

Organisation Assistance:- Assistance to an entrepreneur, New Ventures, Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act Small Scale Industries, Carry on Business (COB) licence, Environmental Clearance, National Small Industries Corporation (NSIC), Government Stores Purchase scheme (e-tender process), Excise exemptions and concession, Exemption from income tax, Quality Standards with special reference to ISO, Financial assistance to MSME, Modernisation assistance to small scale unit, The Small Industries Development Bank of India(SIDBI), The State Small Industries

Development Corporation(SSIDC), Export oriented units, Incentives and facilities to exports entrepreneurs, Export-Import Bank of India, Export oriented zone.

UNIT – IV

Rules And Legislation:- Applicability of Legislation, Industries Development (Regulations) Act, 1951., Factories Act, 1948, The Industrial Employment (Standing Orders) Act, 1946, Suspension, Stoppage of work, Termination of employment, West Bengal Shops and Establishment Act, 1963, Environment (Protection) Act, 1986, The sale of Goods Ac, 1950, Industrial Dispute Act 1947.

Project Report:- Introduction, Idea Selection, Selection of the Product / Service, Aspects of a Project, Phases of a Project, Project Report, Contents of a Project Report, Proforma of a Suggested Project Report for a manufacturing Organization, Suggested Readings.

UNIT –V

Agencies for industrial assistance:- West Bengal Electronics Development Corporation, ICICI West Bengal Infrastructure Development Corporation, West Bengal Industrial Infrastructure Development Corporation, Other Corporations with focus as specific segments, State Industrial Development Corporation (SIDC), State Financial Corporation (SFCs), Directorate General of Supplies and Disposals(DGS & D), Registration with DGS & D, Registration Categories, Registration Procedure, Benefits of DGS & D, Information facilities centre in DGS & D, Khadi and Village Industries Commission (KVIC), Industrial Estate, Financing of Industrial Estates, Shilpabandhu-M Incentives for entrepreneurs 9reference to The West Bengal State Support for Industries Scheme 2008 & 2013.

Reference Book :-

1. Entrepreneurial Development, by S S Khanka.

2. The Entrepreneur, by Mark Casson.

PLANT TRANING (CME-2.17)

Plant Engineering: -Plant; Selection of site of industry; Plant layout; Principles of a good layout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Material handling equipment; Plant maintenance; Importance; Break down maintenance; Preventive maintenance and Scheduled maintenance.

Plant Safety: - Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Prevention of Accidents; Industrial disputes; Settlement of Industrial disputes; Collective bargaining; Conciliation; Mediation; Arbitration; Indian Factories Act 1948 and its provisions related to health, welfare and safety.

Work Study: -Productivity; Standard of living; Method of improving Productivity; Objectives; Importance of good working conditions.

Method Study: -Definition; Objectives; Selection of a job for method study; Basic procedure for conduct of Method study; Tools used; Operation process chart; Flow process chart; Two handed process chart; Man Machine chart; String diagram and flow diagram.

Work Measurement: -Definition; Basic procedure in making a time study; Employees rating factor; Application of time allowances: Rest, Personal, Process, Special and Policy allowances; Calculation of standard time; Numerical Problems; Basic concept of production study; Techniques of Work Measurement; Ratio delay study; Synthesis from standard data; Analytical estimating and Pre determined Motion Time System (PMTS).

Production Planning and Control: -Introduction; Major functions of Production Planning and Control; Pre planning; Methods of forecasting; Routing and Scheduling; Dispatching and Controlling; Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Production and Job Order Production;

Characteristics; Economic Batch Quantity (EBQ); Principles of Product and Process Planning; Make or Buy decision; Numerical problems.

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UNIT – IV

Quality Control: -Definition; Objectives; Types of Inspection: First piece, Floor and Centralized Inspection; Advantages and Disadvantages; Statistical Quality Control; Types of Measurements; Method of Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve (O.C curve); Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 Quality Management System Registration/Certification procedure; Benefits of ISO to the organization.

Principles of Management: -Definition of Management; Administration; Organization; F.W. Taylor's and Henry Fayol's Principles of Management; Functions of Manager; Types of Organization: Line, Staff, Taylor's Pure functional types; Line and staff and committee type; Directing; Leadership; Styles of Leadership; Qualities of a good leader; Motivation; Positive and Negative Motivation; Modern Management Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zero defect concept; 5S Concept; Management Information Systems.

UNIT –V

Financial Management: -Fixed and Working Capital; Resources of Capital; Shares Preference and Equity Shares; Debentures; Type of debentures; Public Deposits; Factory Costing: Direct Cost; Indirect Cost; Factory Overhead; Selling Price of a product; Profit; Numerical Problems; Depreciation; Causes; Methods: Straight line, sinking fund and percentage on Diminishing Value Method; Numerical Problems.

Material Management: -Objectives of good stock control system; ABC analysis of Inventory; Procurement and Consumption cycle; Minimum Stock, Lead Time, Reorder Level-Economic Order Quantity problems; Supply Chain.

Reference Book:-

1 .PLANT TRANING BY C L RAO.

2. PLANT TRANING BY K VENKATA REDDY.

Final year Project

Project (CME-2.18)

Select any one topic:-

1. Utilization Of Sludge Gas.

2. Extraction Of Silica From Burnt Paddy Husk.

3. Detergent Powder From Paddy Husk.

4. Refining Of Used Lube Oils.

5. Nicotinic Acid From Tobacco Waste.

6. Paper Pulp From Groundnut Shell.

7. Caffeine From Waste Tea And Coffee.

8. Solar Pump.