CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
Choice Based Credit System (with effect from 2019-20)
B.TECH (Chemical Engineering)

SEMESTER – VII

S. No.	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	16CH C 24	Mass Transfer Operations –II	3	-	3	30	70	3
2	16CH C 25	Petrochemical Engineering	3	-	3	30	70	3
3	16CH C 26	Process Equipment Design	3	-	3	30	70	3
4	16CH C 27	Transport Phenomena	3	-	3	30	70	3
5		Core Elective-V	3	-	3	30	70	3
6		Open Elective-I	3	-	3	30	70	3
PRACTICALS								
7	16CH C 28	Equipment Design and Drawing Lab	-	3	3	25	50	2
8	16CH C 29	Mass Transfer Operations Lab	-	3	3	25	50	2
9	16CH C 30	Seminar	-	3	-	50	-	2
TOTAL			**18**	**9**	**-**	**280**	**520**	**24**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

Core Elective-V	
16CH E 11	Polymer Technology
16CH E 12	Pulp and Paper Technology
16CH E 13	Pollution Control in Process Industries

Open Elective-I	
16CE O 02	Disaster Mitigation and Management
16ME O 01	Entrepreneurship
16ME O 04	Intellectual Property Rights
16EG O 01	Technical Writing Skills

16CH C 24

MASS TRANSFER OPERATIONS – II

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course helps the students to understand the

1. Distillations methods - batch, semi continuous, continuous distillation for binary miscible systems.
2. Various methods to design distillation columns.
3. Concepts of solvent extraction methods using Triangular diagrams for ternary systems and binary immiscible system along with design.
4. Concepts of various leaching methods and leaching equilibriums with design.
5. Concepts of Absorption, Adsorption equilibrium / Isotherms and design.

Course Outcomes: At the end of the course, the students will be able to

1. Differentiate the application of various types of distillation processes.
2. Design and estimate the number of theoretical stages of distillation column using McCabe- Thiele method and Ponchan-Savarit method.
3. Design and estimate the number of theoretical stages for Liquid-Liquid extraction.
4. Design and estimate the number of theoretical stages for Solid-Liquid extraction.
5. Design and estimate the number of theoretical stages for Adsorber.

UNIT- I: Distillation

VLE Phase diagrams – Tie lines and mixture rule – Flash vaporization and differential distillation for binary mixtures – Steam distillation. Batch distillation with reflux for binary mixtures.

UNIT-II: Continuous fractionation

Continuous fractionation of binary mixtures, Ponchan – Savarit method, McCabe – Thiele method for determination of ideal plates for binary mixtures, Optimum reflux ratio, Use of total and partial condensers. Use of open steam. Packed bed distillation. Principles of Azeotropic and Extractive distillation.

UNIT–III: Liquid – Liquid Extraction

Solubilities of ternary liquid systems. Triangular and solvent free coordinate systems. Choice of solvent. Extraction with insoluble and partially soluble systems – single stage, multistage cross-current and multistage counter-current extraction without reflux and Continuous contact extraction (packed beds). Equipments for liquid – liquid extraction operation.

UNIT–IV: Leaching

Preparation of solid, Unsteady state operation, in-place leaching, heap leaching, percolation leaching, Shanks system, agitated vessels, percolation in closed vessels, Percolation Vs Agitation. Steady state continuous operation–equipment-methods of calculation, stage efficiency and practical equilibrium. Single stage leaching, multistage cross current leaching, multistage counter current leaching.

UNIT-V: Adsorption

Principles of Adsorption and their applications – Types of adsorption – Adsorbents – Adsorption equilibrium – Adsorption Isotherms for vapor and dilute solutions. Single stage and multistage adsorption, Adsorption wave and breakthrough curve and fixed bed adsorption. Equipment for Adsorption operation.

Text Books:

1. R.E.Treybal, “Mass Transfer Operations”, 3rd Edition, McGraw Hill Book Company, 2002.
2. Geankoplis, “Transport Processes and Separation Processes Principles”, 4th Edition, Prentice Hall, 2003.

Suggested Readings:

1. Richardson and Coulson, “Chemical Engineering”, Volume 1, Tata McGraw Hill Publications, 2000
2. Binay.K. Dutta, “Principles of Mass Transfer & Separation Processes”, Eastern Economy Edition, PHI learning Pvt, ltd, 2015.
3. Warren McCabe and Julian Smith and Peter Harriott, “Unit Operations of Chemical Engineering”, 7 th ed., McGraw Hill Book Company, 2005.

16CH C 25

PETRO CHEMICAL ENGINEERING

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course helps the students to understand the

1. Petroleum refinery worldwide.
2. Extraction and production of oil and gas to meet energy needs.
3. Importance of refining crude oil for a wide spectrum of useful products such as petrochemicals, plastics.
4. Manufacturing of Propylene derivatives
5. Manufacturing of higher Hydrocarbons

Course Outcomes: At the end of the course, the students will be able to

1. Grade the crude oil, its composition and applications based on formation theories.
2. Know refining process of crude oil.
3. Apply the techniques of catalytic and non-catalytic cracking methods.
4. Design the manufacture of derivative products.
5. Design the safety and pollution control techniques in petroleum refining industries.

UNIT-I

Origin and formation of petroleum: Organic theories, Inorganic theories and biological methods for explaining the formation of Crude oil. Definition of refining terms - API Gravity, Aniline point, Octane number, Cetane number, Smoke point, Fire point, Flash point, Diesel Index, Naphtha, Types of Naphtha etc. Composition and applications of crude oil. Petroleum Refining - Overall refining of crude petroleum. Production of gasoline, kerosene and lubricating oils.

UNIT-II

Rebuilding of Hydrocarbons and techniques involved: Naphtha cracking: Definition, types, reactions, fluidized bed cracking, description of the reactors. Alkylation - Hydrofluoric acid process and sulphuric acid process Isomerization - Aluminum chloride process and isomerization with platinum catalyst. Polymeriztion - Types of polymerizations, mechanism of polymerization, polymerization in presence of sulphuric acid, polymerizations in presence of phosphoric acid.

UNIT-III

Ethylene Derivatives: various products with ethylene as the starting materials. Manufacturing of the following - Vinyl Chloride Monomer, Perchloroethylene " pyrolysis of carbon tetra chloride, chlorination and pyrolysis method, Ethyl alcohol by direct hydration and liquid phase hydration methods, Vinyl acetate monomer, Ethylene oxide and its applications , Polyethylene, Styrene.

Unit- IV

Propylene derivatives: list of propylene derivatives. Manufacturing of the following - Isopropyl alcohol, Acetone by catalytic dehydrogenation, Propylene oxide, Glycerine by Acrolein, allyl chloride and by isomerization of propylene oxide methods. Derivatives of C_4 Hydrocarbons: List of butadiene derivatives, Manufacturing of butadiene from n-butylene and by oxidative dehydrogenation., Purification of butadiene

UNIT -V

Derivative of Higher Paraffins:-Manufacturing of Isoprene, olefins of C_5 , C_6, long chain and straight chain Olefins.

Derivatives of Aromatics: Sources of aromatic compounds, production of aromatics. Effect of temperature, pressure and catalyst on dehydrogenation process. Separation of aromatics from Non-aromatics and separation of aromatics into individual streams

Text Books:

1. W.L.Nelson, "Petroleum refinery engineering" 4th ed., McGraw Hill company, 2013.
2. B.K.Bhasker Rao, "Modern petroleum refining process", 5th ed., Oxford and IBH, 2008.

Suggested Readings:

1. N.K.Sinha, "Petroleum Refining and Petro Chemicals", 1st edition, Umesh publications, 2003.
2. Kirk-Othmer, "Encyclopedia of Chemical Technology", 3rd Ed..John Wiley and sons.Inc, 2004.

16CH C 26

PROCESS EQUIPMENT DESIGN

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course objectives: This course helps the students to understand the

1. Classification of unfired pressure vessels observed in process industries.
2. Mechanical design of process vessels for shells, domes and other significant component parts.
3. Process design of reactors based on their operation.
4. Sieve-tray hydraulics and downcomer design of distillation columns.
5. Shell and tube heat exchanger design and applications

Course outcomes: At the end of the course, the students will be able to

1. Identify the design needs for process equipment based on operating conditions of chemical plant operation.
2. Design flanges and nozzles and to select the right component parts for any process vessel
3. Design process equipments like storage vessels, reactors.
4. Design continuous distillation for multi component system
5. Design shell and tube heat exchanger (1-2)

UNIT – I: Design of Pressure Vessels

Classification of equipment, types of pressure vessels, General design considerations for process equipment like pressure, temperature, codes and standards, stresses, welding categories, material of construction, corrosion allowance, major and minor constraints.

Design and calculations for thin-walled vessels under internal pressure: cylindrical and spherical shells, domes – flat plates, torispherical, elliptical, hemispherical, conical heads.

Design of thin-walled vessels under external pressure: cylindrical shells, vessel heads, need and types of stiffeners.

UNIT – II: Design of Vessel Components

Significant component parts of process vessels. Flanges and gasket – classification, types, design calculations for loose type non-standard flanges. Equipment supports – types, selection criteria.

Nozzles – design calculations for deciding the compensation requirements for openings and branches. Jackets for process vessels – Types, selection criteria, comparison with immersion coils.

UNIT – III: Design of Reactors

Reactors – classification basis, types, selection criteria, application, comparison. Process design – significance of mass and energy balances, reaction rates. Calculations to estimate volume of reactor.

UNIT – IV: Design of Continuous stage-wise Distillation Column

Design of tall columns under combined loading – source of loads, stress balance – pressure, wind and weight loads.

Prediction of plate efficiency of distillation columns – types and design methodology.

Underwood-Fenskee method for design of continuous distillation with multiple feeds and side streams for multi component system (three component).

UNIT – V: Design of Shell and Tube Heat Exchanger (1-2)

Introduction to Heat Exchangers, Temperature difference, Pressure drop in shell and tube side, overall heat transfer coefficient, LMTD calculation, Flow arrangement for increased heat recovery (1-2 shell tube heat exchanger)

Design of Shell and Tube Heat exchanger, shell side film coefficients, shell side pressure drop.

Text Books:

1. Dr. Shrikanth D. Dawande, "Process Design of Equipments" Vol. 1 & 2, Central Techno Publications, Nagpur, 2000.
2. D Q Kern, "Process Heat Transfer" International Edition 1965, McGraw-Hill Book.

Suggested Readings:

1. M.V. Joshi, "Process Equipment Design", 2nd Ed., McMillan Co. of India Limited, Madras, 1976.
2. J.M.Coulson, J.F.Richardson, R.K. Sinnott, "Chemical Engineering Design", Vo1. 6, Ed 3, Butterworth – Heinemann publishers, New York, 2000.
3. Ernest E. Ludwig, "Applied process design for chemical and petrochemical plants", Vol 3, Elsevier Inc., 2001.
4. Bachurst, J.R. and Harker, J.H, "Process Plant Design", American Elsevier Pub. Co., London, 1973.

16CH C 27

TRANSPORT PHENOMENA

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course objectives: This course helps the students to understand the

1. Fundamentals to solve flow problems involving transport of momentum, energy and mass using a unified approach.
2. Analogy between momentum, mass and energy transport.
3. Turbulent phenomena and the methods of characterizing the turbulent fluxes
4. Equations of change for isothermal and non-isothermal systems and multi-component mixtures.
5. Development of governing equations

Course Outcomes: At the end of the course, student will be able to

1. Apply the first principles to solve various chemical engineering problems.
2. Compare various flow phenomena
3. Develop expressions for steady state velocity, temperature and concentration profiles using shell balance method
4. Apply equations of change to solve flow problems.
5. Develop expressions for unsteady state isothermal and non-isothermal flows

UNIT – I

Introduction – Mechanism of molecular transport of momentum, heat and Mass Transfer. Flux equations – Newton's, Fourier's and Fick's laws - Similarities and differences

Non-Newtonian fluids, transport properties – estimation, temperature and pressure dependence, estimation of transport properties of binary gaseous mixtures

Velocity distributions in laminar flow – shell momentum balances – Flow of falling film – flow of fluids through circular tubes, annulus and Immiscible fluids between parallel plates.

UNIT – II

Temperature distributions in solids and in laminar flow – shell balances - Heat conduction with electrical, Nuclear, viscous and chemical heat source

Heat conduction through composite walls, and cooling fin; Forced convection and free convection

UNIT – III

Concentration distributions in solids and in laminar flow - shell mass balances, diffusion through a stagnant gas film, Diffusion with homogenous chemical reaction and heterogeneous chemical reaction. Diffusion into a falling liquid film-chemical reaction inside a porous catalyst

UNIT – IV

Equations of change for isothermal systems – Equation of continuity, Equation of Motion, Equations of change, use of equations of change to set up steady flow problems. Equations of change for non-isothermal systems – Equation of energy – use of equations of change to set up steady state flow problems. Equation of change for a binary mixture – Equation of continuity of a component in curvilinear coordinates

UNIT – V

Unsteady state problems in momentum, energy and mass transfer operations; Turbulence - Time smoothing of equations of change of momentum, energy and Mass Transfer; Eddy properties - Intensity of turbulence Reynolds stresses; Semi empirical expressions for turbulent –Momentum – energy and mass fluxes

Text Books:

1. R.B.Bird, W.E.Stewart, and E.N.Lightfoot , "Transport Phenomena", John Wiley & Sons. Inc. 2002

Suggested Readings:

1. R.S.Broadkay, "Introduction to Transport Phenomena", McGraw Hill Publications, 1980.
2. J. R. Welty, C. E Wicks and R. E. Wilson, Fundamentals of Momentum, Heat and Mass Transfer, 3rd Ed., 1984
3. Geankoplis, "Transport Processes and Separation Processes Principles". 4th Edition, Prentice Hall, 2003

16CH E 11

POLYMER TECHNOLOGY

(CORE ELECTIVE V)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course objectives: This course helps the students to understand the

1. To provide a fundamental knowledge on polymers and their chemical, physical and mechanical behavior.
2. Understand the structure-processing-property relationship of polymers.
3. Emphasis is on the processing techniques, along with the production of polymers.
4. To understand the synthesis, manufacture, processing and characterization of different polymers
5. To understand the basic issues involved in polymer blends, composites and nanocomposites.

Course Outcomes: At the end of the course, student will be able to

1. Familiarize the polymers, polymerization techniques and behavior in polymers
2. Understand the different types of polymerization.
3. Illustrate the different techniques used to determine the molecular weight of polymers
4. Impart knowledge on various testing methods and characterization of polymers
5. Familiarize the various polymer processing techniques for polymers, rubbers and fibers

UNIT - I

Definitions and concepts of terms used in polymer engineering, Classification of polymers; Polymer structures, functionality; polymerization reactions – mechanism of polymerization; stereospecific polymerization, copolymerization. Polymer material structure and Properties: Deformation, flow and melt characteristics. Morphology and order in crystalline polymers. Rheology and the mechanical properties of polymers. Polymer structure and physical properties.

UNIT - II

Polymerization reactors, polymerization processes, characterization of polymers, analysis of polymerization reactions, polymer degradation, Condensation polymerization, Addition polymerization, Ionic and coordination polymerization.

UNIT - III

Molecular weight and molecular weight distribution in polymers, properties of polymers – physical, chemical, mechanical and electrical properties of polymers, elementary idea on polymer rheology, polymer blends. Experimental methods for molecular weight determination: cryoscopy, ebulliometry, membrane osmometry, light scattering method, viscometry, intrinsic viscosity measurement, gel permeation chromatography. Structure and Properties: Thermal transitions, Crystallinity, Molecular weight characterization, Nuclear Magnetic Resonance (NMR) and Fourier Transform Infrared (FTIR) techniques.

UNIT – IV

Polymer processing: modeling – compression & transfer, injection & jet; casting; extrusion, calendaring, lamination, spinning & finishing. Processing methods , effect of additives used, plasticizers, colourants, heat stabilizers, antioxidants, ultraviolet absorbers, antistatic agents, flame retardants, blowing agents, fillers etc. Molding techniques for plastics, injection molding, compression molding, calendaring, blow moulding, extrusion, thermoforming, spinning methods for fibres, compounding methods for elastomers, general study of elastomer processing methods.

UNIT - V

Industrial polymers: Manufacturing processes, properties and uses of Polyethylene, Polypropylene, Polyvinylchloride, Polystyrene, Nylon, Polyethylene terephthalate. Hydrocarbon plastics and elastomers. Other carbon chain polymers. Heterochain thermoplastics. Thermosetting resins. Polymer Blends: Types, Compatibility, Thermal and Mechanical Properties. Polymer Composites: Types, Properties, Preparation, Fibre-reinforced composites, In-situ composites. Polymer Nanocomposites: Basic concepts, Processing, Characterization.

Text Books:

1. Text Book of Polymer Science, F. W. Billmeyer, John Wiley, New York
2. Polymer Science & Technology, P.Ghosh, TMC

Suggested Readings:

1. The elements of Polymer Science & Engineering, Alfred Rudin, Academic Press, 2nd Edition.
2. Introduction to Polymers, R. J. Young, Chapman & Hall, London

16CH E 12

PULPAND PAPER TECHNOLOGY
(CORE ELECTIVE V)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course will help the students to understand the

1. Basic concepts of Pulp and Paper making processes
2. Details of physical and chemical characteristics of fibrous raw materials and black liquor
3. Various types of cooking and bleaching methodologies
4. Recovery of energy and chemicals used in pulping processes with due techno-economic and environmental considerations
5. Different paper testing methods

Course outcomes: At the completion of this course, students will be able to

1. Design the operation, maintenance and safety aspects for paper making.
2. Identify the factors that drive industry trends.
3. Grade paper and boards based on different testing methods.
4. Select appropriate bleaching technique for required paper quality.
5. Differentiate the important wood and fiber properties that affect paper quality.

UNIT – I: Introduction

Importance of Paper: Definitions of Pulps

Wood Parts & Types: Ultra structure of Cell Wall, Wood cell types, Early & Latewood, Softwoods, Hardwoods & Non-woods. Comparison of different raw materials. Distribution of Wood Constituents – Cellulose, Hemi-cellulose, Lignin, Extractives and Inorganic components.

UNIT – II: Overview of pulping process

Mechanical Pulping: Pressurized ground pulping, Refiner Pulping, Chemo (thermo) mechanical pulping processes.

Kraft Pulping: Description of Kraft Cooking Process, Kraft recovery, Composition & Analysis of white liquor, Chemical reactions & process variables. Pulp yield, End uses of kraft pulps.

UNIT – III: Pulp and black liquor characterization

Pulp testing methods - Kappa number, water retension value, CED viscosity, drainability, beater evaluation, zero span tensile strength.

Black liquor characterization - Chemical properties, viscosity and rheological behavior at different concentrations, thermal properties, calorific value, thermal conductivity, specific heat, black liquor oxidation, desilication and concentration of black liquor.

UNIT- IV: Bleaching operations

Objectives of bleaching – Elemental chlorine free and total chlorine free bleaching; Bleachability and its measurement, bleaching reactions, reaction kinetics and operating variables for different bleaching agents like ClO_2, O_2, O_3, hypochlorite, H_2O_2.

Stages of bleaching – Oxygen delignification, Chlorination, Extraction, Hypochlorite bleaching, Ozone bleaching, Peroxide bleaching, Operating variables for different bleaching stages; ECF and TCF bleaching systems for chemical pulps; bleaching systems for mechanical and high yield pulps.

UNIT – V: Paper Making and its Properties

Paper Testing Methods – Flowsheet of complete pulp and paper making process, Strength properties, Surface properties, Optical properties & Absorption properties. Different grades of paper, boards & newsprint specifications; BIS and ISO standards of paper. Paper properties dependence on paper making processes, Calibration of instruments. Paper recycling process, Effluent treatment processes with environmental considerations.

Text Books:

1. Kenneth W. Britt , " Handbook of Pulp & Paper Technology", 2nd Edition, Reinhold Publishing Corporation, 2004.
2. G.A Smook ., "Handbook for Pulp & Paper Technologists" , 3rd Edition, Angus Wilde Publications, 2003.

Suggested Readings:

1. Hakan Karlsson, "Fiber Guide-Fiber analysis and process applications in the pulp & paper industry", Ab Lorentzen and Wetre, 1st Ed., 2006.
2. EIRI Board ., "Handbook of Pulp & Paper, Paper board and Paper based Technology", Engineers India Research Institute, 2nd Ed., 2015.

16CH E 13

POLLUTION CONTROL IN PROCESS INDUSTRIES
(CORE ELECTIVE V)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course will help the students to understand the

1. Effects of pollution on environment and ecosystems
2. Types and sources of pollution from process industries,
3. Measurement of air and water pollution in process industries
4. Different methods and equipment used in industrial pollution abatement
5. Pollution control practices in process industries

Course outcomes: At the completion of this course, students will be able to

1. Differentiate the types of wastes generated in an industry, their effects on living and non-living things
2. Understand the effect of climate changes, atmospheric dispersion of air pollutants, and operating principles.
3. Working principles of particulate control devices.
4. Quantify industrial wastewater and its treatment.
5. Analyze the hazardous and nonhazardous solid wastes and select the treatment and disposal methods.

UNIT - I Introduction

Definition and types of pollution from chemical industries. Effects of pollution on environment and ecosystems - global warning - greenhouse effect. Laws and standards for pollution. Sources, types, characteristics and effects of air pollutants, liquid effluents, solid wastes in process industries.

UNIT – II Air Pollution

Meteorological aspects of pollution dispersion, adiabatic and environmental lapse rate, Turbulence and stability of atmosphere. Indoor air pollution - smoke and hydrocarbons. Richardson Number, Plume raise, plume behavior and characteristics, effective stack height.

General Control Methods and Equipment**:** removal of sulphur dioxide, oxides of nitrogen and carbon, organic vapors from gaseous effluents. Removal of

particulate matter - principle and working of settling chambers cyclone separators solid traps, fabric and fiber filters, electro-static precipitators.

UNIT – III: Water pollution

Concepts and estimation of oxygen demands - DO, BOD, COD, TOD. Oxygen sag curve, BOD curves and modeling. Wastewater Treatment – Concept, significance and classification as Primary, Secondary, Tertiary methods. Principle, working mechanism and applications of biological treatment techniques like stabilization ponds, Aerated lagoons, conventional activated sludge process, aerobic and anaerobic methods, suspended and attached growth processes, fluidized bed contractors. Trickling filters.

UNIT - IV Introduction to industrial Solid waste management

Industrial solid wastes " Types, classification, properties, management and general disposal methods. industrial solid wastes – environmental effects and disposal methods commonly practiced. Methods practiced in paper and textile industries.

UNIT - V Pollution control practices in Process Industries

Principle, working mechanism and application of tertiary treatment methods like carbon adsorption, Ion-exchange, Reverse Osmosis, Ultra Filtration in process industries.

Sludge treatment and disposal methods like Incineration and land filling. Pollution control in petroleum and fertilizer industries

Text Books

1. C.S.Rao, " Environmental Pollution Control Engineering ", 2nd Ed, New Age International, 2007.
2. S.P.Mahajan, " Pollution control in process industries", 27th Ed, McGraw Hill Pub., 2002.

Suggested Readings:

1. Metcalf and Eddy, " Wastewater Engineering: Treatment and Reuse", 4th Edition , MGH publishing, 2004.
2. M.N Rao and H.V.N Rao, "Air Pollution", Tata McGraw- Hill Publishing Company Limited, New Delhi, 2000.
3. Peavy, H.S., Rowe, D.R. and Technobanolous, G., "Environmental Engineering", McGraw Hill, 1985.

16CE O 02

DISASTER MITIGATION AND MANAGEMENT

(OPEN ELECTIVE I)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course will help the students to understand the

1. Basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. Nature, causes, consequences and mitigation measures of the various natural disasters
3. Risks, vulnerabilities and human errors associated with human induced disasters
4. Impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. Chronological phases in a disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

Course outcomes: At the completion of this course, students will be able to

1. Ability to analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Ability to understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Ability to understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. To understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management

UNIT-I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT-II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT-III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT-IV:

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects-gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT-V:

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response-water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni, *Disaster Risk Reduction in South Asia*, Prentice Hall, 2003.
2. B. K. Singh, *Handbook of Disaster Management*: *techniques & Guideline* , Rajat Publication, 2008.

Suggested Readings:

1. Ministry of Home Affairs". *Government of India, "National disaster management plan, Part I and II"*,
2. K. K. Ghosh," *Disaster Management"*, APH Publishing Corporation, 2006.
3. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
4. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
5. Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs.

16ME O 01

ENTREPRENEURSHIP
(OPEN ELECTIVE I)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course will help the students to understand the

1. The environment of industry and related opportunities and challenges
2. Concept and procedure of idea generation
3. Elements of business plan and its procedure
4. Project management and its techniques
5. Behavioral issues and Time management

Course outcomes: At the completion of this course, students will be able to

1. Identify opportunities and deciding nature of industry
2. Brainstorm ideas for new and innovative products or services
3. Analyze the feasibility of a new business plan and preparation of Business plan
4. Use project management techniques like PERT and CPM
5. Analyze behavioural aspects and use time management matrix

UNIT-I

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries, Types of enterprises, Corporate Social Responsibility.

UNIT-II

Identification and Characteristics of Entrepreneurs: First generation entrepreneurs, environmental influence and women entrepreneurs, Conception and evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development.

UNIT-III

Business Plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary.

UNIT-IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden

UNIT-V

Behavioral Aspects of Entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Readings:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5/e, Tata Me Graw Hill Publishing Company Ltd., 2005.
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.
3. Sudha G.S., "Organizational Behavior", National Publishing House, 1996.

16ME O 04

INTELLECTUAL PROPERTY RIGHTS (OPEN ELECTIVE I)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course will help the students to understand the

1. Fundamental aspects of IP
2. Aspects of IPR acts.
3. Awareness of multi disciplinary audience
4. Awareness for innovation and its importance
5. The changes in IPR culture and techno-business aspects of IPR

Course outcomes: At the completion of this course, students will be able to

1. Will respect intellectual property of others
2. Learn the art of understanding IPR
3. Develop the capability of searching the stage of innovations.
4. Will be capable of filing a patent document independently.
5. Completely understand the techno-legal business angle of IPR and converting creativity into IPR and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR. Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Why protect inventions by patents. Searching a patent, Drafting of a patent, Filing of a patent, the different layers of the international patent system, (national, regional and international options), compulsory licensing and licensers of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets and know-how agreements

UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used as trademarks. Types of trademark, function does a trademark perform, How is a trademark protected? How is a trademark registered. How long is a registered trademark protected for? How extensive is trademark protection. What are well-known marks and how are they protected? Domain name and how does it relate to trademarks? Trademark infringement and passing off.

UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.

UNIT-V

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights Enforcement Measures Emerging issues in Intellectual property protection. Case studies of patents and IP Protection.

Unfair Competition: What is unfair competition. Relationship between unfair competition and intellectual property laws.

Text Books:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications", Macmillan India ltd , 2006
2. B. L.Wadehra; "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications", Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan, "Law of Copyright and Industrial Designs", Eastern law House, Delhi 2010

Suggested Readings:

1. W.R1 Cronish, "Intellectual Property; Patents, copyright, Trad and Allied rights", Sweet & Maxwell, 1993.
2. P. Narayanan, "Intellectual Property Law", Eastern Law Edn., 1997.
3. Robin Jacob and Daniel Alexander, "A Guide Book to Intellectual Property Patents, Trademarks, Copy rights and designs", 4/e, Sweet, Maxwell,.

16EG O 01

TECHNICAL WRITING SKILLS
(OPEN ELECTIVE I)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course will help the students to understand the

1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

Course outcomes: At the completion of this course, students will be able to

1. Communicate effectively, without barriers and understand aspects of technical communication.
2. Differentiate between general writing and technical writing and write error free sentences using technology specific words
3. Apply techniques of writing in business correspondence and in writing articles.
4. Draft technical reports and technical proposals.
5. Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.

Unit I

Communication – Nature and process.

Channels of Communication – Downward, upward and horizontal communication. Barriers to communication.

Technical Communication – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

Unit II

Technical Writing – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing.

Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

Unit III

Business correspondence – Sales letters, letters of Quotation, Claim and Adjustment letters.

Technical Articles: Nature and significance, types. Journal articles and Conference papers, elements of technical articles.

Unit IV

Technical Reports: Types, significance, structure, style and writing of reports. Routine reports, Project reports.

Technical Proposals : Definition, types, characteristics, structure and significance.

Unit V

Mechanics of Meetings: Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.

Technical Presentations : Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.

Text Book

1. Meenakshi Raman & Sangeeta Sharma, **"Technical Communications-Principles and Practice",** Oxford University Press, Second Edition, 2012.
2. 1.M Ashraf Rizvi, **"Effective Technical Communication",** Tata McGraw Hill Education Pvt Ltd, 2012.

Suggested Readings:

1. Kavita Tyagi & Padma Misra, **"Basic Technical Communication",** PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, **"Business Correspondence and Report Writing",** Tata McGraw Hill, 2003

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. https://www.technical-writing-training-and-certification.com/
3. https://academy.whatfix.com/technical-writing-skills

16CH C 28

EQUIPMENT DESIGN AND DRAWING LAB

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

LIST OF EXERCISES

1. Symbols for Piping and Instrumentation.
2. Flow sheet symbols for unit operations.
3. Types of Heat transfer equipment and their representation symbols.
4. Process fluid transport equipment symbols.
5. Development and drawing of few flow sheets.
6. Typical layout, mechanical design and elevation drawings of storage vessels.
7. Design and elevation drawings of Reactor kettles.
8. Layout, design and elevation drawings of heat exchangers.
9. Elevation drawings and design of plate distillation column.

Text Books

1. Vilbrandt, C.T. and Dryden, C.E., "Chemical Engineering plant design", 4th Ed., Kogakusha, 1979.
2. Joshi, M.V. "Process Equipment Design", 2nd Ed., McMillan Co. of India Limited, Madras, 1976.
3. Bachurst, J.R. and Harker, J.A. "Process Plant Design", Heiman Education Books, London, 1973.
4. Evans, F.L., "Equipment Design Hand Book for refineries and Chemical Plants", Vol .I, 1979, Vol. II, 1980, Gulf Publishing Co., Houston, Texas.

16CH C 29

MASS TRASNFER OPERATION LAB

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

LIST OF EXERCISES

1. Determination of concentration profile for the given system
2. Estimation of diffusivity coefficient for the gaseous system (CCl_4 - Air)
3. Estimation of diffusivity coefficient for the liquid system (H_2SO_4 - water)
4. Determination of vapor - liquid equilibrium data for the given system.
5. Estimation of vaporization efficiency and prediction of steam distillation temperature.
6. Verification of the Rayleigh's equation for the system of methanol and water.
7. Determination of the capacity coefficient of the packed column under total reflux conditions and calculation of height equivalent to theoretical plate.
8. Development of the solubility curve for the given system
9. Prediction of Liquid - Liquid equilibrium data for the given system and determination of the plait point.
10. Calculation for percentage of extraction of solute from solid mixture using a solvent (Solid-Liquid extraction).
11. Estimation of the mass - transfer coefficient k_G for Air- Water system and plotting the variation of k_G with Reynold's number.
12. Developing the drying curve by using tray drier and estimation and composition of time required for drying the given solid.

Text Books

1) Christie John Geankoplis, " Transport Processes and Separation Process Principles" , 4th Ed., Prentice Hall India, 2003.
2) McCabe and Julian Smith and Peter Harriott, " Unit Operations of Chemical Engineering", 7 th Ed., McGraw Hill Book Company, 2005.
3) R.E.Treybal, "Mass Transfer Operations", 3rd Edition, McGraw Hill Book Company 1981.

16CH C 30

SEMINAR

Instruction	3 Hours per week
CIE	50 Marks
Credits	2

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall preferably be from any peer reviewed recent journal publications.

Guidelines for awarding marks		
Sl No.	Description	Max Marks
1.	Contents and relevance	10
2.	Presentation skills	10
3.	Preparation of PPT slides	05
4.	Questions and answers	05
5.	Report in a prescribed format	20

CHAITANYABHARATHI INSTITUTE OF TECHNOLOGY (A)
Choice Based Credit System (with effect from 2019-20)
B.TECH (Chemical Engineering)

SEMESTER – VIII

S. No.	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1.	16CH C 31	Plant Design Economics	3	-	3	30	70	3
2.	-	Core Elective-VI	3	-	3	30	70	3
3.	-	Open Elective-II	3	-	3	30	70	3
4.	16CH C 32	Project Seminar	-	3	-	50	-	2
5.	16CH C 33	Project	-	6	viva	50	100	6
Total			**9**	**9**	**--**	**190**	**310**	**17**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE – Continuous Internal Evaluation SEE - Semester End Examination

Core Elective-VI	
16CH E 14	Membrane Separation Technology
16CH E 15	Sugar Technology
16CH E 16	Food Technology

Open Elective-II	
16ME O 05	Nano Materials and Technology
16CS O 03	iOT and application
16PY O 01	History of Science and Technology
16EG O 02	Gender Sensitization

16CH C 31

PLANT DESIGN AND ECONOMICS

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course will help the students to understand the

1. Fundamentals of investments and engineering economics.
2. Flow sheet synthesis and integrate with process equipment design.
3. Design concepts with principles of process economics.
4. Methods to quantify concepts such as fixed capital investment, cash-flow analysis, profitability analysis and decision making.
5. Piping and tubing specifications, P and ID diagrams

Course outcomes: At the completion of this course, students will be able to

1. Calculate the time value of money and depreciation.
2. Estimate fixed and working capitals and operating costs for process plants.
3. Evaluate the profitability of process industry projects using measures such as ROI, NPV and DCF
4. Identity and apply the selection criteria for design of flow sheets, equipment and material.
5. Design the piping specifications as per standards.

UNIT – I

Economic equations. Present and future worth. Equivalence and value for money. Nominal and effective interest rates.
Capitalized cost, sinking fund, definition of bond and problems. Types of depreciation and problems.

UNIT - II

Capital requirements by Chilton and Lang, Schweyer, Cost indices methods. Total investment schedule. Sources of capital. Balance sheet and problems. Economic charts. Problems on break even, variable cost, fixed cost. Estimation of profit and capital ratios.

UNIT - III

Selection of alternative equipment or plants by annual cost. Present cost and Capitalized cost methods. Replacement of existing equipment. Rate of return and payout time methods and problems.

UNIT – IV

Process evolution. Stages of process design. Types of flowsheets. Selection criteria of process equipment - material handling (solids, liquids & gases) - separation equipment (solid - solid sold - liquid, liquid - solid etc), Size reduction equipment, agitators, drying equipment filtration equipment, reactors. Procedure for material selection. Introduction to Design and Automation of process plants. Examples.

UNIT – V

Piping and tube specifications, pipe fabrication methods, piping material, principles of piping layout, piping stresses, stress design and supports. Pressure drop in pipe lines, piping friction factor, design of pipe lines for natural gas, selection of valves. Introduction to P & ID Diagrams.

Text Books

1. Max. Peters, K Timmerhaus and Ronal West, "Plant Design and Economics for Chemical Engineers", 5th Ed., McGraw Hill Publications, 2003.
2. C.Vilbrandt and Dryden C.E, "Chemical Engineering Plant Design", 4th Ed, MGH Book Co., Reprints 2015.

Suggested Readings:

1. Seider W.D., Seader J.D. & Lewin D.R., "Product and Process Design principles: Synthesis, Analysis and Evaluation", John Wiley & Sons, Inc., 2nd ed., 2010
2. J.M. Coulson and J.F Richardson, "Chemical Engineering", Vol.6, 5th ed. Pergamon and ELES, 2003.
3. H.E.Schweyer., "Process Engineering Economics", MGH Book Co, NewYork, 2001.

16CH E 14

MEMBRANE SEPARATION TECHNOLOGY
(CORE ELECTIVE VI)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course will help the students to understand the

1. The fundamental principles and applications of different membrane processes
2. Types of membranes and preparation
3. Selection criteria for membrane processes
4. Various installations for Membrane Processes and simple design considerations
5. Design of membrane systems

Course outcomes: At the completion of this course, students will be able to

1. Understand different types of membrane processes
2. Identify a membrane process for a specific application
3. Understand the types and preparation of membranes
4. Calculate performance factors for various membrane processes
5. Write design equations for simple membrane modules

UNIT – I Introduction to Membrane Separation Processes: Classification of separation processes - Separating agents - principles of gas permeation, reverse osmosis, ultra-filtration, pervaporation, dialysis, Electro-dialysis.
Applications of membranes - for the separation of gases, waste water treatment, pulp and paper, electroplating and Electro-coating industries, food industry - denaturing of liquid foods, cheese making and whey processing

UNIT – II Preparation of Membranes: Basic introduction to different types of membrane materials. Basics of preparation of synthetic membranes - Sintering, Stretching, Track-Etching, Template Leaching, Phase-inversion, Coating, Sol-gel process

UNIT – III Ideal Separation on Capabilities of Membrane Processes: Separation factor, rejection factor, expressions for ideal separation factors in various membrane processes.

Secondary Phenomena in Membrane processes: Secondary physical and transport phenomena in membrane processes, concentration polarization in membrane processes.

UNIT – IV Equipment for Membrane Processes: Flat sheet, tubular, spiral wound and hollow fiber membrane modular designs for various membrane processes, single entry and double entry separating elements, separation stage. Flow configuration in membrane systems.

UNIT – V Design of Membrane Systems: Design equations for perfect mixing and cross flow configuration, separation stages for gas permeation, reverse osmosis and ultra filtration. Design equations for perfect mixing and parallel flow dialyze. Simple design equations for Electro-dialytic stacks

Text Books

1. Kaushik Nath, "Membrane Separation Processes", PHI Learning, 2008
2. Marcel Mulder, "Basic Principles of Membrane Technology", Kluwer Academic Publishers, 2nd Ed., 1996.

Suggested Readings:

1. Membrane Technology Lecture series of Winter School conducted at College of Tech, O.U., December, 1987
2. W L McCabe, J C Smith and P Harriot, "Unit Operations of Chemical Engineering", 7th Ed., Mc-Graw Hill, 2005
3. Christie John Geonkoplis "Transport Processes and Separation Process Principals", Pearson New Intl. Ed., 2013

16CH E 15

SUGAR TECHNOLOGY
(CORE ELECTIVE VI)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course helps the students to understand the

1. Performance measures of different types of unit operations in sugar processing
2. Applications, advantages and limitations of the processing procedure
3. Competence and optimization of advanced technology in sugar processing.
4. Crystallization methodology and their applications
5. Possible byproducts of any sugar industry and production of salable derivatives.

Course outcomes: At the completion of this course, students will be able to

1. Principles and skills of work in sugar cane milling, processing and refining in practical settings.
2. Analyze the composition of different types of sugars by volumetric and gravimetric determination.
3. Different unit operations for effective processing of cane juice.
4. Batch and continuous methods for an efficient operation of sugar industry.
5. Concepts of quality assurance and control in industry as per Indian regulations and practices.

UNIT - I

Importance of sugar industry. Different raw materials for sugar manufacturing, composition of raw materials, history, origin and distribution of sugarcane, production and productivity of sugarcane in India. Indian sugar industry on global screen. Manufacturing processes of raw sugar and crystalline white sugar. Reducing sugars - composition, volumetric and gravimetric determination methods.

UNIT - II

Conveying of raw materials - cane carrier and feeding table working principles. Cane preparation – objective, sieving, preparation index, cane knives, crushing

and shredding applications. Extraction of cane juice by milling operation - basic concept of roller mills, working principles, conditions for good milling operation, milling efficiency, maceration and imbibitions – importance, effect, method, objective and efficiency. Cane juice clarification – simple, compound and neutral defaction procedures. Sulphitation and carbonation - batch and continuous methods. Single and double carbonation process, De-Hans process, comparison of different clarification modern techniques.

UNIT - III

Juice heaters - construction and working principles. Juice filtration - plate and frame filter presses, RVDF, types of filter cake washing. Evaporation- multiple effect evaporators - construction and operation. Steam economy and capacity. Vacuum pan boiling - construction, types of pans, speed of circulation, heating surface to volume ratio, pan boiling techniques, different boiling schemes.

UNIT - IV

Crystallization – nucleation, graining methods, advantages and disadvantages of graining. Theory of crystallization, crystallization zone, crystal growth. centrifuge –construction & working, factors influences on time of curing. Advantages and disadvantages of batch / continuous centrifugal machine. Separation of molasses-different molasses conditioning methods, precautions during molasses conditioning.

Sugar drying -various aspects regarding drying and cooling, rotary dryer. Packing of sugar -types of sugar grader, dilution indicator, quality and safety factors, location and stalking of sugar bags.

UNIT - V

Sugar byproducts: bagasse, pressmud and molasses- their composition and applications. Production of bio-gas, fibre board, furfurol filter mud, extraction of cane wax, manure, industrial alcohol and rectified spirit. Sugar scales and normal weight.

Text Books

1. Meade and Chen, " Hand of book of cane sugar", 11th Ed , Wiley Interscience, New York, 2001.
2. James C.P Chen, "Cane Sugar Hand book", 12th Ed, Elsevier Pub. Co., New York, 1993.

Suggested Readings:

1. R B L Mathur, Hand Book of Cane Sugar Technology", 2nd Ed, Oxford & IBH, 1978.
2. John H. Payne, "Unit operation in cane sugar production", Sugar series book 4, Elsevier Pub. Co., New York, 1982.

16CH E 16

FOOD TECHNOLOGY
(CORE ELECTIVE VI)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course objectives: This course helps the students to understand the

1. Basic food preparation techniques. Food quality.
2. Physical, chemical, and/or microbiological changes in food and mechanical manipulation.
3. Learn fundamentals of modifying food to meet current nutrition recommendations
4. Learn to find credible sources of information re. food science and nutrition.
5. Food processing Applications and Packaging

Course Outcomes: At the end of the course, student will be able to

1. Explain techniques in food processing
2. Design process equipment to achieve the desired quality of food.
3. Develop novel food processes that have a minimal effect on food quality
4. Select control strategies to maintain food quality
5. Apply the scientific method to food science problems

UNIT – I

Introduction: General aspects of food industry, World food demand and Indian scenario, Constituents of food, Quality and nutritive aspects, Product and Process development, engineering challenges in the Food Processing Industry.

UNIT – II

Basic principles: Properties of foods and processing theory, Heat transfer, Effect of heat on micro-organisms, Basic Food Biochemistry and Microbiology: Food Constituents; Food fortification, Water activity, Effects of processing on sensory characteristics of foods, Effects of processing on nutritional properties, Food safety, good manufacturing practice and quality Process Control in Food Processing.

UNIT – III

Ambient Temperature Processing: Raw material preparation, Size reduction, Mixing and forming, Separation and concentration of food components, Centrifugation, Membrane concentration, Fermentation and enzyme technology, Irradiation, Effect on micro-organisms, Processing using electric fields, high hydrostatic pressure, light or ultrasound.

UNIT – IV

Heat processing using steam, water and air: Blanching, Pasteurization, Heat sterilization, Evaporation and distillation, Extrusion, Dehydration, Baking and roasting, Heat processing by direct and radiated energy: Dielectric heating, Ohmic heating, Infrared heating, Gamma irradiation.

UNIT – V

Post Processing Applications Packaging: Coating or enrobing, Theory and Types of packaging materials, Printing, Interactions between packaging and foods, Environmental considerations.

Text Books:

1. Fellows P., Food Processing Technology: Principles and Practice, Wood head Publishing, 4th Edition, 2016.
2. Toledo R, Fundamentals of Food Process Engineering, Springer, 3rd Edition, 2010.

Suggested Reading:

1. Singh R.P. & Heldman D.R., Introduction to Food Engineering, Academic Press, 3rd Edition, 2001.

16ME O 05

NANO MATERIALS AND TECHNOLOGY
(OPEN ELECTIVE II)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course helps the students to understand the

1. Nanotechnology approach and challenges
2. Materials and characterization procedures
3. Zero and One dimensional Nano structures
4. Various Fabrication Techniques
5. Special nano materials and Nano biomaterials

Course outcomes: At the completion of this course, students will be able to

1. Understand the developments and challenges in nano technology
2. Understand magnetic and electronic properties and its microstructure
3. Learn synthesis and characterization techniques of Zero and One dimensional Nano structures and their applications
4. Study various Nano Material Fabrication Techniques
5. Understand the applications of special nano materials and nano bio materials

UNIT - I

Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance of Nanotechnology, Bottom-up and Top-down approaches, challenges in nanotechnology

UNIT - II

Materials of Nanotechnology: Introduction, Si-based materials, Ge-based materials, Ferroelectric materials, Polymer materials, GaAs& InP (HI-V) group materials, Nanotribology and materials, characterization using Scanning Probe Microscope, AFM

UNIT - III

Nano Structures: Zero dimensional Nanostructure, synthesis procedure by heterogeneous method, characterization techniques, properties and applications of Nano particles

One dimensional Nanostructures: Synthesis procedure, characterization procedure and principles involved, properties and applications of Nano Wires

UNIT - IV

Nano Fabrication: Introduction, Basic fabrication techniques by Lithography and doping, MEMS fabrication techniques, Nano fabrication techniques by E-beam, Nano-imprint fabrication, Epitaxy and strain engineering

UNIT - V

Special Nano Materials: Introduction, Synthesis procedure by metal-polymer, Characterization procedures, applications

Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, applications

Text Books:

1. Dieter Vollath, "Nanomaterials: An introduction to Synthesis, properties and applications", Wiley, 2013
2. Guozhong Cao, "Nanostructures and Nano Materials, Synthesis properties and applications", Imperial College Press
3. Carl C Koch, "Nano materials Synthesis , Properties and applications", Jaico Publishing House

Suggested Reading:

1. Willia Tllsey Atkinson, "Nano Technology", Jaico Publishing House
2. George W. Hanson, "Fundamentals of Nanoelectronics", Pearson Education, 2009
3. T. Pradeep, "Nano: Essentials-understanding Nano Science and Technology", TMH, 2007

16CS O 03

Iot AND APPLICATIONS
(OPEN ELECTIVE II)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: The main objectives of this course are:

1. Impart necessary and practical knowledge of components in Internet of Things.
2. Understand working of IOT Systems.
3. Develop skills required to build IOT based systems.

Course Outcomes: On Successful completion of this course, student will be able to

1. Understand Internet of Things and its hardware and software components.
2. Interface I/O devices, sensors & communication module.
3. Remotely monitor data and control devices.
4. Develop real time IOT based projects.
5. Advance towards research based IOT.

UNIT – I

Introduction to IoT: Sensors, Types of sensors and Transducers, Actuators and Types of Actuators.

UNIT – II

Basics of Networking: Functional Components of IoT, IoT interdependencies, IoT Service oriented architecture, IoT categories, IoT gateways, IoT and associated technologies, Key technologies for IoT, IoT challenges.

UNIT – III

IoT Hardware Components: Computing (Arduino/Raspberry Pi), Communication, Sensors, Actuators, I/0 interfaces, Programming API's (for Arduino/ Raspberry Pi).

UNIT – IV

IoT Application Development: Solution framework for IoT applications-Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, Authorization of devices

UNIT – V

IoT Systems and Applications: Smart Lighting, Weather Monitoring System, Weather Reporting Bot, Forest Fire Detection, Alcohol Detection System, Smart Parking Environment**.,** Drip-irrigation, Biological water treatment system**,** Work flow Automation in Industries, Smart Intrusion Detection System, monitoring space risks and hazardous conditions in industrial regions like underground tanks , trap door margins.

Text Books:

1. Raj and Anupama C. Raman,"The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
2. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi, 2018.
3. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.

Suggested Reading:

1. Dr. SRN Reddy, Rachit Tirnkral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2018.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2013.
3. Raj Kamal, "Internet of Things:Architecture and Design", McGraw Hill, 2017.
4. Cuno Pfister, "Getting Started with the Internet of Things", 0 Reilly Media, 2011.
5. O. Vermesan, P. Fries**, "**Internet of Things – Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers, Series in Communications, 2013.

Online Resources:

1. Li Da Xu, Wu He, and Shancang Li, "Internet of Things in Industries: A Survey ", IEEE Transactions on Industrial Informatics, Vol. 10, No. 4, Nov. 2014.
2. Gotovtsev, Pavel M., and Andrey V. Dyakov. "Biotechnology and Internet of Things for green smart city application." 2016 IEEE 3rd World Forum on Internet of Things (WF-IoT). IEEE, 2016.
3. Yanjing, Sun, et al. "Research and design of agriculture informatization system based on IOT." Journal of Computer Research and Development 48 (2011): 316-331.
4. Somov, Andrey, et al. "Bacteria to power the smart sensor applications: Biofuel cell for low-power IoT devices." 2018 IEEE 4th World Forum on Internet of Things (WF-IoT). IEEE, 2018.
5. Han, Shuqing, et al. "Analysis of the frontier technology of agricultural IoT and its predication research." IOP Conference Series: Materials Science and Engineering. Vol. 231. No. 1. IOP Publishing, 2017.

16PY O 01

HISTORY OF SCIENCE AND TECHNOLOGY
(OPEN ELECTIVE II)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course helps the students to understand the

1. To enablestudents to understand science as a socio-cultural product in specific socio-historical contexts.
2. To expose students to philosophical, historical and sociological perspectives to look atscience as a practice deeply embedded in culture and society.
3. To inculcate the scientific culture and ethics in the development of technologies.

Course outcomes: At the completion of this course, students will be able to

1. Demonstrate knowledge of broad concepts in the history of science, technology ranging over time, space and cultures.
2. Recognize the values of a wide range of methodologies, conceptual approaches and the impact of competing narratives within the history of science, technology.
3. Identify, locate and analyze relevant primary and secondary sources in order to construct evidence-based arguments.
4. Think independently and critically, using appropriate methodologies and technologies to engage with problems in the history of science, technology.
5. Demonstrate academic rigor and sensitivity to cultural and other diversity, and understanding of the ethical implications of historical and scientific enquiry within a global context.

Unit-I

Science - The Beginning (through 599 BC): The Stone Ages, Knowledge among hunter gatherers,Agricultural Revolution and other revolutions,Civilization,Major advances.

Science in Antiquity (600 BC - 529 AD): Philosophy, a precursor to science, Hellenistic world and the Roman Empire, Other cultures of the period, major advances.

Unit-II

Medieval Science (530 AD - 1452 AD): The decline of science in Europe , Science in China, Science and mathematics in India, Arab science, revival of science in Europe, technology revolution of the Middle ages, Major advances.

The Renaissance and the Scientific Revolution (1453 AD – 1659 AD): Renaissance, Scientific Revolution, Technology, Major advances.

Unit-III

Scientific Method: Measurement and Communication (1660 AD – 1734): European domination, The scientific method, Major advances.

The Industrial Revolution (1735 AD – 1819 AD): Industrial Revolution, Rise of the engineer, Major Advances.

Unit-IV

Science and Technology in the 19th Century (1820 AD – 1894 AD): philosophical basis of 19th-century science,Science and the public, Science and technology, Major advances.

Rise of Modern Science and Technology (1895 AD – 1945 AD): The growth of 20thcentury science, Newphilosophies, Quantum reality, Energy sources, Electricity: a revolution intechnology, Majoradvances.

Unit-V

Big Science and the Post-Industrial Society (1946 AD – 1972 AD): Big science, Specialization and changing categories, Technology changes society, Major advances.

The Information Age (1973 AD – 2015 AD): Information and society, Globalization, The post-industrial society,Problems of the Information age, Major Advances

Text Books:

1. Bryan Bunch and Alexander Hellemans, "The History of Science and Technology", Houghton Mifflin Company (New York), 2004
2. JD Bernal, "Science in History", 4 Volumes, Eklavya Publishers, 2012

Suggested Readings:

1. "The 100 Most Influential Scientists of All Time", Edited by Kara Rogers, Britannica Educational Publishing, 2010
2. Alberto Hernandez, "A Visual History of Science and Technology", The Rosen Publishing Group, 2016

16EG O 02

GENDER SENSITIZATION
(OPEN ELECTIVE II)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: This course helps the students to understand the

1. To develop students' sensibility with regard to issues of gender in contemporary India.
2. To provide a critical perspective on the socialization of men and women.
3. To expose the students to debates on the politics and economics of work. To help students reflect critically on gender violence.

Course outcomes: At the completion of this course, students will be able to

1. Develop a better understanding of important issues related to what gender is in contemporary India.
2. Be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature, and film.
3. Attain a finer grasp of how gender discrimination works in our society and how to counter it. Students will acquire insight into the gendered division of labour and its relation to politics and economics.
4. Understand what constitutes sexual harassment and domestic violence and be made aware of New forums of Justice.
5. Draw solutions as to how men and women, students and professionals can be better equipped to work and live together as equals.

UNIT – I

Understanding Gender:
Gender: Why Should We Study It? (Towards a World of Equals: Unit -1)
Socialization: Making Women, Making Men (Towards a World of Equals: Unit -2)
Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT – II

Gender And Biology:
Missing Women: Sex Selection and Its Consequences (Towards a World of Equals: Unit -4)

Declining Sex Ratio. Demographic Consequences.
Gender Spectrum: Beyond the Binary (Towards a World of Equals: Unit -10)
Two or Many? Struggles with Discrimination.

UNIT – III

Gender and Labour:
Housework: the Invisible Labour (Towards a World of Equals: Unit -3)
"My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (Towards a World of Equals: Unit -7)
Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

UNIT-IV

Issues Of Violence
Sexual Harassment: Say No! (Towards a World of Equals: Unit -6)
Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading:
"Chupulu".
Domestic Violence: Speaking Out (Towards a World of Equals: Unit -8)
Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading:
New Forums for Justice.
Thinking about Sexual Violence (Towards a World of Equals: Unit -11)
Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Face of
Violence.

UNIT – V

Gender: Co - Existence
Just Relationships: Being Together as Equals (Towards a World of Equals: Unit -12)
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers.
Additional Reading: Rosa Parks-The Brave Heart.

Text Books:

1. A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote,VasudhaNagaraj, AsmaRasheed, GoguShyamala, DeepaSreenivas and Susie Tharu "Towards a World of Equals: A Bilingual Textbook on Gender" published by Telugu Akademi, Hyderabad, Telangana State, 2015.

Suggested Readings:

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. Abdulali Sohaila. "I Fought For My Life…and Won."Available online at:
3. http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Web Resources:

1. https://aifs.gov.au/publications/gender-equality-and-violence-against-women/introduction
2. https://theconversation.com/achieving-gender-equality-in-india

16CH C 32

PROJECT SEMINAR

Instruction	3 Hours per week
CIE	50 Marks
Credits	2

The objective of 'Project Seminar' is to enable the student take up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D. The work shall include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/ Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental Committee.

Guidelines for the award of Marks:Max. Marks: 50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Department Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

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PROJECT

Instruction	6 Hours per week
CIE	50 Marks
SEE	100 Marks
Credits	6

The object of Project is to enable the student extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/ Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for the award of marks in CIE: (Max. Marks: 50)

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Department Review Committee	05	Review 1
	08	Review 2
	12	Submission
Supervisor	05	Regularity and Punctuality
	05	Work Progress
	05	Quality of the work which may lead to publications
	05	Report Preparation
	05	Analytical / Programming / Experimental Skills

Guidelines for awarding marks in SEE: (Max. Marks: 100)Max. Marks: 100

Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiners together	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the project ● Innovations ● Applications ● Live Research Projects ● Scope for future study ● Application to society
	20	Viva-Voce