CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
SCHEME OF INSTRUCTION AND EXAMINATION
B.Tech – IV YEAR
CHEMICAL ENGINEERING

SEMESTER - I

S.No	Syllabus ref. no.	Subject	Scheme of Instruction			Scheme of Examination			
			Periods per week			Duration in Hours	Maximum Marks		Credits
			L	T	P/D		End exam	Sessionals	
THEORY									
1.	CH 411	Chemical Process Safety	4	0	0	3	75	25	3
2.	CH 412	Mass Transfer Operations -II	4	0	0	3	75	25	3
3.	CH 413	Petrochemical Engineering	4	0	0	3	75	25	3
4.	MB 216	Principles and Practice of Management	4	0	0	3	75	25	3
5.	CH 414	Process Equipment Design	4	0	0	3	75	25	3
6.		**Elective – II**	4	0	0	3	75	25	3
PRACTICALS									
7.	CH 415	Equipment Design and Drawing	0	0	3	3	50	25	2
8.	CH 416	Mass Transfer Operations Laboratory	0	0	3	3	50	25	2
9.	CH 417	Project Seminar	0	0	3	–	–	25	1
Grand Total (Theory + Practicals)			**24**	**0**	**9**	–	**550**	**225**	**23**

L: Lecture, T: Tutorial, D: Drawing, P: Practical

S.No	Syllabus ref. no.	**Elective – II**
1.	CH 461	Fertilizer Technology
2.	CH 462	Membrane Separation Processes
3.	CH 463	Mineral Processing Technology
4.	CH 464	Polymer Technology
5.	CH 465	Pulp and Paper Technology

SEMESTER – II

S.No	Syllabus ref. no.	Subject	Scheme of Instruction			Scheme of Examination			
			Periods per week			Duration in Hours	Maximum Marks		Credits
			L	T	P/D		End exam	Sessionals	
THEORY									
1.	CH 421	Plant Design and Economics	4	0	0	3	75	25	3
2.	CH 422	Transport Phenomena	4	0	0	3	75	25	3
3.		**Elective – III**	4	0	0	3	75	25	3
4.		**Elective – IV [Open Electives]**	4	0	0	3	75	25	3
PRACTICALS									
5.	CH 423	Seminar	0	0	3	–	–	25	1
6.	CH 901	Project	0	0	6	Viva	100	50	9
Grand Total (Theory + Practicals)			**16**	**0**	**9**	–	**400**	**175**	**22**

L: Lecture, T: Tutorial, D: Drawing, P: Practical

S.No	Syllabus ref. no.	**Elective – III**	S.No	Syllabus ref. no.	**Elective – IV**
1.	CH 471	Corrosion Engineering	1.	CE 422	Disaster Mitigation and Management
2.	CH 472	Fluidization Engineering	2.	ME 464	Entrepreneurship
3.	CH 473	Pollution Control in Process Industries	3.	PE 484	Nano Materials and Technology
4.	CH 474	Sugar Technology	4.	CH 481	Nuclear Engineering

CH 411

CHEMICAL PROCESS SAFETY

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course helps the students to understand the:
1. importance of safety culture in process industry.
2. disregard for ethical decision making based on numerous case studies.
3. interaction and implementation of trade-offs concept in chemical plant operation.
4. examples of problems that can occur with inadequate process design, improper process modification.

Course Outcomes: At the end of the course, the students will be able to:
1. evaluate effect of chemical hazards and risks of toxicants.
2. analyze chemical incidents and possible consequences to plant facilities, workers, and the general public.
3. apply the technique of safe process design.
4. analyze fire and explosion hazards.
5. integrate safety concepts into chemical plant design.
6. follow the ethics during process plant operation.

UNIT – I

Introduction: Process industrial safety − definition, importance. Safety awareness − Safety aspects of site selection, plant planning and layout, check list, inline arrangement of tower drums, exchangers, pumps and main pipelines.
Case studies of major disasters due to safety violations: Chernobyl disaster, Bhopal disaster, recent oil spills. Chemical hazardous and workers safety.

UNIT – II

Organized labor interest in safety: Involvement of unions in accident prevention, recommendation of occupational health committees. Work of MCA in accident prevention at process industries. Risk assessment procedures and typical operational practices. Necessary precautionary measures.
Hazards: Identification and operability studies. Involvement of chemical criminals in process industries and their prevention. DOW Fire and explosion index, calculation of the DOW Fire and EI. Chemical safety data sheets and guides.

UNIT – III

Safety education and training: Training of personnel, on- the- job and job instructed training, meeting and instructional presentations. Effects of toxic Agents and chemicals on skin, eyes, respiratory tract, digestive tract. Primary protection equipment (PPE) – types, significance and applications.
Measuring safety effectiveness: criteria for effective measurement, disabling (Lost-time) injuries, frequency rate, severity rate. Problem related safe-t-score. Involvement of inspector of factories in accident prevention. The technique of safe process design, separation sections, materials handling, storage sections, flowsheet review.

UNIT – IV

Fires and explosions: Definition of fire, fire triangle, Classification of fires as Class - A, B, C and D. Reaction of fires.
Fire extinguishers: Portable fire extinguishers − applications and their uses, Construction and working of water, Mechanical foam, CO_2, stored powder, ABC powder. Automatic multiple CO_2 extinguishers in chemical process industries.

UNIT – V

Emergency preparation and accident investigation: On-site and off-site emergency plan and infrastructure, learning from accidents, layered investigation, equipments aiding in diagnosis.
Safety audit: Introduction, essentials, requirements, programs and procedures.

Text Books:
1. D. A. Crowl and J.F. Louvar, "Chemical Process Safety", Prentice Hall, New Delhi, 2011.
2. Howard H. Fawcett and W. S. Wood, "Safety & Accident prevention in chemical operations", 2nd Ed., John Wiley and Sons Inc, 1982.

Suggested reading
1. Coulson and Richadson, "Chemical Engineering Design", 3rd ed., Vol 6, TMH, 1999.
2. Fulekar M.H, "Industrial Hygiene and Chemical Safety", I.K. International Publisher, 2006.
3. Sanders R.E., "Chemical Process Safety: Learning from case Histories", Butterworth-Heinemann (Elsevier) pub, 2005.

CH 412

MASS TRANSFER OPERATIONS - II

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 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.
6. design of equipment for Mass Transfer Operations.

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). Equipment's 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 reading:

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.

CH 413

PETROCHEMICAL ENGINEERING

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 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.

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.
6. find the suitable refining technology for maximizing gasoline yield.

UNIT−I

O**rigin 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 Reading

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.
3. Meyers Robert, “Hand Book of Petroleum Refining Processes”, 3rd edition McGraw Hill, 2003.

MB 216

PRINCIPLES AND PRACTICE OF MANAGEMENT

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course helps the students to understand:
1. basic principles, concepts and functions of management in industry.
2. key competencies and skills required for problem-solving and decision-making in managerial situations.
3. the different organizational designs and structures.
4. materials, operations and marketing management.
5. the role and functions performed by HR managers.

Course Outcomes: At the end of the course, student will be able to apply the
1. managerial skills for managing a Unit / Branch.
2. the different operations / functional areas to process industry as an organization.
3. assess the situations in an organization by critical examination and provide better decisions.
4. dynamics of business and sense to formulate the direction of change.
5. purchasing objects and principles to material management
6. concept of marketing management to a global scenario.

UNIT - I

Management definition, Administration Vs Management Principles and Functions of Management, levels of management - System and Contingency approach to management - steps in Planning - Decision making process - organization: Definition, Line, staff, functional and matrix type organization, span of control (Graicuna`s Formulae), Centralization Vs Decentralization.

UNIT - II

Communication - Process, Grapevine, Networks and Barriers of communication - Managerial grid, Theory of X, Y and Z; Job Enrichment Vs Job enlargement - Control process - Introduction to Personnel Management: Functions, staffing process, need for HRD, Training & Development (TWI Programme)

UNIT - III Measurement of Morale - Job Design -Industrial Relations: Human relation Vs Industrial relations, Trade Unionism, Industrial Unrest, Wage and Incentive concepts - Role of ILO - MIS in industry - Management of public enterprises.

UNIT - IV Introduction to Financial Management : Sources of Finance, Capital & its Structure (CFS & FFS) Financial statements, cost sheet - Introduction to Purchase & Material management Purchasing objects and principles, types of purchasing, Vendor selection, rating, evaluation & Development - Inventory control, ABC analysis, stores organization and pricing of issues - concept of Warehousing.

UNIT - V Production and marketing Management: Types of Production, Quality control (Tools used), PPC, Maintenance management - Marketing management ; Definition and concept of marketing, functions of marketing, market research, Types of markets, Sales Forecasting, Promotion mix - Pricing - Product Identification - A brief note on International Marketing.

Text Books:

1. Harold Koontz and Heinz Weihrich, "Essentials of Management-An International Perspective", 9th Ed., Tata McGraw-Hill Edu Pvt. Ltd, 2012.
2. Khan & Jain, "Financial Management", 7th Ed., Tata McGraw-Hill Edu Pvt. Ltd, 2014.

Suggested Readings:

1. David A. DeCenzo, David A, Robbins, Stephen P, "Fundamentals of Human Resource Management", 11th Ed, John Wiley and Sons Inc, 2015.
2. Elwood S Buffa, Rakesh K. Sarin, "Modern Production/Operations Management", 8th Ed, Wiley India Pvt. Ltd., 2007.
3. Jennifer George and Gareth Jones "Understanding and Managing Organizational Behavior", Published by Pearson Education Inc., 2013.
4. I. M. Pandey, "Financial Management", 10th Ed. Vikas Publishing House, 2013.
5. Gary Dessler, "Human Resources Management", 11th Eastern Economy Ed., 2011.

CH 414

PROCESS EQUIPMENT DESIGN

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course objectives: This course helps the students to understand the:
1. classification of unfired pressure vessels observed in process industries.
2. design needs for process equipment of any chemical plant.
3. mechanical design of process vessels for shells, domes and other significant component parts.
4. process design of reactors based on their operation.
5. sieve-tray hydraulics and downcomer design of distillation columns.

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. calculate the dimensions of shell and domes of process vessels.
3. select appropriate component parts for any process vessel and calculate the dimensions of flanges, nozzles.
4. apply the calculation procedures for design of significant process equipment like storage vessels, reactors.
5. apply McCabe- Thiele method and design continuous distillation with multiple feeds or side streams.
6. apply the calculation procedures for hydraulics and downcomer design for trays of a distillation column.

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 – 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.

Impellers – types, dimensions and selection criteria based on nature of material to be mixed, power requirement. design calculations to estimate shaft dimensions for impellers.

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.

Application of McCabe-Thiele method for design calculations of continuous distillation with multiple feeds and with removal of side streams.

UNIT – V: Design of Plate contactors

Sieve-plate hydraulic design – performance, construction, area considerations, flooding, liquid-flow arrangement, weir dimensions, entrainment, weep-point. Plate pressure drop – dry plate, residual and total drop. Design of downcomer back-up – clear liquid, weir crest, head loss, residence time.

Text Books:

1. J.M.Coulson, J.F.Richardson, R.K. Sinnott, "Chemical Engineering Design", Vo1. 6, Ed 3, Butterworth – Heinemann publishers, New York, 2000.
2. Dr. Shrikanth D. Dawande, "Process Design of Equipments" Vol. 1 & 2, Central Techno Publications, Nagpur, 2000.

Suggested Reading

1. M.V. Joshi, "Process Equipment Design", 2nd Ed., McMillan Co. of India Limited, Madras,1976.
2. Ernest E. Ludwig, "Applied process design for chemical and petrochemical plants", Vol 3, Elsevier Inc., 2001.
3. Bachurst, J.R. and Harker, J.H, "Process Plant Design", American Elsevier Pub. Co., London, 1973.

CH 461

FERTILIZER TECHNOLOGY
(Elective II)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course objectives: This course helps the students to understand:
1. the use of fertilizers to improve soil productivity and crop yield
2. the different types of the nitrogenous, phosphatic and potash fertilizers
3. various fertilizer application methods
4. different organic fertilizer production methods

Course outcomes: At the end of the course, the students will be able to:
1. identify the raw materials required for manufacture of fertilizers.
2. process description and flowsheet involved in the manufacture of various fertilizers.
3. significant unit operations involved in manufacture of various fertilizers.
4. characterize fertilizers on the basis of their properties.
5. Identify engineering problems in fertilizer manufacturing.
6. Select appropriate synthetic fertilizers.

UNIT – I:
Introduction: Fertilizer Technology, Plant Nutrients, Role of essential elements for plant growth. Availability of feed stocks.
Nitrogen Fertilizers: Feed stocks for the production of Ammonia, Ammonia synthesis by – Haber and Kellogg processes. By-product ammonia recovery by direct and indirect methods.

UNIT - II
Manufacture of Urea, Manufacture of other nitrogenous fertilizers such as ammonium sulfate, ammonium nitrate, calcium ammonium nitrate, ammonium chloride. Manufacture of nitric acid.

UNIT - III
Phosphorous fertilizers– manufacture of single and triple super phosphate.
Production o f ammonium phosphates – mono-, Di- and nitro phosphates, Manufacture of phosphoric acid by wet process and thermal process.

UNIT - IV
Potassium fertilizers, mixed and NPK fertilizers.
Introduction to new variety of fertilizers – liquid fertilizers. Bio fertilizers – introduction, advantages over chemical fertilizers, types and uses.

UNIT - V
Fertilizer application techniques for different soil controlled release fertilizers. Effluent treatment methods for various fertilizer plants.
Environmental impact of fertilizer plants on Ecosystem. Indian Fertilizer industry – production Economics and future plans.

Text Books:
1. Brahma Mishra, " Fertilizer Technology and Management", IK International Publishing House Pvt. Ltd., 2012
2. FAO, "Fertilizers and their use", 4th Edition, Scientific Publisher, New Delhi, 2015
3. Dr. Shalini Suri, "BioFertilizers and Biopesticides", APL publishing Corporation, 2011.

Suggested Reading:
1.UNIDO, " Fetilizer Manual", 3rd edition, Kluwer Academic Publishers,1998.

Web Resources :
1. www.webpages.uidaho.edu
2. www.wiley-vch.de

CH 462

MEMBRANE SEPARATION PROCESES
(Elective - II)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: To enable the students to understand
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

Course Outcomes: At the end of the 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. Acquire knowledge about membrane modules
6. 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 Reading:
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

CH 463

MINERAL PROCESSING TECHNOLOGY
(Elective II)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course helps the students to understand:
1. the unit operations in mineral processing technology and mineral concentration processes.
2. the importance and principles of material handling in mineral processing plant with special emphasis on feeding and conveying of bulk material.
3. acquire practical skills in concentrates handling, grade determination, recovery and loss calculations.

Course Outcomes: At the completion of this course, students will be able to:
1. identify the principles governing a range of processes applied in mineral industry.
2. describe typical unit processes and flowsheets for production of a number of metals.
3. design the movement techniques of solids in fluids during processing.
4. design the slurry transport of materials and their separation.
5. apply basic engineering principles to develop flowsheets.
6. produce conceptual designs for simple extraction processes.

UNIT – I: **Introduction**
Scope and importance of Mineral Processing, Properties and Types of Minerals. Pretreatment of ores: removal of harmful materials, sampling of ores, moisture sampling, assay sampling, sampling systems, sample division methods, online analysis.

UNIT – II:
Mineral liberation: degree of liberation, concentration, measures of assessing metallurgical performance namely recovery, ration of concentration, grade, enrichment ratio.
Laboratory sizing: particle size and shape, sieve analysis, sub sieve techniques, microscopic sizing, centrifugal methods (Warman cyclosizer), online particle size analysis

UNIT – III:
Movement of solids in Fluids and classification: principles, types of classifiers, Gravity concentration − principles, concentration in vertical surren (Jigging), Jigs, types of Jigs viz., Harz Jig, circular and radial jigs, coal jigs (Baumb and Batac jigs). Gravity concentration in streaming currents, pinched sluice, cones, spirals, shaking tables.

UNIT –IV:
Slurry transport of materials: composition of slurry, online instrumentation for mass flow measurement, pumping equipment and piping for slurry transport. Heavy medial separation: principles, liquids and suspension for heavy media separation, separation vessels. Gravitational vessels, Wemco separator, drum separator, centrifugal separators, DMS cyclone, Vorsyl separator, LARCODEMS, Dyna whirlpool separator; DMS circuits.

UNIT – V:
Flotation – History and theory: contact angle, work of adhesion; Floatation Reagents: collectors, frothers, regulators; and their action – Floatation practice: ore and pulp preparation, reagents and conditioning.
Machines: pneumatic (Davcra cell, flotation column, Jameson cell, froth separators) and mechanical (Denver cell, Wemco cell). Electro flotation, skin flotation and table flotation.

Text Books:
1. B. A. Wills "Mineral Processing Technology" Maxwell International, 8th Ed., 1987.(Copyrights 2015).
2. S. K. Jain "Ore Processing" Oxford and IBH Publishing Co. (P) Ltd.,1st Ed., India, 1986.

Suggested Reading:
1. Warren L. McCabe, Julian C. Smith, Peter Harriott, "Unit Operations of Chemical Engineering" McGraw Hill Chemical Engineering Series, 7th Ed., 2005.
2. Maurice C. Fuerstenau, "Principles of Mineral Processing "Published by SME, 3rd Ed., 2003.
3. Robert Hallowell Richards, "A Textbook of Ore Dressing " MGH.3rd Ed., reprint 2015.

CH 464

POLYMER TECHNOLOGY
(Elective II)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course enables the students to understand the
1. different types and properties of polymers
2. various polymerization mechanisms
3. significance of polymer blends and their applications
4. techniques for polymerization
5. basics of polymer composites.

Course Outcomes: At the end of the course, students will be able to
1. identify polymers of industrial significance based on their properties.
2. distinguish various techniques for polymerization.
3. select polymer materials for industrial applications.
4. prefer polymer blends and alloys based on techno-economical consideration.
5. differentiate between different polymer composites based on their structural properties.
6. identify the importance of polymer nano-composites.

UNIT −I INTRODUCTION:
Polymers − definition, bonding, functionality, molecular weights and classification. Significant properties and applications of polymeric materials in process industries. Transition in polymers. Selection of Polymers for high and low temperature applications for process industries. Growth of polymer industry in India. Thermodynamics of polymer solutions, solubility parameter and its determination − Flory Huggins theory.

UNIT− II POLYMERIZATION MECHANISM:
Kinetics of polymerization mechanism. Types of polymerization − chain-polymerization, free radical, Step polymerization, anionic & cationic co-ordination polymerization, Poly-condensation.
Mechanism of ring opening, poly-addition and condensation polymerization.

UNIT −III POLYMER BLENDS:
Polymer blends and alloys, definition, reasons for blending, types of blends. Compatibilization, methods of blending, Techno-economical consideration for blending. Polymer rheology, recent applications of polymers, Electro-active polymers and biomedical applications.

UNIT− IV POLYMERIZATION TECHNIQUES:
Manufacture of polymers, different techniques practised, merits and demerits along with examples.
Bulk Polymerization – PET and PBT manufacture. Solution polymerization – Polypropylene manufacture. Suspension polymerization − PS and PMMA. Emulsion polymerization − SBR;
Processing of polymers − Compounding, moulding − Injection, rotational, compression, Extrusion, blow moulding.

UNIT −V POLYMER COMPOSITES:
Introduction, constituent materials, applications, polymers matrices. Polymer resins − epoxy, vinyl ester, silicone. Structural aspects influencing properties − Intermolecular and Intra molecular structures.
Manufacturing techniques of polymer composite materials − hand layup process, bag moulding process, filament winding, pultrusion. Introduction to polymer nano-composites.

Text Books:
1. P . Ghosh, " Polymer Science & Technology", TMH Publishing, New Delhi, 2002.
2. B.T. Astron, " Manufacturing of Polymer Composites", Chapman & Hall, 1997

Suggested Reading
1. Vasant R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar, "Polymer Science", New Age International, 1986.
2. Harry R. Allcock & Frederick W Lampe & James E. Mark, " Contemporary Polymer Chemistry", Prentice Hall, New Jersey, 2003.
3. L.A. Utraclci, "Polymer Blends & Alloys", Hanser Publishers, 1988
4. J.R. Fried, " Polymer Science & Technology", Prentice Hall Publications, 1999.

CH 465

PULP AND PAPER TECHNOLOGY
(Elective II)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 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. Varios types of cooking and bleaching methodologies.
4. Recovery of energy and chemicals used in pulping processes with due techno-economic and environmental considerations.

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.
6. identify, formulate and solve design problems pertaining to pulp digesters.

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 Reading:

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.

CH 416

EQUIPMENT DESIGN AND DRAWING

Instruction	3L Periods per week
Duration of University Examination	3 Hours
University Examination	50Marks
Sessionals	25 Marks
Credits	2

LIST OF EXERCISES

1. Symbols for Piping and Instrumentation.
2. Flowsheet 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 flowsheets.
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.

Suggested Reading:

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.

CH 417

MASS TRANSFER OPERATION LABORATORY

Instruction	3L Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

LIST OF EXPERIMENTS
(Minimum of 8 experiments to be performed)

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 (H2SO4 - 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 Reynolds's number.
12. Developing the drying curve by using tray drier and estimation and composition of time required for drying the given solid.

Suggested Reading:

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.

CH 418

PROJECT SEMINAR

Instruction	3L Periods per week
Sessionals	25 Marks
Credits	1

The objective of the project seminar is to actively involve the student in the initial work required to undertake the final year project. Dealing with a real time problem should be the focus of the under graduate project.

It may comprise of

- Problem definition and specifications.
- A broad understanding of the available techniques to solve a problem of interest.
- Presentation (Oral & written) of the project.

The department should appoint a project coordinator who will coordinate the following.

- Grouping of students as project batch(a maximum of 3 in group)
- Allotment of projects and project guides
- Project monitoring at regular intervals.

Each project group/batch is required to

1. Submit a one page synopsis of the seminar to be delivered for display on notice board.
2. Give a 30-40 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write up on the talk delivered.

Three (3) teachers will be associated with the evaluation of the project seminar for the award of the sessional marks which should be on the basis of performance on all the three items stated above.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
SCHEME OF INSTRUCTION AND EXAMINATION
B.Tech – IV YEAR
CHEMICAL ENGINEERING

SEMESTER - I

S.No	Syllabus ref. no.	Subject	Scheme of Instruction			Scheme of Examination			
			Periods per week			Duration in Hours	Maximum Marks		Credits
			L	T	P/D		End exam	Sessionals	
THEORY									
1.	CH 411	Chemical Process Safety	4	0	0	3	75	25	3
2.	CH 412	Mass Transfer Operations -II	4	0	0	3	75	25	3
3.	CH 413	Petrochemical Engineering	4	0	0	3	75	25	3
4.	MB 216	Principles and Practice of Management	4	0	0	3	75	25	3
5.	CH 414	Process Equipment Design	4	0	0	3	75	25	3
6.		**Elective – II**	4	0	0	3	75	25	3
PRACTICALS									
7.	CH 415	Equipment Design and Drawing	0	0	3	3	50	25	2
8.	CH 416	Mass Transfer Operations Laboratory	0	0	3	3	50	25	2
9.	CH 417	Project Seminar	0	0	3	–	–	25	1
Grand Total (Theory + Practicals)			**24**	**0**	**9**	–	**550**	**225**	**23**

L: Lecture, T: Tutorial, D: Drawing, P: Practical

S.No	Syllabus ref. no.	**Elective – II**
6.	CH 461	Fertilizer Technology
7.	CH 462	Membrane Separation Processes
8.	CH 463	Mineral Processing Technology
9.	CH 464	Polymer Technology
10.	CH 465	Pulp and Paper Technology

SEMESTER – II

S.No	Syllabus ref. no.	Subject	Scheme of Instruction			Scheme of Examination			
			Periods per week			Duration in Hours	Maximum Marks		Credits
			L	T	P/D		End exam	Sessionals	
THEORY									
7.	CH 421	Plant Design and Economics	4	0	0	3	75	25	3
8.	CH 422	Transport Phenomena	4	0	0	3	75	25	3
9.		**Elective – III**	4	0	0	3	75	25	3
10.		**Elective – IV [Open Electives]**	4	0	0	3	75	25	3
PRACTICALS									
11.	CH 423	Seminar	0	0	3	–	–	25	1
12.	CH 901	Project	0	0	6	Viva	100	50	9
Grand Total (Theory + Practicals)			**16**	**0**	**9**	–	**400**	**175**	**22**

L: Lecture, T: Tutorial, D: Drawing, P: Practical

S.No	Syllabus ref. no.	**Elective – III**	S.No	Syllabus ref. no.	**Elective – IV**
5.	CH 471	Corrosion Engineering	5.	CE 422	Disaster Mitigation and Management
6.	CH 472	Fluidization Engineering	6.	ME 464	Entrepreneurship
7.	CH 473	Pollution Control in Process Industries	7.	PE 484	Nano Materials and Technology
8.	CH 474	Sugar Technology	8.	CH 481	Nuclear Engineering

CH 421

PLANT DESIGN AND ECONOMICS

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course objectives: This course helps the students to understand the:

1. fundamentals of investments and engineering economics.
2. flowsheet 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.

Course outcomes: After completion of the course student should 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. calculate the Rate of return and payout time for design of any process plant.
4. evaluate the profitability of process industry projects using measures such as ROI, NPV and DCF
5. identity and apply the selection criteria for design of flowsheets, equipment and material.
6. 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 Reading:

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.

CH 422

TRANSPORT PHENOMENA

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: Introduces the students to

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

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
6. Time smooth equations of change.

UNIT – I

Introduction – Mechanism of molecular transport of momentum, heat and Mass Transfer. Flux equations – Newton's, Fouriers' 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. Creeping flow around sphere

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 in curvilinear coordinates, 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, 1960
2. R.B.Bird, W.E.Stewart, and E.N.Lightfoot , "Transport Phenomena", John Wiley & Sons. Inc. 2002

Suggested Reading:

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

CH 471

CORROSION ENGINEERING
(ELECTIVE − III)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course helps the students to understand the:

1. definition and classification of corrosion.
2. principles of corrosion, common corrosion forms,
3. different corrosion testing methods.
4. corrosion control methods and material selection for cost reduction.
5. modern theories to explain corrosion

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

1. identity the type of corrosion.
2. correlate the damage with the cause of corrosion.
3. identify the correct method of testing any corrosion.
4. select the appropriate preventive method to avoid corrosion.
5. select the significant coating for corrosion prevention.
6. apply modern method of corrosion measurement.

UNIT− I: Introduction:
Definition, corrosion environments, damage, classification of corrosion. Principles and corrosion rate expressions. Environmental effects such as velocity, temperature, galvanic coupling. Metallurgical and other aspects

UNIT− II: Different forms of corrosion:
Uniform attack, galvanic corrosion, crevice corrosion, fitting corrosion, inter– granular corrosion, selective leaching, erosion corrosion, stress corrosion and hydrogen damage.
Pitting: pit shape and growth, velocity, metallurgical variables, evaluation of pitting damage, prevention.

UNIT− III: Corrosion testing methods:
Classification, purpose, surface preparation, measuring and weighing, duration, plant interval test, NACE test methods, slow – strain rate test and paint test.
Composites testing: Exposure techniques, Huey test, Sea water test, Stress corrosion, Corrosion of palstics, Invivo corrosion.

UNIT −IV: Corrosion prevention methods:
Selection of metals and alloys–Cast iron, steel, Al, Mg, Ti, Composites and Refractory metals.
Non-metallics: Thermosetters, laminates and reinforced plastics, Rubbers, Wood, Ceramics, Carbon and Graphite. Alteration of environment such as changing mediums, lowering temperature, design rules, design of cathodic and anodic protection, selected coating techniques to prevent corrosion; Failure analysis. High temperature corrosion.

UNIT −V: Advanced techniques:
Modern theory–principles and applications, electrode kinetics, predicting corrosion behavior, corrosion prevention, Corrosion rate measurements in Petroleum Industry with examples.

Text Books:

1. Pierre R. Roberge, " Handbook of Corrosion Engineering", 2nd edition, MCGraw-Hill, Newyork, 2012
2. Zaki Ahmad, "Principles of Corrosion Engineering and Corrosion Control", Butterworth-Heinemann, 2006.

Suggested Reading

1. Pierre R Roberge, "Corrosion Engineering – Principles and Practice, MCGraw-Hill, 2008
2. Pierre R. Roberge, Corrosion Basics: An Introduction, NACE International, 2006.

Web resources :

1. www.academia.edu/5491377/corrosion_engineering_mars_g._fontana

CH 472

FLUIDIZATION ENGINEERING
(ELECTIVE − III)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credit	3

Course Objectives: This course helps the students to understand:

1. Basic fundamentals of fluidization and fluidized bed behavior.
2. Minimum fluidization and pressure drop across the bed.
3. Various models to analyze the behavior and mixing patterns.
4. Heat and mass transfer aspects of fluidized bed.
5. Concepts of fluidized bed combustion chamber.

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

1. Calculate the minimum fluidization velocity and optimum operating fluidization velocity.
2. Design the cooling tube length for required heat transfer area.
3. Design the complete fluidized bed in terms of pressure drop across the bed a
4. Design the distributors, TDH, height, diameter, power consumption of compressor for air.
5. Distinguish between boiler and furnaces, methods of starting up.
6. Calculate the amount of chemicals required to control the emission like SO2.

UNIT – I INTRODUCTION:

Processes involving contact between solid particles and a Fluid, Packed Beds, Fluidized Beds advantages and disadvantages of fluidized beds for industrial applications. Fundamental fluidized bed behavior, Fast fluidization, circulating fluidized beds.

Particles and Fluidization: Physical properties of solid particles, size and sharp, size range, surface area of particles in a bed, Bed voidage, classification of particles according to Fluidization characteristics, pressure drop across packed beds, minimum fluidization velocity and its determination.

UNIT – II TWO – PHASE THEORY OF FLUIDIZATION:

Bubbles and Fluidization Regimes, Bubble rise velocity, Bed expansion, Bubble growth and slugging, Mixing, Elutriation and Transport of solids, General mechanism of mixing of particles, mixing and segregation of particles, Terminal velocity of particles, Elutriation, transport disengaging height, solids transport. Davidson's Model, Diffusion model, Bubbling bed model ideal mixing stage model, two regime models.

UNIT – III FLUIDIZED BED HEAT TRANSFER:

Heat Transfer in Beds of Particles, Gas -to- particle heat transfer, Bed – to- surface heat transfer, particle convection component, interphase gas connective component, Radioactive component, Estimation of Bed–to surface Heat Transfer coefficient, Heat Transfer between the Bed-Distributor, side walls, immersed tubes or components, Heat Transfer to surfaces located above the Bed, Free surface, Design for physical operation, Batch and continuous operation for Mass & Heat Transfer and Drying of solids.

UNIT IV DESIGN OF SIMPLE FLUIDIZED BEDS:

Introduction, Estimation of Bed Dimensions and Fluidizing velocity, Transport disengaging Height, Distributors, Heat removal from fluidized beds from cooling tubes in the bed, optimum size of a fluidized bed reactor. Power consumption.

UNIT – V FLUIDIZED BED COMBUSTION:

Introduction, combustion systems for solid fuels combustors and the first law of thermodynamics, fluidized Bed combustion of solid fuels, pressurized fluidized bed combustion, size of fluidized bed combustion system, size of inert particles in the bed, turndown efficiency of fluidized bed combustion, Equipment, combustion of fuel particles in a fluidized bed, Distinguish between boiler and furnaces, methods of starting up, circulating or 'fast' fluidized bed combustion systems, control of emission of SO2.

Text Books:

1. J.R. Howard Adam Hilger, "Fluidized Bed Technology -Principles & Applications", IOP, Pub Ltd., NY. 1989.

Suggested Reading

1. Diazo Kuni & Octave Levenspiel, " Fluidization Engineering", 2nd Edition, John Wiley and Sons, 2002.
2. John M. Matsen, Grace John R , "Fluidization", Springer-Verlag New York Inc., 1980.

CH 473

POLLUTION CONTROL IN PROCESS INDUSTRIES
(ELECTIVE − III)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course objectives: This course helps the students to understand:

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. the essential principles and equipment used in industrial pollution abatement

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. analyze the effect of climate changes, atmospheric dispersion of air pollutants, and operating principles.
3. design and calculate the required particulate control devices.
4. quantify and analyze industrial wastewater and its treatment.
5. identify appropriate unit operations & unit processes for conversion of polluted water to bearable standard limits.
6. 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 Solid waste management:

Industrial solid wastes − Types, classification, properties, management and general disposal methods. Hazardous industrial solid wastes – environmental effects and disposal methods commonly practiced.

Methods practiced in chemical, 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 Reading

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.

CH 474

SUGAR TECHNOLOGY
(ELECTIVE – III)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course helps the students to understand:
1. the performance measures of different types of unit operations in sugar processing
2. applications, advantages and limitations of the processing procedure
3. the competence and optimization of advanced technology in sugar processing.
4. the possible byproducts of any sugar industry and production of salable derivatives.

Course Outcomes: At the end of the course, student will be able to apply the
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.
6. methods to reclaim byproducts.

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 Reading:

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.

CE 422

DISASTER MITIGATION AND MANAGEMENT
(ELECTIVE – IV)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts.
2. To impart knowledge in students about the nature, mechanism causes, consequences and mitigation measures of the various natural disasters including hydro metrological and geological based disasters.
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters including chemical, biological and nuclear warfare agents.
4. To equip the students with the knowledge of various chronological phases in the disaster management cycle.
5. To create awareness about the disaster management framework and legislations in the context of national and global conventions.
6. To enable students to understand the applications of geospatial technologies like remote sensing and geographical information systems in disaster management.

Course Outcomes:

1. Ability to analyse and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at local level
2. Ability to 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 natural and human induced disasters for the participatory role of engineers in disaster management.
4. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans
5. Ability to understand various participatory approaches/strategies and their application in disaster management
6. Ability to understand the concepts of remote sensing and geographical information systems for their effective application in disaster management.

UNIT-I:

Introduction to Natural, human induced and human made disasters – Meaning, nature, types and effects; International decade of natural disaster reduction (IDNDR); International strategy of natural disaster reduction (ISDR)

UNIT-II:

Natural Disasters– Hydro meteorological disasters: Causes, impacts, Early warning systems, structural and non-structural measures for floods, drought and cyclones; Tropical cyclones: Overview, cyclogenesis, drought monitoring and management.; Geographical based disasters: Earthquakes and Tsunami- Overview, causes, impacts, zoning, structural and non-structural mitigation measures; Tsunami generation; Landslides and avalanches: Overview, causes, impacts, zoning and mitigation measures. Case studies related to various hydro meteorological and geographical based disasters.

UNIT III:

Human induced hazards: Risks and control measures in a chemical industry**,** Causes, impacts and mitigation measures for chemical accidents, chemical disaster management, current status and perspectives; 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 and traffic accidents .

UNIT IV:

Use of remote sensing and GIS in disaster mitigation and management; Scope of application of ICST (Information, communication and space technologies in disaster management, Critical applications& Infrastructure; Potential application of Remote sensing and GIS in disaster management and in various disastrous conditions like earthquakes, drought, Floods, landslides etc.

UNIT V:

Concept of Disaster Management: Introduction to disaster management, Relationship between Risk, vulnerability and a disaster, Disaster management cycle, Principles of disaster mitigation: Hazard identification and vulnerability analysis, Early warning systems and forecasting; Infrastructure and development in disaster management; Disaster management in India: National disaster management framework at central, state, district and local levels. Community based disaster management.

Text Books:

1. Rajib, S and Krishna Murthy, R.R, "Disaster Management Global Challenges and Local Solutions" Univ. Press Hyd., 2012.
2. Notes / Reading material published by National Disaster Management Institute, Ministry of Home Affairs, Govt. of India.

Suggested Reading:

1. Navele, P & Raja, "C.K. Earth and Atmospheric Disasters Management, Natural and Manmade". B.S. Pub., Hyd., 2009.
2. Fearn-Banks, K, "Crises computations approach: A case book approach", Route ledge Pub., Indian Edu., New York 2011.
3. Battacharya, T., "Disaster Science and Management", Tata McGraw Hill Company, New Delhi, 2012.

ME 464

ENTREPRENEURSHIP
(ELECTIVE – IV)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To understand the essence of Entrepreneurship
2. To know the environment of industry and related opportunities and challenges
3. To know the concept a procedure of idea generation
4. To understand the elements of business plan and its procedure
5. To understand project management and its techniques
6. To know behavioral issues and Time management

Outcomes: After completing this course, students will be able to:

1. Apply the entrepreneurial process
2. Analyze the feasibility of a new business plan and preparation of Business plan
3. Evaluate entrepreneurial tendency and attitude
4. Brainstorm ideas for new and innovative products or services
5. Use project management techniques like PERT and CPM
6. 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 Reading:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 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.

PE 484

NANO MATERIALS AND TECHNOLOGY
(ELECTIVE – IV)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Students are able to understand the nanotechnology approach and challenges
2. To give the student familiarities about materials of nanotechnology
3. Students are able to understand the nano structurers
4. Students are able to learn nano fabrication
5. Students are able to understand special nano materials
6. Students are able to understand bio materials

Outcomes: At the end of the course

1. Understand the developments and challenges in nano technology
2. Understand synthesis and properties of nanostructured materials
3. Analyze magnetic and electronic properties of nano materials
4. Analyze nano fabrication methods and their applications
5. Understand the characterization of nano and bio materials and their use
6. Analyze the synthesis and characterization of nano wires and tubes

Unit I

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

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, FFM

Unit III

Nano Structures: Zero dimensional Nanostructure (Nano particles), synthesis procedure, characterization techniques, properties and applications of Nano particles

One dimensional Nanostructures (Nano Wires, Nano Tubes), various Synthesis procedure, characterization procedure and principles involved, properties and applications of Nano Wires, Types of Nano Tubes, Synthesis procedure, characterization properties and applications of Nano Tubes

Unit IV

Nano Fabrication: Introduction, Basic fabrication techniques (Lithography, thin film deposition, and doping), MEMS fabrication techniques, Nano fabrication techniques (E-beam Nano-imprint fabrication, Epitaxy and strain engineering, Scanned probe techniques).

Unit V

Special Nano Materials: Nano Composites: Introduction, Synthesis procedures, various systems (metal-polymer, metal-ceramics and Polymer-ceramics), Characterization procedures, applications, Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, principles involved, applications

Text Books:

1. A.K. Banopadyay, 'Nano Materials', New Age Publications
2. T. Pradeep, 'Textbook of Nanoscience and Nanotechnology', McGraw Hill Edu. (India) Pvt Ltd., New Delhi
3. Dieter Vollath, Nanomaterials: An Introduction to Synthesis, Properties and Applications,Wiley, 2013

Suggested Reading:

1. Carl C. Koch, 'Nano Materials Synthesis, Properties and Applications', Jaico Publishing House
2. Willia Tllsey Atkinson, 'Nano Technology', Jaico Publishing House
3. George W. Hanson, 'Fundamentals of Nanoelectronics', Pearson Education, 2009
4. T. Pradeep, 'Nano: Essentials-understanding Nano Science and Technonology', TMH, 2007
5. Sabu Thomas, Nandakumar Kalarikkal, A. Manuel Stephan, B. Raneesh, "Advanced Nanomaterials: Synthesis, Properties, and Applications", Apple Academic Press

CH 481

NUCLEAR ENGINEERING
(ELECTIVE − IV)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course helps the students to understand:

1. fundamentals of nuclear fission reactions and products.
2. types of nuclear fuel materials, properties, characteristics.
3. nuclear fuel separation and enrichment methods along with flowsheets.
4. non-fuel materials required for design of the reactor structure, cladding and for moderation.
5. different types of reactors, concepts of heat removal, control and safety systems.
6. spent fuel management.

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

1. identify the various radioactive elements based on the mechanism of fission process.
2. processing and handling techniques for enrichment of fuel materials.
3. properties and radiation effects of materials for design of cladding structure.
4. concepts of fuel source, heat removal, control and safety needs for operation of nuclear reactors .
5. design and working of fast breeder reactors.
6. techniques practiced for handling, storage and reprocessing of spent fuel.

UNIT – I: Nuclear fission

Atomic structure and isotopes of radioactive material, nuclear elements, nuclear binding energy, radioactive nuclides and nuclear stability, radioactivity, radioactive decay - alpha decay, beta decay, gamma rays.

Neutron reactions, fission cross-sections, fission rate and reactor power, prompt and delayed fission neutrons, fission products.

UNIT – II: Nuclear fuel materials

Types of fuel materials, properties and significant characteristics, fuel cycle, pre-reactor fuel operations, isotopic enrichment, isotopic separation requirements. Nuclear fuel utilization – breeding ratio, Uranium, Thorium and Plutonium utilization.

UNIT – III: **Non-fuel reactor materials**

Classification, mechanical properties, radiation effects of materials, corrosion of metals, structural and cladding materials, moderator and reflector materials.

UNIT – IV: Nuclear fission reactors

General features, classification, reactor development for power production. Design features, concepts of heat removal, control and safety systems for: pressurized water reactors (PWR), boiling water reactors (BWR). Heavy water moderated reactors (HWMR) and Fast breeder reactors (FBR).

UNIT – V: Spent fuel management

Characteristics of spent fuel, storage, disposal, reprocessing of spent fuel, solvent extraction separation process, other possible separation processes.

Text Books:

1. Samuel Glasstone and Alexander Sesonske, "Nuclear Reactor Engineering", 3rd Ed, CBS Publishers and distributors, New Delhi, 1986.

Suggested reading:

1. Benjamin M. MA, "Nuclear reactor materials and applications", Van Nostrand Reinhold Co., New York, 1975.
2. John R. Lamarsh, "Introduction to Nuclear Engineering", Addison-Wesley publishing Co., Philippines, 1975.
3. Raymond L. Murray, "Nuclear Energy", Pergamon Press, New York, 1975.

CH 423

SEMINAR

Instruction	3L Periods per week
Sessionals	25 Marks
Credits	**1**

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of 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. Students are to be exposed to following aspects of seminar presentations.

- Literature survey
- Consolidation of available information
- Power point Preparation
- Technical writing

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Give twenty(20) minutes presentation through OHP/ PPT/ Slide Projector followed by Ten(10) minutes discussion
3. Submit a report on the seminar topic with list of references and hard copy of the slides.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule should 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 should be from any peer reviewed recent journal publications.

CH 901

PROJECT

Instruction	6L Periods per week
University Examination	Viva-voce
University Examination	100 Marks
Sessionals	50 Marks
Credits	9

Dealing with a real time problem should be the focus of under graduate project.

All projects will be monitored at least four times in the II-semester through individual presentations (Project batch wise).

Every student should maintain a project dairy, wherein he/she needs to record the progress of his/her work and get it signed at least once in a week by the guide(s). If working outside and college campus, both the external and internal guides should sign the same.

Sessional marks should be based on the marks, awarded by a project monitoring committee of faculty members as well as the marks given by the guide.

Common norms are established for final documentation of the project report, the students are directed to download from the website regarding the guidelines for preparing the project report and the project report format.

The project report shall be evaluated for 100 Marks by the External Examiner.

If the project work found inadequate in the end examination, the candidate should repeat the project work with a new problem or improve the quality of work and report it again.

Break up for 100 Marks in the end examination:

1. Power point presentation 20 Marks
2. Thesis/Report preparation 40 Marks
3. Viva-voce 40 Marks