



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE

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School of Bio and Chemical Engineering

Department of Chemical Engineering

1.1.3 Courses having focus on Employability / Entrepreneurship / Skill Development

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Employability



Entrepreneurship



Skill Development

SCHA1101	PRINCIPLES OF CHEMICAL ENGINEERING	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To introduce and provide an overview of chemical engineering.
- To enable the students to learn about the fluid flow, heat transfer and mass transfer in engineering applications.

UNIT 1: CHEMISTRY, CHEMICAL ENGINEERING AND CHEMICAL TECHNOLOGY**9 Hours**

Chemical process industries: History and their role in Society; Role of Chemical Engineer; History and Personalities of Chemical Engineering; Greatest achievements of Chemical Engineering, **Challenges in Petroleum sector.**

UNIT 2: COMPONENTS OF CHEMICAL ENGINEERING**9 Hours**

Role of importance of Basic sciences in chemical engineering. Batch Processing, **Safety issues in Scale up to Commercial scale.** Dimensionless Analysis: Dimensionless numbers. Application of Dimensional Analysis to a Reactor.

UNIT 3: CONCEPT OF UNIT PROCESSES AND UNIT OPERATIONS**9 Hours**

Description of different Unit Processes and Unit Operations; **Designing of equipment; Flowsheet representation of process plants,** Evolution of an Industry – Sulphuric acid and Soda ash manufacture. Demonstration of simple chemical engineering experiments; Plant visit to a chemical industry

UNIT 4: ROLE OF COMPUTER IN CHEMICAL ENGINEERING**9 Hours**

Chemical Engineering Software; Visit to Process Simulation Lab; Relation between Chemical Engineering and other engineering disciplines; Traditional vs. modern Chemical Engineering; Versatility of Chemical Engineering; Role of Chemical Engineers in the area of Food, Medical, Energy, Environmental, Biochemical, Electronics etc.

UNIT 5: SAFETY ENVIRONMENT AND ETHICS FOR CHEMICAL ENGINEERS**9 Hours**

Paradigm shifts in Chemical Engineering; Range of scales in Chemical Engineering; **Opportunities for Chemical Engineers; Future of Chemical Engineering. Safety in Chemical Process Industries,** Hazards – Case studies.

Max.45 Hours**COURSE OUTCOMES:**

- CO1. Understand the history and development of chemical industry since origin
- CO2. Examine the role and functions of chemical engineers in the engineering industry and to know the basics of interdisciplinary engineering fields.
- CO3. Analyze the relation between various unit operations and unit processes and to develop the process flow diagram.
- CO4. Justify the role of computers in the application of chemical engineering fields
- CO5. Identify the hazards and safety ethics in process industries
- CO6. Evaluate the challenges for the chemical engineers in future

TEXT / REFERENCE BOOKS

1. Anantharaman N., MeeraSheriffa Begum K. M., Mass Transfer Theory and Practice, 1st Edition, PHI, 2011.
2. Dryden, C.E., "Outlines of Chemicals Technology", Edited and Revised by Gopala Rao, M. and M.Sittig, 3rd Edition, Affiliated East-West press, 2000.
3. McCabe, W.L., Smith, J. C. and Harriot, P. "Unit operations in Chemical Engineering", McGraw Hill, 7th Edition, 2001
4. Finlayson, B. A., Introduction to Chemical Engineering Computing, John Wiley & Sons, New Jersey, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Examination duration: 3 Hours

Part A: 10 questions of 2 marks each - No choice

20 Marks

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

80 Marks

SCSA1102	FUNDAMENTALS OF PYTHON PROGRAMMING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

1. To understand why Python is a useful scripting language for developers.
2. To learn how to use lists, tuples, and dictionaries in Python programs.
3. To learn how to build and package Python modules for reusability.
4. To learn how to read and write files in Python.
5. To learn how to use exception handling in Python applications for error handling.
6. To learn how to design and program Python applications.

UNIT 1 INTRODUCTION

9Hrs

History of Python- Introduction to the IDLE interpreter (shell)- Expressions- Data Types- Built-in function- Conditional statements- Iterative statements- Input/output- Compound Data Types- Nested compound statements- Introduction to Object Oriented Concepts.

UNIT 2 FILES AND EXCEPTIONS HANDLING , MODULES, PACKAGES

9Hrs

File Operations- Iterators- Exception handling- Regular Expressions- Creating Modules- Import Statement- Introduction to PIP- Installing Packages via PIP- Using Python Packages

UNIT 3 GUI PROGRAMMING

9Hrs

GUI Programming in Python- Introduction to GUI library- Layout management- Events and bindings- Fonts- Colours- Canvas- Widgets (frame, label, button, checkbox, entry, listbox, message, radiobutton, text, spinbox).

UNIT 4 DATABASE AND NETWORK

9Hrs

Database (using NoSQL): Connector Module- Cursor- Statements- Exceptions in database. Network connectivity: Socket module- Client- Server- Email- URL Access

UNIT 5 CASE STUDY

9Hrs

Web Programming using Python. Image Processing- Facebook Analysis- Twitter Analysis.

COURSE OUTCOMES On completion of the course the student will be able to

- CO1- Describe primary goals of basic python using data, expression, statements and Apply the best features of mathematics, engineering and natural science to program real life problems using math functions, Regular expression.
- CO2- Design GUI Application in Python and to apply different database operations.
- CO3 -Evaluate information and choose appropriate action using Decision making or Control Structures in python
- CO4 -Understand and Develop Client Server Network Application using Python
- CO5 - Illustrate string and compound data using the List, Tuples and Dictionaries in Python
- CO6 -Create real world problems with creative thinking and solution of the with cost effectiveness.

Text Books/Reference Books

1. Y. Daniel Liang, Introduction to Programming Using Python, Pearson, 2013.
2. Paul Gries, Jennifer Campbell, Jason Montojo, Practical Programming:
3. An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014
4. Magnus Lie Hetland, Beginning Python: From Novice to Professional, Apress

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Examination duration: 3 Hours

 Employability

 Entrepreneurship

 Skill Development

Part A: 10 questions of 2 marks each - No choice

20 Marks

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

80 Marks

SBTA1101	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C	Max. Marks
		0	0	0	0	100

COURSE OBJECTIVE:

- To impart knowledge on the issues related to environment and to emphasize the importance of a clean environment.

UNIT 1: INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES**9 Hours**

Definition, scope and importance, need for public awareness, forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams, floods, drought, conflicts over water, dams-benefits and problems, mineral resources: use effects on forests and tribal people. water resources: use and over-utilization of surface and ground water, exploitation, environmental effects of extracting and using mineral resources, **case studies – food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems**, water logging, salinity, case studies. **Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources: Case studies.** Land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification, role of an individual in conservation of natural resources, equitable use of resources for sustainable lifestyles.

UNIT 2: ECOSYSTEMS AND BIODIVERSITY**9 Hours**

Concept of an ecosystem, structure and function of an ecosystem - producers, consumers and decomposers - energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Introduction to biodiversity, definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, biodiversity at global, national and local levels. India as a mega-diversity nation, hot-spots of biodiversity, threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, endangered and endemic species of India, conservation of biodiversity, in-situ and ex-situ conservation of biodiversity.

UNIT 3: ENVIRONMENTAL POLLUTION**9 Hours**

Definition - causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards. **Solid waste management: causes, effects and control measures of urban and industrial wastes, role of an individual in prevention of pollution, pollution case studies, disaster management: floods, earthquake, cyclone and landslides.**

UNIT 4: SOCIAL ISSUES AND THE ENVIRONMENT**9 Hours**

From unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, watershed management, resettlement and rehabilitation of people; its problems and concerns, case studies, environmental ethics: issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. **Wasteland reclamation, consumerism and waste products** – environment protection act: air (prevention and control of pollution) act - water (prevention and control of pollution) act, wildlife protection act; forest conservation act. Issues involved in enforcement of environmental legislation, Key initiatives of Rio declaration, Vienna convention, Kyoto protocol, Johannesburg summit and public awareness.

UNIT 5: HUMAN POPULATION AND THE ENVIRONMENT**9 Hours**

Population growth, variation among nations, population explosion, family welfare programme, environment and human health, human rights, value education, HIV / AIDS, women and child welfare, **role of information technology in environment and human health, case studies.** Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain. Visit to a local polluted site-urban/rural/ industrial/agricultural-study of common plants, insects, birds-study of simple ecosystems, pond, river, hill slopes etc.

Max.45 Hours**COURSE OUTCOMES:**

- CO1. To identify, formulate, and solve environmental engineering problems using the techniques, skills, and modern engineering tools necessary for environmental engineering practice
- CO2. To design systems, processes and equipment for control and remediation of water, air, and soil quality environment within realistic constraints of economic affordability and social acceptability
- CO3. To assess the potential environmental impacts of development projects and design mitigation measures
- CO4. To have basic knowledge about environment protection and operation of pollution control devices

CO5. To design and conduct experiments, as well as interpret data and communicate effectively

CO6. To function in multi-disciplinary teams and understand the ethical and professional responsibility

TEXT / REFERENCE BOOKS

1. Meenakshi. P, Elements of Environmental Science and Engineering, 1st Edition, Prentice Hall of India, New Delhi, 2009.
2. Ravikrishnan. A, Environmental Science & Engineering, 3rd Edition, Sri Krishna Publications, Chennai, 2008.
3. Wrigh. R. T &Nebel B.J, Environmental science-towards a sustainable future by Richard 9th edition, Prentice Hall of India, NewDelhi, 2011.
4. ErachBharucha, Text Book of Environmental Studies, 3rd Edition, University Press, Chennai, 2010.
5. Gilbert M.Masters, "Introduction to Environmental Engineering and Science, " 4th Edition, Pearson education, 2012.

SCHA1301	HEAT TRANSFER	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To provide an adequate knowledge on different modes of heat transfer and their applications in process industries.

UNIT 1: INTRODUCTION TO MODES OF HEAT TRANSFER**9 Hours**

Basic Considerations: Importance of heat transfer in Chemical Engineering operations. Modes of heat transfer. Mean temperature difference. Conduction: Concept of heat conduction. Fourier's law of heat conduction. One-dimensional steady state heat conduction equation for flat plate, hollow cylinder and hollow sphere. Heat conduction through a series of resistances. Critical thickness of insulation, Analogy between flow of heat and flow of electricity. Thermal conductivity, Conduction through liquids. Conduction through extended surfaces.

UNIT 2: CONVECTIVE HEAT TRANSFER PROCESSES**9 Hours**

Film Coefficients and their applications: Individual and overall heat transfer coefficients and relationship between them. Transient heat conduction. Convection: Concept of heat transfer by convection. Natural and forced convection. Applications of dimensional analysis for convection. Derivation of equations for forced convection under laminar, transition and turbulent conditions. Equations for natural convections. Heat transfer from condensing vapors. Heat transfer to boiling liquids. Influence of boundary layer on heat transfer.

UNIT 3: HEAT EXCHANGERS**9 Hours**

Parallel and counter flow heat exchangers. Log mean temperature difference. Single pass and multi pass heat exchangers. Plate heat exchangers. Use of correction factor charts. Heat exchanger effectiveness and its use. Number of transfer units charts for different configurations. Fouling factor and Wilson's plot. Various types of heat exchangers. Heat exchanger design. Design of condensers. Effect of non-condensable. Heat transfer equipment auxiliaries: Steam trap.

UNIT 4: RADIATION**9 Hours**

Concept of thermal radiation. Concept of black and gray bodies. Stefan-Boltzmann law. Kirchoff's law. Radiation between surfaces. Radiation from gases. Clouds of particles and luminous flames. Radiation error in temperature measurement. Radiation from shields. Radiation shape factor and relations between shape factor. Combined heat transfers by conduction and convection in radiation.

UNIT 5: EVAPORATION**9 Hours**

Introduction. Types of evaporators. Single and multiple effect evaporation. Capacity and economy of multi effect evaporators. Thermo re-compression evaporators Vapour re-compression and thermal re-compression evaporators, Effect of liquid head and boiling point elevation. Duhring's rule. Liquid characteristics. Material and energy balance in evaporators. Illustrated examples.

Max.45 Hours**COURSE OUTCOMES:**

- CO1. Understand the real time applications of solid medium heat transfer
- CO2. Develop the real time application of fluid medium heat transfer
- CO3. Calculate the overall heat transfer coefficients in designing heat exchangers
- CO4. Solve radiative problems and apply knowledge to thermal engineering problems
- CO5. Design of Evaporators
- CO6. Apply the heat transfer principles with phase change (boiling and condensation) and evaporation

TEXT / REFERENCE BOOKS

- McCabe M.L. and Smith J.C., Unit Operations in Chemical Engineering, 7th Edition, McGraw Hill, 2009.
- Donald Q. Kern, Processes Heat Transfer, 5th Edition, Tata McGraw Hill, 2001.
- McAdams W.H., Heat Transmission, 5th Edition, McGraw Hill, 2011.

4. Necati Ozisik M., Basic Heat Transfer, 4th Edition, McGraw Hill and Kogakusha, 2002.
5. Holman, J.P., Heat Transfer, 9th ed., Tata McGraw-Hill, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA1303	FLUID MECHANICS	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To impart to the student knowledge on fluid properties, fluid statics, dynamic characteristics for through pipes and porous medium, flow measurement and fluid machineries.

UNIT 1: FLUID FLOW PHENOMENA**9 Hours**

Nature of fluids-properties of fluids, incompressible and compressible, hydrostatic equilibrium. Manometers U-Tube and inclined. Potential flow, boundary layer, the velocity field, laminar flow, Newtonian and Non Newtonian fluids, Newton's law of viscosity, turbulence. Reynolds number and transition from laminar to turbulent flow, Eddy viscosity, flow in boundary layers, laminar and turbulent flow in boundary layers, boundary layer formation in straight tubes.

UNIT 2: KINEMATICS OF FLUID FLOW**9 Hours**

Streamlines and stream tubes, equation of continuity, Bernoulli equation. Flow of incompressible fluids in conduits and thin layers: friction factor, relationships between skin friction parameters, average velocity for laminar flow of Newtonian fluids, Hagen-Poiseuille equation, hydraulically smooth pipe, von Karman equation, roughness parameter, friction-factor chart, equivalent diameter. Form frictional losses in Bernoulli's equation, couette flow.

UNIT 3: FLOW PAST IMMERSED BODIES AND FLUIDIZATION**9 Hours**

Drag and drag coefficients. Drag coefficients of typical shapes, Ergun equation, terminal settling velocity, free and hindered settlings, Stokes' law, Newton's law, criterion for settling regime. Fluidization, conditions for fluidization, minimum fluidization velocity.

UNIT 4: TRANSPORTATION OF FLUIDS**9 Hours**

Introduction to pipe and tubing, joint and fittings, stuffing boxes, mechanical seals, gate valves and globe valves, plug cocks and ball valves, check valves. Classification and selection of pumps, blowers and compressors. Pumps, developed head, power requirement, suction lift and cavitation, NPSH, constructional and working principle of single-suction volute centrifugal pump, Characteristics curves of centrifugal and reciprocating pump.

UNIT 5: METERING OF FLUIDS**9 Hours**

Constructional features and working principles of Venturi meter, Orifice meter, Area meters-Rota meter, Point velocity-Pitot tube, V-element meter, Target meter-ultrasonic meters, vortex shredding meter, magnetic meters, turbine meter. Application of Bernoulli's equation to venturi and orifice meter, flow rate measurements.

Max.45 Hours**COURSE OUTCOMES:**

- CO1. Understand the fundamental aspects of fluid –flow phenomena
- CO2. Analyze the fluid kinetics
- CO3. Compute the ΔP for the flow past immersed bodies
- CO4. Determine the principle and operation of various aspects of transportation of fluids.
- CO5. Apply the concepts of metering of fluids in the selection of flow meters
- CO6. Analyze the criteria for settling regime

TEXT / REFERENCE BOOKS

- McCabe, W.L, Smith J.C and Harriot. P., Unit Operations in Chemical Engineering, 7th Edition, Mc-Graw-Hill, 2009.
- Bansal R K, Text book of Fluid Mechanics, Lakshmi Publication, 2008.
- Coulson J.M. and Richardson J.E., Chemical Engineering, Volume 1, 3rd Edition, Pergamon Press, 2000.
- White, F.M., Fluid Mechanics, 4th Edition, McGraw-Hill Inc., 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA1304	CHEMICAL PROCESS CALCULATIONS	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To perform stoichiometric calculations for chemical and non-chemical systems and to understand quantitative relationships between matter and energy involved in physiochemical processes.

UNIT 1: INTRODUCTION**12Hours**

Units and Dimensions, Basic and derived units, use of model units in calculations, Methods of expressing, compositions of mixture and solutions. Gas Calculations: Ideal and real gas laws, Gas constant, Calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT 2: : MATERIAL BALANCE WITHOUT CHEMICAL REACTION**12Hours**

Application of material balance to unit operations like distillation, evaporation, crystallization, extraction, absorption and stripping, drying, mixing.

UNIT 3: MATERIAL BALANCE WITH CHEMICAL REACTION**12Hours**

Stoichiometric principles, Limiting and excess reactant, conversion, selectivity and yield. Application of material balance to systems with recycle, bypass and purging.

UNIT 4: FUELS AND COMBUSTION**12Hours**

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gaseous fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur containing compounds.

UNIT 5: ENERGY BALANCE**12Hours**

Heat capacity of solids, liquids and gases, mean heat capacity, sensible heat and latent heat, evaluation of enthalpy, Standard heat of reaction, heat of formation, combustion, solution, mixing. Calculation of standard heat of reaction, Effect of pressure and temperature on heat of reaction - Energy balance for systems with and without chemical reaction

Max.60Hours**COURSE OUTCOMES:**

- CO1. Make the conversions for temperature, pressure, energy, concentration etc.
- CO2. Carry out material balance for various unit operations without reaction
- CO3. Perform the material balance with chemical reaction
- CO4. Calculate conversion, recycle ratio for the system involving recycling/purge/bypass streams
- CO5. Carry out energy balance for various systems with and without chemical reaction
- CO6. Analyze the fuel composition and flue gas analysis

TEXT / REFERENCE BOOKS

- Himmelblau, D.M., Basic Principles and Calculations in Chemical Engineering, 8th Edition, Prentice Hall Inc., 2012.
- K. V. Narayanan, B. Lakshmikutty, Stoichiometry and Process Calculations, 2nd Edition, Prentice Hall of India Pvt. Ltd., 2016.
- Venkataramani, V and Anantharaman.N., Process Calculations, 2nd Edition, Prentice Hall of India Pvt. Ltd., 2011.
- Bhatt, B.L., Vora, S.M., Stoichiometry, 5th Edition, Tata McGraw-Hill, 2011.
- Richard M. Felder, Ronald W. Rousseau, Elementary Principles of Chemical Processes, 3rd Edition, John Wiley & Sons, Inc. Singapore, 2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA1305	CHEMICAL PROCESS TECHNOLOGY	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE: This course helps the students to understand the various processes involved in chemical industries for the production of organic and inorganic chemicals

UNIT 1 INTRODUCTION - CHLORO ALKALI INDUSTRIES

9 hours.

Introduction - Basic principles of unit operations and unit process to common devices used in manufacturing processes like Reactors, Steam jet ejectors, Pumps, Thickeners, Dryers, Electrostatic precipitators, Condenser, Vacuum evaporator in block diagram - Standard symbols used for such devices, Process flow sheet. Manufacturing of soda ash, caustic soda and chlorine - manufacture of bleaching powder.

UNIT 2 SULPHUR, SULPHURIC ACID AND SILICATE INDUSTRIES

9 hours.

.Mining and manufacture of sulphur, recovery of sulphur from polluting gases, sulphur trioxide and sulphuric acid, hydrochloric acid, sodium sulphate, sodium thiosulphate. Manufacture of Portland cement, Manufacture of Glasses and Special glasses.

UNIT 3 INDUSTRIAL GASES AND PAINTS

9 hours.

Manufacture of Carbon dioxide, Hydrogen, Oxygen, Nitrogen, Acetylene, Water Gas, Producer Gas, Production of Natural Gas. Introduction of Paints, Pigments, Emulsions and Varnishes, Manufacture of Paints, Manufacture of White and Coloured Pigments.

UNIT 4 NATURAL PRODUCTS

9 hours.

Edible and essential oils, soaps and detergents, glycerin, pulp and paper, starch and its derivatives, Manufacturing of sugar.

UNIT 5 SYNTHETIC ORGANIC CHEMICALS

9 hours.

Methane and synthesis gas, ethylene, acetylene and propylene. Aromatic chemicals - Benzene, toluene, and xylene. Production of thermo-plastic and thermo-setting resins: polyethylene, polypropylene, and Polyvinylchloride, Polymers and their engineering applications. Polyamides and polyesters and processes for the production of natural and synthetic rubber.

Course Outcomes:

- CO1 - Demonstrate the schematic representation of various unit process and operation
- CO2 - Analyze the various methods of manufacturing process pertain to chloro-alkali industry
- CO3 - Explain the various techniques for sulfuric acid manufacturing
- CO4 - Apply the basic fundamentals in manufacturing of industrial gases and paints
- CO5 - Develop the flow sheet for the manufacturing of natural products
- CO6 - Develop the flow sheet for the production of synthetic organic chemicals

REFERENCE BOOKS:

- Gopala Rao. M. and Marshall Sittig, "Dryden's Outlines of Chemical Technology", 3rd Edn., EastWest Press, New Delhi, 2008
- George .T Austin, "Shreve's Chemical Process Industries", 8th Edn., McGraw-Hill International Editions, Singapore, 2002.
- Srikumar Koyikkal, "Chemical Process Technology and Simulation", 3rd Edn PHI Learning Ltd, 2013.
- Shukla and G.N. Pandey "Text book on Chemical Technology", 2nd Edn, Vikas publishing company, 2001

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA1402	CHEMICAL REACTION ENGINEERING - I	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To impart knowledge on the kinetics of isothermal and non-isothermal reactions for simple and multiple reactors.

UNIT 1: INTREPRETATION OF REACTOR DATA**9 Hours**

Classification of reactions, reaction rate, rate constant, order, molecularity, concentration dependent term of rate equation, temperature dependent term of rate equation, arrhenius theory, collision theory, transition state theory, kinetics of non-elementary reactions, integral and differential methods for finding order of reaction, half-life period, constant volume and variable volume reaction.

UNIT 2: DESIGN OF SINGLE IDEAL REACTORS**9 Hours**

Material balance, Energy balance, batch operation, continuous operation, semi-batch operation, ideal conditions, design of ideal batch reactor, ideal plug flow reactor, ideal mixed flow reactor, semi-batch reactor, recycle reactor.

UNIT 3: DESIGN OF MULTIPLE REACTOR SYSTEMS**9 Hours**

Mixed flow reactors in series and parallel connection, Plug flow reactors in series and parallel connection, reactors of different types in series, size comparison of reactors using performance charts.

UNIT 4: MULTIPLE REACTIONS**9 Hours**

Series reactions, parallel reactions, series-parallel reactions, qualitative discussion about product distribution in mixed flow reactor and plug flow reactor, quantitative treatment of product distribution in mixed flow reactor and plug flow reactor, overall fractional yield, instantaneous fractional yield, selectivity.

UNIT 5: NON-ISOTHERMAL REACTIONS**9 Hours**

Heat of reaction, equilibrium constants from thermodynamics, equilibrium conversion, temperature effects on chemical reaction rates, optimum temperature progression, size of reactor, design procedures for adiabatic and non-isothermal operation of batch and flow reactors, reactor stability, exothermic reactions in mixed flow reactors.

Max.45 Hours**COURSE OUTCOMES:**

The student will be able to

- CO1. Apply basic concepts of reaction kinetics
- CO2. Design performance equations for ideal reactors
- CO3. Analyze design aspects for multiple reactors
- CO4. Evaluate product distribution of multiple reactions
- CO5. Demonstrate the effect of temperature and pressure on conversion
- CO6. Develop skills to design reactors for non-isothermal operations

TEXT / REFERENCE BOOKS

- Levenspiel, O., Chemical Reaction Engineering, 3rd Edition, John Wiley & Sons, New York, 2007.
- Fogler, H.S., Elements of Chemical Reaction Engineering, 5th Edition, Prentice-Hall of India Pvt. Ltd, 2016.
- Smith, J.M. Chemical Engineering Kinetics, 3rd Edition, McGraw-Hill Book Company, New York, 2013..

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA1403	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE: To understand the flow, temperature field in engineering problems and diffusion in mass transfer operations. Students can develop a Computational Fluid Dynamics code to solve chemical engineering problems

UNIT 1: OVERVIEW OF CFD AND CONSERVATION LAWS

9 hours

Role of CFD, Problem solving in CFD, Components of CFD Software, Governing Equations of Fluid flow and Heat Transfer, Mass conservation, Momentum and Energy equation, Differential and Integral forms, Conservation and non-conservation form.

UNIT 2: TURBULENCE AND ITS MODELLING

9 hours

Transition from Laminar to Turbulent flow, Effect of turbulence on time-averaged Navier-Stokes equations, Characteristics of simple turbulent flows, Free turbulent flows, Flat plate boundary layer and pipe flow, Turbulence models, Mixing length model, Reynolds stress equation models.

UNIT 3: FINITE VOLUME METHOD

9 hours

Introduction, One dimensional steady state diffusion, Two-dimensional diffusion problems, Discretised equations for diffusion problems, One-dimensional unsteady state heat conduction, Discretisation of transient convection-diffusion equation, Solution procedures for unsteady flow calculations, Implementation of Inlet, outlet and wall boundary conditions, Constant pressure boundary condition.

UNIT 4: CFD METHODS

9 hours

CFD Methods for the Euler Equation- Linearization and Jacobian Matrix, Eigen values and Eigenvectors, Flux Splitting Methods. CFD Methods For Navier-Stokes Equations-Beam Warming Algorithm, Mac Cormack's scheme, Upwind Techniques.

UNIT 5: GRID GENERATION

9 hours

Structured Grid generation, Unstructured Grid generation, Adaptive Grid generation, Physical aspects, simple and multiple connected regions, grid generation by PDE solution.

Max.45 hours

Course Outcomes:

- CO1 Understand the basic concept of CFD and conservation laws in chemical engineering.
- CO2 Ability to develop model for a given fluid flow system.
- CO3 Experiment with finite volume techniques for fluid flow and heat transfer models.
- CO4 Analyze finite difference method for mass transfer problems.
- CO5 Evaluate computational fluid flow problems using finite volume techniques.
- CO6 Solve and Get familiarized to develop grid generation and analysis of complex fluid-flow systems.

TEXT / REFERENCE BOOKS:

- Anderson, J. D., Computational Fluid Dynamics: The Basics with Applications, 2nd Edition, McGrawHill International Editions, 2012.
- Fletcher, C. A. J., Computational Techniques for Fluid Dynamics, 3rd Edition Springer Verlag, 2001.
- Versteeg, H.K. and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2nd Edition, Pearson Education Ltd., 2007.
- Chung T. J., Computational Fluid Dynamics, 2nd Edition, 2nd Edition Cambridge University Press, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Examination duration: 3 Hours

Part A: 10 questions of 2 marks each - No choice

20 Marks

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

80 Marks

SCHA1501	MASS TRANSFER – II	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To study LLE, principles of adsorption and concept of separation.

UNIT 1: DISTILLATION**9 Hours**

Vapor liquid equilibria, Raoult's law and deviations from ideality, Methods of distillation - Batch, Continuous, Flash, Vacuum, Azeotropic, Extractive and Molecular distillation. Design method - McCabe Thiele method, PonchonSavarit method, Fenske equation, Introduction to multi-component distillation.

UNIT 2: ABSORPTION**9 Hours**

Equilibrium and operating line concept in absorption calculations, Calculation of NTU, HTU, Number of stages, Packed and plate type absorbers. Absorption with chemical reaction, HETP Operating characteristics of stage wise and differential contactors. Absorption equipment – Packed and Plate towers, Centrifugal Absorbers and spray towers.

UNIT 3: ADSORPTION**9 Hours**

Introduction to adsorption, adsorbents and adsorption processes, Types of adsorption, Nature of adsorbents, Theories of adsorption- Freundlich, Langmuir, BET theories, Adsorption isotherms, Operation of adsorption columns, Break through curve, Batch and continuous operations, Multistage cross and counter current operations, Equipments- fixed-bed adsorbers, moving bed adsorbers, pressure swing adsorber and thermal swing adsorbers.

UNIT 4: EXTRACTION**9 Hours**

Equilibrium in ternary systems, Stage wise contact equipments, Calculations for batch and continuous extractors, Multistage Cross current extraction, Multistage counter current extraction, Calculation of number of stages, Equipments – Mixer settlers, Plate column, Packed column, Pulse column & RDC.

UNIT 5: LEACHING**9 Hours**

Introduction. Types of evaporators. Single and multiple effect evaporation. Capacity and economy of multi effect evaporators. Thermo re-compression evaporators Vapour re-compression and thermal re-compression evaporators, Effect of liquid head and boiling point elevation. Duhring's rule. Liquid characteristics. Material and energy balance in evaporators. Illustrated examples.

Max.45 Hours**COURSE OUTCOMES:**

CO1 Design calculation of distillation column

CO2 Determine the number of stages and height of continuous absorber

CO3 Design of adsorber and calculate the adsorbent requirement

CO4 Describe the principles of Extraction and estimate the number of ideal stages.

CO5 Describe the principles of leaching and estimate the number of ideal stages.

CO6 Formulate and solve mass balances for extraction, absorption, adsorption and distillation.

TEXT / REFERENCE BOOKS

- Treybal, R.E, Mass Transfer Operations, 3rd Edition, McGraw Hill, 2004.
- McCabe and Smith, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill, 2009.
- Coulson J.M. and Richardson J.F., Chemical Engineering, Vol. II, Pergamon Press. 2002.
- Gavhane K. V., Mass Transfer II, 11th Edition, NiraliPrakashan, 2011.
- Anantharaman N., MeeraSheriffa Begum K. M., Mass Transfer Theory and Practice, 1st Edition, PHI, 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA1502	PROCESS ENGINEERING ECONOMICS	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- The course deals with the thought processes, concepts, methods, and knowledge bases used by engineers to cost engineering projects and to evaluate the merit of making a particular investment, and to choose the best of a series of alternative investments to achieve a desired objective.

UNIT 1: PROCESS DESIGN DEVELOPMENT**9 Hours**

Types of Designs, Material and Energy Balance, Equipment Sizing and Selection, Process Flow Sheet and P&I Diagrams, Selection of Plant Location and Layout, Factors affecting Plant Design.

UNIT 2: ENGINEERING ECONOMICS FOR PROCESS ENGINEERS, INTEREST & INVESTMENT COSTS**9 Hours**

Time Value of Money, Equations for Economic Studies, Equivalence, Amortization, Capital Recovery, Depreciation- Nature of Depreciation, Methods of determining depreciation, Depletion.

UNIT 3: COST ESTIMATION AND ANNUAL REPORTS**9 Hours**

Capital Requirements for Process Plants, Cost Indices. Equipment Costs, The William six-tenth's Factor, Service Facilities, Capital requirements for Complete Plant, The Balance Sheet, Sources of Capital, Variable Costs, Fixed Costs, Income Statement, Income Statement Ratios.

UNIT 4: ECONOMICS OF INVESTMENT ALTERNATIVE**9 Hours**

Economics of Selecting alternates, Annual Cost methods, Present worth method, Equivalent Alternate, Rate of Return and payout-time, Economic Production Charts, Capacity Factors, Break Even Analysis – basic assumptions – break even chart – managerial use of breakeven analysis.

UNIT 5: ECONOMIC BALANCE**9 Hours**

Essentials of economic balance, economic balance in batch operations, cyclic operations, economic balance for insulation, evaporation, heat transfer equipments.

Max.45 Hours**COURSE OUTCOMES:**

- CO1. Apply the material and energy balance in process plant
- CO2. Understand the concept of economics in a process plant, time value of money and cost indices
- CO3. Compute the financial statements, Depreciation and Accounting in Cost estimation.
- CO4. Evaluate the economics of a process through cost estimation
- CO5. Determine the optimum cost for operation
- CO6. Develop economic balance for chemical engineering equipment's

TEXT / REFERENCE BOOKS

- Max. S, Peters and Klaus. D Timmerhaus., Plant Design and Economics for Chemical Engineers, 5th Edition, Mc Graw Hill International Editions, New York, 2004.
- Herbert E Schweyer, Process Engineering Economics, McGraw Hill, 2017.
- Jelen F.C and Black J.H., Cost and Optimization Engineering, 4th Edition, McGraw Hill, 2000.
- James.R.Couper., Process Engineering Economics, 1st Edition, Marcel Dekker Inc, New York, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA1503	INSTRUMENTATION AND PROCESS CONTROL	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- This course enables the students to know about control methods and make the students knowledgeable in various types of measuring instruments used in chemical process industries.

UNIT 1: INSTRUMENTATION**9 Hours**

Temperature measurement: Thermocouples, Resistance thermometers, Optical and Radiation pyrometers. Pressure measurement: Use of manometers, Bourdon gauge, Bellows type gauge. Flow measurement: Variable area meters. Positive displacement type meters. Liquid level measurement: Direct and differential method, measurement in open and pressure vessels. Measurement of Viscosity, Conductivity, pH and Humidity of gases.

UNIT 2: BASIC CONCEPTS OF PROCESS CONTROL**9 Hours**

Laplace transformation and its application in process control. Response of first order systems Examples of first order systems Process Dynamics of linear open systems. Second order and first order systems in series higher order systems Transfer Function Step, Ramp, Pulse and Sinusoidal inputs and Linearization.

UNIT 3: LINEAR CLOSED LOOP SYSTEMS**9 Hours**

Development of a block diagram, Controllers and Final control element Closed loop control systems. Block Diagram for feedback control systems, Servo and Regulator problems. Principles of Pneumatic and Electronic controllers. Transportation Lag Transient response of closed loop control systems, Control valve PI, P, PID control.

UNIT 4: STABILITY ANALYSIS**9 Hours**

Stability, Stability criterion, Routh test for stability; Routh-Hurwitz criterion, Root-Locus analysis. Introduction to frequency response of closed-loop systems, Frequency response - Substitution Rule, Bode diagrams Bode stability criterion. Gain and Phase margins Ziegler Nichols control settings and Transient response, Nyquist diagram.

UNIT 5: CONTROL VALVES & INDUSTRIAL CONTROL SYSTEMS**9 Hours**

Control valves, Valve sizing Characteristics Control valve construction, Valve positioning. Introduction to industrial control systems - Programmable Logic Controllers (PLCs), Distributed Control Systems (DCS), Supervisory control and Data Acquisition (SCADA). Cascade control, Feed forward control and Feedback control.

Max.45 Hours**COURSE OUTCOMES:**

- CO1. Develop mathematical modeling of different process using differential equation.
- CO2. Ability to analyze, formulate and select suitable sensor for the given industrial applications
- CO3. Design and tune process (PID) controllers.
- CO4. Evaluate stability, frequency response, and other characteristics
- CO5. Apply control schemes to various processes
- CO6. Select control valves for different systems.

TEXT / REFERENCE BOOKS

- Coughanowr D.R and Koppel L.M., Process Systems Analysis and Control, 3rd Edition, McGraw Hill, New York, 2009.
- Harriot P., Process Control, 3rd Edition, Tata McGraw Hill, New Delhi, 2008.
- George Stephanopoulos., Chemical Process Control, 2nd Edition, Prentice Hall of India Pvt. Ltd., 2015.
- Vyas.R.P., Process control and instrumentation, 8th Edition, Central Techno Publications, Nagpur 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA1504	CHEMICAL REACTION ENGINEERING - II	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To familiarize the methods of accounting non-ideal behavior of ideal reactors, design of heterogeneous reactors for solid catalyzed reactions and non-catalytic fluid-particle reactions.

UNIT 1: NON - IDEAL REACTOR**9 Hours**

Non-ideal reactors, Reasons for non-ideal flow behaviors, Concept of mixing: micro and macro mixing, Residence Time Distribution (RTD) functions, C, E and F curves, calculation of mean residence time from E and F curves, Tanks in series models, Axial dispersion model, segregated flow model.

UNIT 2: NON-CATALYTIC REACTIONS**9 Hours**

Material balance, Energy balance, batch operation, continuous operation, semi-batch operation, ideal conditions, design of ideal batch reactor, ideal plug flow reactor, ideal mixed flow reactor, semi-batch reactor, recycle reactor.

UNIT 3: CATALYST AND CATALYTIC REACTIONS**9 Hours**

Introduction to catalysis, Physical properties of catalyst: Surface area (BET isotherm), Void volume and solid density, Pore volume distribution; Catalyst preparation, Promoters, Inhibitors and Poisons, Steps in a catalytic reaction, rate of catalytic reaction (adsorption, surface reaction and desorption as rate limiting step).

UNIT 4: CATALYTIC REACTORS**9 Hours**

The rate equation for Surface Kinetics, Pore diffusion resistance combined with Surface Kinetics, Effectiveness factor, Thiele modulus, Heat effects during reaction, Performance equations for Reactors containing porous catalyst particles, Experimental methods for finding rates.

UNIT 5: NON-ISOTHERMAL REACTIONS**9 Hours**

Heterogeneous catalytic reactors: Fixed bed reactors, Fluidized bed reactors, Slurry reactors, Trickle bed reactors: Design aspects with some simple examples.

Deactivation of catalyst, Mechanism of deactivation of catalyst, Rate and performance study of deactivation.

Max.45 Hours**COURSE OUTCOMES:**

The student will be able to

- CO1. Understand non-ideal behavior of reactors and their causes
- CO2. Understand non-ideal behavior of reactors and their causes
- CO3. Analyze various preparation and characterization methods of catalysts
- CO4. Design performance equations for reactors containing porous catalyst particles
- CO5. Apply kinetic concepts to heterogeneous reactors
- CO6. Interpret the mechanism of deactivation of catalyst

TEXT / REFERENCE BOOKS

- Octave Levenspiel, Chemical Reaction Engineering, 3rd Edition, Wiley Publications Ltd., 2007.
- Smith, J.M. Chemical Engineering Kinetics, 3rd Edition, McGraw-Hill Book Company, New York, 2013.
- Fogler, H.S., Elements of Chemical Reaction Engineering, 5th Edition, Prentice-Hall of India Pvt. Ltd, 2016.
- Froment, G.F and Bischoff, K.B., Chemical Reactor Analysis and Design, 3rd Edition, John Wiley and Sons, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA1701	PROCESS MODELING AND SIMULATION	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- The objective of this course is to give a broad coverage of the field of mathematical modeling and simulation in chemical engineering. Both steady-state and dynamic models will be examined and discussed.

UNIT 1: BASICS OF MODELLING**9 Hours**

Introduction to Modeling, need of models and their classification, Uses of Mathematical Models, Scope of Coverage, Principles of Formulation. Fundamental Laws-Continuity Equation, Energy Equation, Equations of Motion. Regression and Correlation Analysis.

UNIT 2: MODELING OF HEAT TRANSFER AND OTHER EQUIPMENTS**9 Hours**

Two Heated Tanks, Double Pipe Heat Exchanger, Shell and Tube Heat Exchanger, Evaporators, Mixing process, interacting and non-interacting system and Gravity flow tank.

UNIT 3: MODELING OF REACTORS**9 Hours**

Batch Reactor, Series of Isothermal Constant-Holdup CSTR, CSTR with Variable Holdup, Non Isothermal CSTR, Semi batch Reactor, Plug Flow Reactor, Packed Bed Reactor and bioreactor models.

UNIT 4: MODELING OF MASS TRANSFER OPERATIONS**9 Hours**

Absorption Columns, Ideal Binary Distillation column, Multi component Non-Ideal Distillation Column, Batch Distillation with Holdup, Single Component vaporizer multi component flash drum and extraction models.

UNIT 5: DYNAMIC SIMULATION**9 Hours**

Dynamic Simulation of Batch Reactor, Non Isothermal CSTR, Three CSTR in Series, PFR, Binary Distillation Column, Evaporator, Absorption column and Gravity Flow Tank.

Max.45 Hours**COURSE OUTCOMES:**

- CO1. Organize the important physical phenomena from the problem statement
- CO2. Demonstrate the stages involved in the development of a process model.
- CO3. Develop model equations for heat transfer and other equipment
- CO4. Analyze model equations for the given reactors
- CO5. Explain model equations for the given mass transfer operations
- CO6. Solving the chemical engineering models developed

TEXT / REFERENCE BOOKS

1. Amiya K. Jana, "Chemical Process Modelling and Computer Simulation" 2nd Edn, PHI Learning Ltd, 2012.
2. Amiya K. Jana, "Process Simulation and Control Using ASPEN", 2nd Edn, PHI Learning Ltd, 2012.
3. Ramirez W., Computational Methods in Process Simulation, 2nd Edition, Butterworth's Publishers, New York, 2000.
4. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes", John Wiley, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCH3002	PETROLEUM AND PETRO CHEMICAL TECHNOLOGY	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- The subject deals with the characterization, distillation, refining of petroleum crude and the petrochemicals obtained by processing petroleum products.

UNIT 1: CLASSIFICATION OF CRUDE AND REFINING**9 Hours**

Theories on origin of petroleum, composition of crude oil, classification and evaluation of crude oil, laboratory testing techniques of crude quality like flash point, fire point etc., Characterization of crude oils : TBP and ASTM distillation, Correlation Index, Density, API gravity, Viscosity, UOP characterization factor, etc. Physical & Thermal properties of petroleum, ASTM, TBP, EFV distillation curves. Properties of crude oil: Distillation: Properties of crude oil octaneno. etc Pre-treatment, Electric desalting, Refining of petroleum – atmospheric and vacuum distillation.

UNIT 2: THERMAL AND CATALYTIC PROCESSES**9 Hours**

Thermal cracking, catalytic cracking, catalytic reforming, Naphtha cracking, coking, Hydrogenation processes, Alkylation processes, Polymerization and Isomerization process.

UNIT 3: TREATMENT TECHNIQUES**9 Hours**

Treatment techniques for removal of objectionable gases and to improve performance, treatment of gasoline, treatment of kerosene, treatment of lubes. Extraction of aromatics and olefins, Recovery operations from petroleum products.

UNIT 4: INTRODUCTION AND CHEMICALS FROM METHANE AND ETHANE**9 Hours**

History and importance of Petrochemical industry, growth in India, Classification of Petrochemicals, Feedstock of the Petrochemicals. Production of Methanol, Formaldehyde, Ethylene glycol, PTFE, ammonia, Ethylene, Manufacture of Vinyl Chloride monomer, vinyl Acetate manufacture, Ethanol from Ethylene, Acetylene manufacture.

UNIT 5: CHEMICALS FROM HIGHER ALKANES**9 Hours**

Cracking of naphtha and gas for the production of ethylene, propylene, isobutylene and butadiene., synthetic fibers.

Max.45 Hours**COURSE OUTCOMES:**

At the end of the course, student will be able familiarized in the

- CO1. Understand fundamental concepts of Petroleum Refining about processing, quality control and general overview of the industry
- CO2. insights of primary treatment processes to produce the precursors.
- CO3. Analyse the techniques for the removal of sulphur and other impurities from petroleum products
- CO4. Applications of second and third generation petrochemicals.
- CO5. Synthesis of petrochemical products from refinery
- CO6. Acquainted with technologies used for the production of desired petro products

TEXT / REFERENCE BOOKS

- Prasad, R., "Petroleum Refining Technology", Khanna Publishers, New Delhi, 2000
- Lewis F. Hatch & S Matar, From Hydrocarbon to Petrochemicals, 2nd Edition, 2000, Gulf Publishing Co. Houston, Texas, USA.
- Uttam Ray Chaudhuri "Fundamentals of Petroleum and Petrochemical Engineering", CRC Press, 2011.
- Jones D.S.J.S. Process equipment in petroleum refining. In: Jones D.S.J.S., Pujadó P.R. (eds) Handbook of Petroleum Processing. Springer, Dordrecht, 2008

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

Employability

Entrepreneurship

Skill Development

SCHA3004	FERTILIZER TECHNOLOGY	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- This course helps the students to understand the various processes involved in chemical industries for the production of nitrogenous fertilizers and also to know the technological advancements in agriculture and fertilizer industry.

UNIT 1: INTRODUCTION TO FERTILIZERS & NITROGENOUS FERTILIZERS**9 Hours**

Plant nutrients and its types, Fertilizer and its types, Production of Ammonia and Nitric acid, Methods of production, Specification, storage and handling of nitrogenous fertilizers, Ammonium sulphate, Ammonium nitrate, Urea, Calcium ammonium nitrate, Ammonium chloride.

UNIT 2: POTASSIUM FERTILIZERS**9 Hours**

Sources of potassium, Location, Methods of production, Specification, storage and handling of potassic fertilizers, potassium chloride, Potassium chloenites. Function of potassium in plants.

UNIT 3: PHOSPHATIC FERTILIZERS**9 Hours**

Raw materials, Phosphate rock, Sulfur, pyrites etc., processes for the production of sulphuric and phosphoric acids; Phosphatic fertilizers, ground rock phosphate, Bone meal, Single super phosphate, Triple super phosphate, Thermal phosphate and their methods of production, storage and handling and specifications.

UNIT 4: COMPLEX AND NPK FERTILIZERS**9 Hours**

Types of complex fertilizers, composition, Production of ammonium phosphate fertilizers, Ammonium sulfate, Diammonium phosphate, Nitro phosphate, Mono Ammonium Phosphate and various grade of NPK fertilizers.

UNIT 5: MISCELLANEOUS FERTILIZERS**9 Hours**

Mixed fertilizers and granulated mixtures, Biofertilizers and nutrients. Secondary and micronutrients; fluid fertilizers, controlled release fertilizers.

Max.45 Hours**COURSE OUTCOMES:**

- CO1. Elaborate the production of nitrogenous fertilizers
- CO2. Explain the production of potassium fertilizers
- CO3. Analyze the application of phosphate fertilizer & their production
- CO4. Develop the production process for NPK Fertilizers/Biofertilizers
- CO5. Analyze the application of mixed fertilizers
- CO6. Evaluate the environmental impacts and their mitigation measures pertain to fertilizer industry

TEXT / REFERENCE BOOKS

- Handbook of Fertilizer Technology, Fertilizer Association of India, New Delhi, 2000.
- Gopala Rao M. and Marshall Sittig, Dryden's Outlines of Chemical Technology, 3rd Edition., East-West Press, New Delhi, 2010.
- Fertilizer technology and management, Brahma Mishra, I.K International Publishing House PVT Its, 2011
- Fertilizer Manual, Kluwer Academic Publishers, Netherlands, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Examination duration: 3 Hours

Part A: 10 questions of 2 marks each - No choice

20 Marks

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

80 Marks

SCHA3005	ADVANCED SEPARATION PROCESSES	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To identify about the kind of separation processes in general and novel separations are integral part of any process chemical industries.

UNIT 1: THERMAL SEPARATION**9 Hours**

Thermal Diffusion: Basic Rate Law, Theory of Thermal Diffusion Phenomena for gas and liquid mixtures, Equipment's design and Applications. Zone Melting: Equilibrium diagrams, Controlling factors, Apparatus and Applications, Zone Refining and Zone leveling.

UNIT 2: SORPTION TECHNIQUES**9 Hours**

Types and choice of adsorbents, Normal Adsorption techniques, Chromatographic techniques, Equipment and Commercial processes, Recent advances and Economics, Molecular Sieves. Latest developments in separation techniques: Cryogenic, Supercritical fluid extraction, Bio-separation, and Azeotropic separation.

UNIT 3: MEMBRANE SEPARATION PROCESSES**9 Hours**

Principle of membrane separations process; Classification: Reverse osmosis, Ultrafiltration, Micro-filtration, Nano-filtration and Dialysis; Analysis and modeling of membrane separation processes; Membrane modules and application; Ion selective membranes and their application in electro-dialysis; Pervaporation and gas separation using membranes; Electrophoresis; Liquid membranes and its industrial applications.

UNIT 4: IONIC SEPARATION**9 Hours**

Controlling factors, Applications, Equipments for Electrophoresis, Dielectrophoresis, Electro Dialysis and Ion – Exchange. Adductive Crystallization Applications, Economics and Commercial processes.

UNIT 5: MULTICOMPONENT DISTILLATION AND FOAM SEPARATION**9 Hours**

Introduction to multi component separation system. Introduction to Multi component distillation-Key components, Estimation of minimum theoretical stages using Fenske's equation. Foam and bubble separation: Principle; Classification; Separation techniques; Column operations. Surface Adsorption, Nature of foams, Apparatus, Applications, and controlling factor.

Max.45 Hours**COURSE OUTCOMES:**

- CO1 Understand the basic theory and equipment's to thermal diffusion
- CO2 Ability to distinguish different sorption techniques and its mechanism
- CO3 Analyze the various membrane separation processes
- CO4 Estimate the mechanism and applications of ionic separation technique
- CO5 Apply separation principles and theory to multi-component distillation
- CO6 Predict the minimum theoretical stages using Fenske's equation

TEXT / REFERENCE BOOKS

- Seader, J.D, and Henley E.J., Separation Process Principles, 3rd Edition, John Wiley & Sons, Inc., 2011.
- Perry R.H. and. Green D.W., Perry's Chemical Engineers Hand book, 8th Edition. McGraw Hill, New York, 2006.
- Sinaiski E.G. and Lapiga E.J., Separation of Multiphase, Multicomponent Systems, 1st Edition, Wiley-VCH Verlag GmbH & Co, 2003.
- Suresh S and Amit Keshav, Text book of Separation processes, Studium Press India LTD, 2012
- Coulson J. M. and Richardson J. F., Chemical Engineering, Vol. II, 4th Edition, Butterworth, Heinemann, London, 2005

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA3008	FOOD TECHNOLOGY	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To impart knowledge to the students about advanced technology in food science and recent trends adapted in food industry.

UNIT 1: FOOD PROCESSING ENGINEERING–FUNDAMENTALS**9 Hours**

Fundamentals of Food Process Engineering, Application of Quantitative methods of Material & Energy Balances in Food Engineering Practices. Constituents of Food, Quality and Nutritive aspects, Food Adulterations, Deteriorative factors and Control.

UNIT 2: UNIT OPERATIONS IN FOOD INDUSTRIES**9 Hours**

Fluid Flow, Thermal Process Calculations, Refrigeration, Evaporation and Dehydration operations in Food Processing.

UNIT 3: FOOD CANNING TECHNOLOGY**9 Hours**

Fundamentals of Food Canning Technology, Heat Sterilization of Canned food, Containers – metal, Glass and Flexible packaging. Canning Procedures for Fruits, Vegetables, Meat, Poultry and Marine Products.

UNIT 4: FOOD PRESERVATION METHODS**9 Hours**

Preservation by Heat and Cold, Dehydration, Concentration, Drying, Irradiation, Microwave heating, Sterilization and Pasteurization, Fermentation and Pickling, Packaging Methods.

UNIT 5: PRODUCTION AND UTILIZATION OF FOOD PRODUCTS**9 Hours**

Cereal, Grains, Pulses, Vegetables, Fruits, Spices, Fats and Oils, Bakery, Confectionary and Chocolate Products. Soft and Alcoholic Beverages, Dairy Products, Meat, Poultry and Fish Products.

Max.45 Hours**COURSE OUTCOMES:**

The student will be able to

- CO1. Understand the constituents, quality and nutritive aspects of food
- CO2. Analyze Unit Operations in food processing industries
- CO3. Evaluate various food canning technologies
- CO4. Demonstrate the various methods of food preservation
- CO5. Analyze the various methods of food processing
- CO6. Develop the flow diagram to interpret manufacturing process of various food products

TEXT / REFERENCE BOOKS

- Heid J.L. Joslyn M.A., Fundamentals of Food Processing Operation, 6th Edition, The AVI publishing Co., Westport 2018.
- Potter N.N., Food Science, 6th Edition, The AVI publishing Co., Westport, 2007
- Heldman D.R., Food Process Engineering, 4th Edition, The AVI publishing, 2005
- Owen. R.Fennema., Food Chemistry, 4th Edition, Marcel Dekker Inc New York, 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA3010	INDUSTRIAL SAFETY & HAZARD ANALYSIS	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To emphasize the importance of safety and to gain knowledge on the hazards and their analysis in industries.

UNIT 1: INDUSTRIAL SAFETY**9 Hours**

Industrial safety principles, accidents, site selection and plant layout, design for ventilation, , basic rules and requirements which govern the chemical industries. Emergency response systems for hazardous goods, Emergency planning and preparedness, Major Industrial accidents, causes, methods of prevention, Case Study.

UNIT 2: HAZARDS**9 Hours**

Chemical hazards classification, hazards due to fire, explosion and radiation, various explosions: VCE, UVCE and BLEVE. Potential hazards, Chemical and Physical job-safety analysis, Safety in High-pressure and high temperature operations, toxic effects, highly radioactive materials, Safe handling and operation of materials and machineries.

UNIT 3: HAZARD ANALYSIS**9 Hours**

Types of hazard analysis, hazard identification, Material safety data sheet, specifications, Safety Audit, Hazard and Operability Studies Steps involved and significance, Fault tree analysis, Event tree analysis., Failure Mode Effect Analysis procedure and Illustrated examples.

UNIT 4: SAFETY APPRAISAL**9 Hours**

Safety audit, Effective steps to implement safety procedures, periodic training and regular maintenance, personal protective equipment, types, Safety Program, Elements of safety Program, Fire Formation, Fire Triangle, Fire prevention and firefighting equipment.

UNIT 5: HEALTH HAZARDS AND LEGAL ASPECTS**9 Hours**

OSHA Regulations and Significance, Health hazards -occupational, Industrial health hazards. Health standards and rules, Safe working environment, Factories act, Labor welfare act, ESI act, Workmen compensation act, Provisions and features.

Max.45 Hours**COURSE OUTCOMES:**

The student will be able to

- CO1. Apply basic rules and requirements which govern chemical industries
- CO2. Outline the various hazards and their implications
- CO3. Analyze the different hazards, their impact and prevention
- CO4. List the importance of safety audit and periodic appraisal for prevention of accidents
- CO5. Explain various fire extinguishing solutions and to ensure fire prevention
- CO6. Discuss the various acts available for employee safety and maintain periodic OSHA regulations

TEXT / REFERENCE BOOKS

- Blake R.P., Industrial Safety, 3rd Edition, Prentice Hall Inc., New Jersey, 2006.
- Deshmukh. L.M., Industrial Safety Management, 3rd Edition, Tata McGraw Hill, New Delhi, 2008.
- Jain.R.K and Sunil Rao., Industrial Safety, Health and Environmental Management Systems, 1st Edition, Khanna Delhi 2006.
- ShrikantDawande., Chemical Hazards and Safety, 2nd Edition, Khanna publishers,2012.
- Daniel A.Crowl, Joseph F. Louvar., Chemical Process Safety : Fundamentals with applications, 3rd Edition, Prentice Hall Inc., New Jersey, 2011..

END SEMESTER EXAMINATION QUESTION PAPER PATTERN
 Employability

 Entrepreneurship

 Skill Development

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA3011	GREEN TECHNOLOGY	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To demonstrate the achievement of efficient and economically viable chemical production without being hazardous to human health and environment

UNIT 1: INTRODUCTION**9 Hours**

Fundamentals of Green Technology, need, goal and limitations of Green technology, sustainable development, twelve principles of Green technology.

UNIT 2: GREEN CHEMISTRY**9 Hours**

Green chemistry metrics (atom economy, atom efficiency, E-factor), Green synthesis like photochemical, microwave, sonochemistry and electrochemistry, green reagents, green catalysts, solvent free reactions, toxicity reactions.

UNIT 3 GREEN PROCESSES**9Hours**

Renewable energy technologies like solar, wind, hydropower, geothermal and biomass energy, phytoremediation, eco-restoration, issues and challenges.

UNIT4 GREENER NANOSYNTHESIS AND GREEN NANOMATERIALS**9 Hours**

Greener Synthetic methods for metal and semiconductor and inorganic oxide, functionalized metal nanoparticles. Green materials, biomaterials, biopolymers, bioplastics, composites, Sensors, Biomimetic Sensors, Smart nanomaterials.

UNIT 5 GREEN NANOMATERIALS FOR ALTERNATIVE ENERGY/REMEDIATION**9 Hours**

Nanomaterials for fuel cells and hydrogen generation and storage. Nanostructures for efficient solar hydrogen production, solar thermal Energy and Photovoltaic. Nanomaterials -Remediation: Nano membranes, Nanofibers, Nano Adsorbents, Nano Catalysts, Nano-sensors.

Max.45 Hours**COURSE OUTCOMES:**

- CO1. Understand the principles of green chemistry and technology
 CO2. Outline to Concepts of Greener Nano synthesis and
 CO3. Apply the Green Nanomaterials to show relevance to green chemistry and technology
 CO4. To familiarize with the synthesis of nanomaterials
 CO5. To understand the application of green nanomaterials for alternative energy
 CO6. Identification, design and evaluation of remediation issues using green nanomaterials

TEXT / REFERENCE BOOKS

1. Mike Lancaster, Green Chemistry: An introductory Text, RSC Publishing V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
2. Jay Warmke, Annie Warmke, Green Technology, Educational Technologies Group, 2009.
3. David. T, Allen and David R. Shonnard, "Green engineering" Prentice Hall NJ, 2002
4. James clark, "Green chemistry" Blackwell publishing, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

Employability

Entrepreneurship

Skill Development

SCHA3012	SMART MATERIALS FOR INDUSTRIES	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To acquire basic understanding of advanced materials, their functions and properties for technological applications and emphasize the significance of materials selection in the design process

Unit I INTRODUCTION TO SMART MATERIALS**9 HOURS**

Smart materials and structures- System intelligence- components and classification of smart structures, common smart materials and associated stimulus-response, Application areas of smart systems Ferroelectric materials: Piezoelectric materials- piezoelectric effect, Direct and converse, parameter definitions, Piezoceramics, Piezopolymers, Piezoelectric materials as sensors, Actuators and bimorphs

Unit II SHAPE MEMORY ALLOYS**9 HOURS**

Shape memory alloys (SMAs), Shape memory effect, Martensitic transformation, One way and two-way SME, training of SMAs, binary and ternary alloy systems, Functional properties of SMAs. Characterization tests for smart materials: Principles, instrumentation and applications of: Ion beam techniques- Surface mass spectrometry, LEIS, ISS; Mass spectrometry.

Unit III CHROMIC MATERIALS**9 HOURS**

Thermochromism, Photochromism, Electrochromism, Halochromism, Solvatochromism- principle and design strategies and applications in industries. Introduction to synchrotron radiation and its applications in materials science; Vibrational spectroscopy of surfaces based on colour change.

Unit IV POLYMERIC MATERIALS**9 HOURS**

Thermally responsive polymers, Electroactive polymers microgels, Synthesis, Properties and Applications, Protein-based smart polymers, pH-responsive and photo-responsive polymers, Self-assembly, Molecular imprinting using smart polymers, Approaches to molecular imprinting, Drug delivery using smart polymers

Unit V SENSORS AND SMART HYDROGELS**9 HOURS**

Elastic memory composites, Smart corrosion protection coatings, Self-healing materials, Sensors, Actuators, Transducers, MEMS, Deployment devices, Molecular machines, Smart hydrogels- synthesis, properties and application in industries.

COURSE OUTCOMES:

- CO1. Describe the basic features of smart materials.
 CO2. Illustrate the characteristics of shape memory alloys
 CO3. Obtain a knowledge on chromic materials
 CO4. An understanding of knowledge about Polymeric materials
 CO5. Demonstrate the usage of sensors and smart hydrogels
 CO6. Students will familiarize with various materials in industries.

TEXT / REFERENCE BOOKS

- D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007.
- M. Addington, D.L. Schodek, Smart Materials and New Technologies in Architecture, Elsevier 2005.
- M. Schwartz, New Materials, Processes, and Methods Technology, CRC Press, 2006.
- Galaev, B. Mattiasson (Eds.), Smart Polymers: Applications in Biotechnology and Biomedicine, 2nd ed., CRC Press, 2008.
- N. Yui, R. J. Mrsny, K. Park (Eds.), Reflexive Polymers and Hydrogels: Understanding and Designing Fast Responsive Polymeric Systems, CRC Press, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA3013	COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To impart computational techniques for chemical engineering calculations

UNIT 1: BASICS OF MATLAB**9 Hours**

Starting MATLAB, Help, Simple, Functions, Output, Algebra Vectors, Graphs, Interrupting, Syntax, Suppressing Output, Defining Matrices, Size of Matrix, The Identity Matrix, Specialized Matrices, Diagonal Matrices, The Manipulating Matrices, Matrices, matrix Multiplication, String Arrays, Printing Output, MATLAB Scripting Language: M-File MATLAB Search Path, Path Management, and Startup, File, Function, Errors.

UNIT 2: FORMULATION OF PHYSICAL PROBLEMS**9 Hours**

Mathematical statement of the problem, Representation of problems, Formulation on extraction in single & multiple stages, Radial heat transfer through a cylindrical conductor, salt accumulation in stirred tank.

UNIT 3: INITIAL VALUE PROBLEMS**9 Hours**

Initial value problems for ordinary differential equations-Euler's method, Trapezoidal method, Runge Kutta methods for second and fourth order, interpolation, Newton-cotes integration, Gaussian quadrature.

UNIT 4: NUMERICAL OPTIMIZATION AND PARAMETER ESTIMATION TECHNIQUES**9 Hours**

Methods for constrained and unconstrained optimization- Lagrangian methods, Simplex, Newton line search method, Trust region Newton method, Single response linear regression, least square regression, Applications- Fitting a kinetic rate law to time dependent data.

UNIT 5: BOUNDARY VALUE PROBLEMS**9 Hours**

Introduction to boundary value problems, shooting method, finite difference method, finite volume method, finite element method. Applications of BVP-Chemical reaction and diffusion in a spherical catalyst, finite differences for a convection, diffusion equation.

Max.45 Hours**Course Outcomes:****CO1:** Understand the basic concepts of Matlab**CO2:** Outline to Formulate physical problems**CO3:** Solve Initial value problems**CO4:** Examine numerical optimization**CO5:** Evaluate parameter estimation techniques**CO6:** Estimate boundary value problems**TEXT / REFERENCE BOOKS:**

1 Beers K.J., Numerical Methods for Chemical Engineering: Applications in MATLAB, 1st Edition, Cambridge University Press, 2007.

2. Jain M.K., Iyengar S.R.K., Jain R.K., Numerical methods: Problems and solutions, 4th Edition, New age international publishers, 2003.

3 Davis. M.E., Numerical Methods and Modeling for Chemical Engineers, 1st Edition, John Wiley & Sons, 1984.

4. Loney N.W., Applied mathematical models for chemical Engineers, 2nd Edition, CRC press, 2006.

5. Mickley, Reid and Sherwood, Applied Mathematics in Chemical Engineering, 2nd Edition, Tata-McGraw-Hill, New Delhi, 1978

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Examination duration: 3 Hours

20 Marks

SCHA4002	ENERGY ENGINEERING	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To impart in depth understanding of the issues related with renewable energy and their development.

UNIT 1: INTRODUCTION TO CONVENTIONAL & NON-CONVENTIONAL ENERGY SOURCES**9 Hours**

Conventional energy sources; non-conventional energy sources; Energy sources, Coal, Oil, Natural gas, nuclear fuels, Hydro power advantages. Classification of fuels. Introduction to solar energy, Solar radiation and its measurement, solar constant, solar radiation at earth's surface, solar radiation geometry, solar radiation measurement. Applications, solar water heating, space heating, space cooling, solar thermal electric conversion. Agriculture and industrial process heating, solar distillation, solar pumping, solar cooking.

UNIT 2: ENERGY FROM BIOMASS (BIO – ENERGY): INTRODUCTION**9 Hours**

Biomass conversion Technologies. Wet processes, Dry processes. Biogas generation. Factors affecting biodigestion or generation of gas. Classification of biogas plants. Advantages and disadvantages of floating drum plant. Advantages and disadvantages of fixed dome type plant. Types of biogas plants (KVIC model & Janata model). Selection of site for biogas plant.

UNIT 3: BIO – ENERGY (THERMAL CONVERSION) AND ELECTRICAL CONDUCTION (MHD)**9 Hours**

Methods of obtaining energy from biomass, Thermal gasification of biomass, Classification of biomass gasifiers, Chemistry of gasification process, Applications of the gasifiers. Magneto hydrodynamic generator, electrical conductivity and formation of MHD, performance comparison of open and closed cycle.

UNIT 4: WIND ENERGY AND OTEC**9 Hours**

Basic components of WECS (wind energy conversion system): Classification of WECS, Types of wind machines, horizontal axis machines, vertical axis machines. Applications of wind energy. Energy from the oceans: Introduction, Ocean thermal electric conversion (OTEC), Methods of ocean thermal electric power generation, Open cycle OTEC system, Closed or Anderson OTEC cycle, hybrid cycle. Application of energy from oceans.

UNIT 5: FUEL CELLS BASICS AND WASTE HEAT RECOVERY**9 Hours**

Fuel Cells, Difference between batteries and fuel cells, Components of fuel cells, Principle of working of fuel cells, Fuel cell types: Alkaline fuel cells. Polymer electrolyte fuel cells, Phosphoric acid fuel cells, Molten carbonate fuel cells, Solid oxide fuel cells, Applications. Co-generation- waste heat recovery and heat pump.

Max.45 Hours**COURSE OUTCOMES:**

The student will be able to

- CO1. Explain various conventional and non- conventional energy resources and application of solar energy
- CO2. Evaluate the performance of various types of bio gas plants
- CO3. Demonstrate the working principle of biomass gasifiers
- CO4. Interpret the various types of wind energy conversion and ocean thermal electric conversion
- CO5. Demonstrate the working principle of various kinds of fuel cells.
- CO6. Evaluate the performance of waste heat recovery systems and heat pump.

TEXT / REFERENCE BOOKS

- Rai G.D., Non Conventional Energy Sources, 4th Edition, Khanna Publishers, New Delhi, 2004.
- Rao S.S., Energy Technology, 3rd Edition, Khanna Publishers, New Delhi, 2009
- R.K.Singal, Efficient utilization of energy, 2nd Edition, New Age International Publishers, New Delhi, 2017
- Christopher H. and Armsteed H., Geothermal Energy, 3rd Edition, John Wiley, New York, 2000..

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA4003	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To provide a basic understanding of the EIA process as it is used for research, planning, project or program evaluation, monitoring, and regulatory enforcement and to introduce students to the legal, economic, administrative and technical process of preparing and/or evaluating environmental impact documents.

UNIT 1: INTRODUCTION**9 Hours**

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. Types and Limitations of EIA. **Cross sectoral issues and terms of reference in EIA** – Public Participation in EIA. EIA process.

UNIT 2: METHODS FOR EIA**9 Hours**

Methods of EIA – Check lists – Matrices – Networks – **Cost-benefit analysis – Analysis of alternatives.**

UNIT 3: PREDICTION AND ASSESSMENT**9 Hours**

Assessment of Impact on land, water, air, social & cultural activities and on flora & fauna- Mathematical models- Public participation – Rapid EIA.

UNIT 4: ENVIRONMENTAL MANAGEMENT PLAN**9 Hours**

Environmental Management Plan – preparation, implementation and review – Mitigation and Rehabilitation Plans– Policy and guidelines for planning and monitoring programmes – **Post project audit** – Ethical and Quality aspects of Environmental Impact Assessment. ISO 14001.

UNIT 5: CASE STUDIES**9 Hours**

EIA related to the following sectors – Infrastructure – construction and housing Mining – Industrial – Power plants – River valley and Hydroelectric – coastal projects.

Max.45 Hours**COURSE OUTCOMES:**

The student will be able to

- CO1. Understand the major principles of Environmental impact assessment (EIA)
- CO2. Analyze the different steps in Environmental impact assessment
- CO3. Categorize the prediction and assessment of impacts
- CO4. Apply ethical and quality aspect in EIA process
- CO5. Illustrate different case studies of EIA in practice
- CO6. Conclude the implications of current jurisdictional and institutional arrangements in relation to Environmental impact assessment.

TEXT / REFERENCE BOOKS

- Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey, 2003.
- Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science, London, 2000.
- Y.Anjaneyulu: Environmental Impact Assessment Methodologies, BS Pub. 2002.
- Judith Petts, Handbook of Environmental Impact Assessment Vol. I & II, Blackwell Science, 2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SCHA4004	ENVIRONMENTAL POLLUTION AND CONTROL	L	T	P	C	Max. Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- To impart knowledge on the principles of various processes involved in the treatment of Industrial Pollutants such as Air, Water and Solid.

UNIT 1: INTRODUCTION**9 Hours**

Environment definition -The biosphere - Hydrologic cycle –Nutrient cycles, pollution of air, water and soil. Air pollution laws and air quality standard. Water pollution quality standards and law. MINAS. Air pollution effect on human, plant and animal. Acid rain.

UNIT 2: AIR POLLUTION AND ITS CONTROL**9 Hours**

Introduction-Sources of air pollution, Air pollution control methods-Source correction method, Cleaning of gaseous effluent, Particulate Emission control and equipment used in particulate emission control.

UNIT 3: WATER POLLUTION AND ANALYSIS**9 Hours**

Origin of waste water, Types of waste pollutants and their effects, Waste water sampling and analysis, Determination of organic and inorganic matters, Physical characteristics, Bacteriological measurements.

UNIT 4: NOISE POLLUTION**9 Hours**

Introduction, sources of noise pollution, Characteristics of sound, noise units, types of noise, effects and control of noise pollution. Radioactive pollution (RAP), Sources of RAP-Classification of its radiation effects on humans, plants and animals.

UNIT 5: SOLID WASTE AND ITS MANAGEMENT**9 Hours**

Sources and Classification of solid waste, Public health aspects, Methods of collection, Disposal Methods, Potential methods of disposal of solid waste.

Max.45 Hours**COURSE OUTCOMES:**

- CO1. Understanding of air/water pollution regulations and their scientific basis
- CO2. Evaluate the various air pollution control equipments
- CO3. Analyze waste water sampling methods and determine the impact of pollution
- CO4. Explain the control measures for noise and radioactive pollution
- CO5. Evaluate the sources and effects of solid waste
- CO6. Develop the potential methods of disposal of solid waste.

TEXT / REFERENCE BOOKS

- Kapoor B.S., Environmental Engineering, 4th Edition, Khanna Publishers, 2000.
- Rao C.S., Environmental Pollution Control Engineering, 2nd Edition, New Age International Publications, 2001.
- Jain P.C. & Monica Jain., Engineering Chemistry. 5th Edition, Dhanpat Rai Publications, 2002.
- Dara S.S., A Text Book of Engineering Chemistry, 3rd Edition, S.Chan & Co Ltd, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Part A: 10 questions of 2 marks each - No choice

Part B: 2 questions from each unit of internal choice; each carrying 16 marks

Examination duration: 3 Hours

20 Marks

80 Marks

SAIC4001	INDUSTRY 4.0	L	T	P	C	Max. Marks
		2	0	2	2	100

UNIT 1 ADVANCED TECHNOLOGY AND ADVANCED MATERIALS**7 Hrs.**

Advanced electro-optical sensing technology-active, passive multi-spectral and hyper spectral imaging; electronic beam steering; vacuum technology, surface and coating technology, health care technology, Nanotechnology- Nano mechanics, Nano optoelectronics; energy storage technology-next generation Li-based Batteries, Hydrogen storage, solar photovoltaics', Flexible electronics. Intellectual Property Rights - case studies governing/pertaining to Materials/Technology.

UNIT 2 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING**7 Hrs.**

Establishment of smart biotechnology factory, Artificial intelligence in Bioprocess technology, Omics – Big data analysis through automation, 3D bio printing for tissue engineering. Simulation tools, RSM and Box model. Cyber physical system based telemedicine, diagnosis and therapeutics through real time biosensors. Bio nanotechnology. Intellectual Property rights (IPR): Case Studies.

UNIT 3 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT**7 Hrs.**

Introduction – Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) – Unmanned Aerial Vehicles, sensors – Additive manufacturing in construction – Concrete 3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond. Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal - Integration of energy, water and environmental systems for a sustainable development- Emerging Technologies: Robot Highway- Vertical farming - Intellectual Property rights: Case studies

UNIT 4 SMART MANUFACTURING**8 Hrs.**

Smart factories and interconnection, Smart Manufacturing – automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self-propelled vehicles, e mobility, green fuels, drones – unmanned aerial vehicles (UAVs), aerodynamics. Robotic Automation and Collaborative Robots – Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies – Frugal Innovations – Emerging Technologies - Autonomous Robots, Swam Robot, Modular Robotics, Space craft, Intellectual Property Rights (IPR): Case Studies.

UNIT 5 SMART WORLD**8 Hrs.**

Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing: Changing trends in transistor technology: Processor, Emerging Trends: Deep Space, Swarm Robots, Cyborg, Geofencing, Pervasive Computing, Intellectual Property Rights- Case Studies.

UNIT 6 CYBER PHYSICAL SYSTEMS**8 Hrs.**

Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Deep Learning, Gamification, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) :Case Studies.

COURSE OUTCOMES:

- CO1. Apply the basic concepts for electro optical sensing technology and selection of materials.
CO2. Analyze the technology on AI and Big Data for biomedical applications.

- CO3. Elaborate the various technologies for sustainable built environment.
 CO4. Evaluate different smart manufacturing technologies for industrial robotics-based automation.
 CO5. Compare various advanced technologies for development of smart city.
 CO6. Build Cyber physical systems using AI for Industry, Agriculture and disaster management applications.

Max. 45

Hrs.

TEXT / REFERENCE BOOKS

1. William D. Callister, Materials Science and Engineering: An Introduction, John Willey and Sons Inc. Singapore, 2001.
2. Raghavan V., Physical Metallurgy: Principle and Practice, Prentice Hall India Pvt. Ltd., 2006.
3. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, 2019.
3. Klaus Schwab, Fourth Industrial Revolution, Random House USA Inc., New York, USA, 2017.
4. Oliver Grunow, "SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies", Studylab Publications, 2016.
5. Alasdair Gilchrist, "INDUSTRY 4.0: Industrial Internet of Things", Apress, 2016.
6. Sang C.Suh, U.JohnTanik, John N Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 11 Questions of 2 marks each-No choice

22 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 13 marks

78

Mark

SAIC4004	INDUSTRY 4.0 FOR BIO-CHEMICAL ENGINEERS	L	T	P	C	Max. Marks
		1	0	2	2	100

COURSE OBJECTIVE:

- To demonstrate the achievement of efficient and economically viable production without being hazardous to human health and environment. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

UNIT 6: MODELLING AND SIMULATION**6 Hours**

Introduction to Industry 4.0 - The Various Industrial Revolutions - Modeling Principles: Introduction, definition of modeling and simulation, different types of models, application of mathematical modeling.

Simulation: Introduction, Simulation Tools, Process Simulation Software Platforms and Applications, Trends in Process Simulation Engineering

UNIT 2: SMART INDUSTRY**6 Hours**

Road to Industry 4.0-Green manufacturing, Robotic Automation, Industrial Applications-Manufacturing, Control, Maintenance and Assembly, RFID- Type, RFID system, applications, RFID inhealth care, Embedded Systems - Embedded firmware, Platform software design, Wireless design,Embedded testing, modeling & automation, Hardware platform design, Device Management, Monitoring – Industrial monitoring, condition monitoring, Health monitoring.

UNIT 3 BIG DATA ANALYTICS AS SERVICE PROVIDER**7 Hours**

Technologies for enabling Industry 4.0 - Role of data, information, knowledge and collaboration in future organizations. Big Data - Background - Programming- Python and R - Git - Docker - Pipelines - DNA and RNA Sequencing - Massively parallel sequencing - Applications - Next Generation Sequencing and its future and big data analytics in healthcare - Big Data Repositories - Cloud platforms and computing for automation - Embedded systems in healthcare - Digitization the future of healthcare - medical cyber physical systems - Case study - Integration of Multi-Omics Big Data in Cardiovascular Risks and Diseases.

UNIT4 PLANT/PROCESS MANAGEMENT**6 Hours**

Business issues in Industry 4.0 - Nanobiotechnology: Synthesis of different Nanostructures, Characterization of Nanostructures, Nanostructures in Diagnosis and Therapy. Tissue Engineering: Scaffolds: Natural and Artificial polymers, Scaffold fabrication, 3D Bioprinting; Bioreactors for Tissue Engineering; Effect of different Parameters, Conditions; Tissue engineering for Skin, Bone, Vasculature and Cornea; Regulatory framework in development and marketing tissue-based products.

UNIT 5 PROTOTYPING – TESTING AND COMMUNICATION**20 Hours**

Applications and Case Studies - New ideas – centered design process – functional prototype - testing methods/ideas – prototyping and test beds – proof of concept – assembly – prototyping apps – addressing the complex problems.

Max.45 Hours**COURSE OUTCOMES:**

- CO7. Articulate on the new age technologies in the modeling of biochemical engineering.
 CO8. Integrate different emerging technologies to evolve Smart Factories
 CO9. Deduce the components that lead to industrial digital revolution
 CO10. Ability to assess the developments in bioengineering.
 CO11. Criticize the professional and ethical issues in novel industrial technologies.
 CO6. Develop a prototype/innovative ideas in the various fields of biochemical engineering.

TEXT / REFERENCE BOOKS

1. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, Handbook of Industry 4.0 and SMART Systems, 1st Editio, CRC Press, 2020
2. Sider W.D., Seader J. D., and Lewin D.R., Product and Process Design principles, Synthesis, Analysis and Evaluation, 2nd Edition, John Wiley and Sons, 2010.
3. Thomas Varghese & K.M. Balakrishna, Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials, Atlantic, 2012
4. UthayanElangovan, Smart Automation to Smart Manufacturing: Industrial Internet of Things, Momentum Pr, 1st Edition, 2019.

END SEMESTER EXAMINATION PATTERN

Max Marks: 100

PROJECT PRESENTATION

SCSA2102	Fundamentals of Python Programming Lab	L	T	P	Credits	Total Marks
		0	0	4	2	100

1. Program to handle Input and Output statements
2. Program using Lists, Tuples, Dictionary and Sets
3. Program using conditional statements
4. Program using looping constructs
5. Program using functions and modules
6. Program using File handling
7. Program using Exception handling
8. GUI Programming using Python - Canvas Widget
9. GUI Programming using Python -Frame,label,button,checkbox,entry, listbox,message,radiobutton,text,spinbox
10. Database Programming using Python
11. Socket Programming using Python

COURSE OUTCOMES:

- CO1. Describe primary goals of basic python program using data, expression and statements.
- CO2. Evaluate information around the world and choose appropriate action using control structure, loops.
- CO3. Develop programs for code reusability using functions.
- CO4. Create a python program to implement Exception Handling and File concept for various applications.
- CO5. Design GUI based applications.
- CO6. Create database for a specified application.

SCHA2306	ORGANIC CHEMICAL PROCESSES & THERMODYNAMICS LAB	L	T	P	C	Max. Marks
		0	0	4	2	100

1. Organic Preparations -Synthesis of compounds involving the following reactions

- a. Reduction
- b. Bromination
- c. Acetylation
- d. Hydrolysis
- e. Nitration

2. Qualitative Analysis -Analysis of following classes of compounds

- a. Aldehydes
- b. Ketones
- c. Acids
- d. Alcohols
- e. Amines
- f. Esters

3. Quantitative Analysis -Analysis of following classes of compounds

- a. Fertilizer
- b. Cement
- c. Sugar
- d. Drugs
- e. Proximate analysis of coal

4. Thermodynamics Experiments

- a. Heat of solution
- b. Heat of Neutralization
- c. Heat of Ionization

COURSE OUTCOMES:

- CO1. Identify the physical and chemical properties of common organic functional groups.
- CO2. Quantitative reasoning to determine quantities of energy involved in chemical changes
- CO3. Predict the reactivity of an organic compound from its structure.
- CO4. Develop basic skills for the multi-step synthesis of organic compounds.
- CO5. Predict the major and minor products of a variety of organic reactions with appropriate stereochemistry.
- CO6. Identify the physical and chemical properties of common organic functional groups.

SCHA2307	UNIT OPERATIONS LAB	L	T	P	C	Max. Marks
		0	0	4	2	100

1. Flow through Venturimeter
2. Flow through Orifice meter
3. Flow through Pitot tube
4. Characteristics of a Reciprocating pump
5. Characteristics of a Centrifugal pump
6. Characteristics of a Gear pump
7. Flow through packed bed
8. Flow through helical coil
9. Flow through V- Notches
10. Flow through annular pipe/ non circular conduits
11. Particle size distribution - differential and cumulative analysis by manual method using standard screens
12. Determination of Screen Effectiveness by Mechanical Method using Standard screens
13. Energy requirement and crushing constants determination using Ball mill
14. Energy requirement and crushing constants determination using Drop weight crusher
15. Determination of filtration constants at constant pressure conditions using Vacuum Leaf Filter
16. Minimum thickener area calculations performing Batch Sedimentation test

COURSE OUTCOMES:

- CO1 Estimate the critical parameters for various unit operations
CO2 Design and drawing of mass transfer equipment's
CO3 Design of pressure vessels and heat transfer equipment's
CO4 Design of thickeners and cyclone separators
CO5 Applying the principles of selection & design of supports and enclosures for vessels and columns
CO6 Acquire the knowledge of CAD in design of equipment's

SCHA2404	HEAT TRANSFER LAB	L	T	P	C	Max. Marks
		0	0	4	2	100

1. Measure the emissivity of the test plate and plot a graph between emissivity and temperature.
2. Determine the thermal conductivity of metal rod. (Brass rod)
3. Determine the thermal conductivity of hylem, wood, and asbestos.
4. Find the thermal conductivity of the given insulated material by using lagged pipe.
5. Determine the temperature distribution for a cylinder due to heat transfer by natural convection.
6. Study and compare temperature distribution heat transfer rate, overall heat transfer co-efficient in parallel flow heat exchanger.
7. Study and compare temperature distribution, heat transfer rate, overall heat transfer co-efficient in counter flow heat exchanger

COURSE OUTCOMES:

- CO1. Apply the concepts of heat transfer to the operation of heat transfer equipments.
- CO2. Estimate the heat transfer rate and heat transfer co-efficient
- CO3. Estimate the thermal conductivity of solid material
- CO4. Evaluate the performance of heat exchangers
- CO5. Calculate the emissivity of the test plate
- CO6. Collect and analyze the heat transfer data practically.

SCHA2506	MATLAB	L	T	P	C	Max. Marks
		0	0	4	2	100

1. Practicing MATLAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, Edit window, Shortcuts, Help files.
2. Data types, Constants and Variables, Character constants, operators, Assignment statements.
3. Control Structures: For loops, While, If control structures, Switch, Break, Continue statements.
4. Program to calculate the vapor pressure of water by using Antoine equation
5. Program to find the Bottoms and distillate composition in distillation column
6. Program to find out the feed and product composition in mixer
7. Estimation of average boiling point of a water /ethanol system at different water composition
8. Estimation of composition in sequence of distillation column
9. Calculation of vapor pressure vapour using pressure vs. temperature data in fourth order polynomial equation
10. Calculation of average density, conductivity and specific heat for water in various range of temperature

COURSE OUTCOMES:

- CO1. Use MATLAB effectively to analyze and visualize data
- CO2. Implement simple mathematical functions/equations in numerical computing environment
- CO3. Interpret and visualize simple mathematical functions and operations there on using plots/display
- CO4. Analyze the program and estimate the output for chemical environment
- CO5. Apply numeric techniques and computer simulations to solve engineering-related problems
- CO6. Create and control simple programs in MATLAB

SCHA2603	PROCESS DYNAMICS AND CONTROL LAB	L	T	P	C	Max. Marks
		0	0	4	2	100

1. Simulation of proportional controller using Matlab
2. Step Response of first order system with and without delay using Matlab
3. Step Response of second order system with and without Delay using Matlab
4. Simulation of Ziegler Nicholas Method of controller tuning using Matlab.
5. Simulation of Cascade control loop Using Matlab
6. Step response of interacting level system
7. Step response of Non-interacting level system
8. Characteristics of ON-OFF Controller in Thermal Process
9. Characteristics of control valve (Actuated and Flow Lift characteristics)
10. Characteristics of I/P Converter
11. Characteristics of P/I Converter
12. Study and control of a Level process using ON-Off, P, PI, PD and PID controllers
13. Study and control of a Pressure process using ON-Off, P, PI, PD and PID controllers
14. Study and control of a Flow process using ON-Off, P, PI, PD and PID controllers

COURSE OUTCOMES:

- CO1. Apply the concepts of first order and second order system with feedback using MATLAB
- CO2. Develop the mathematical model for interacting and non-interacting system
- CO3. Analyze the characteristics of control valve.
- CO4. Design controller parameter using Tuning methods
- CO5. Implementation of P,PI and PID for different processes
- CO6. Evaluate the performance of cascade and ratio control

SCHA2604	PROCESS EQUIPMENT DESIGN AND DRAWING LAB	L	T	P	C	Max. Marks
		0	0	4	2	100

1. Detailed design and drawing of enclosures and supports.
2. Detailed design and drawing of agitated vessel.
3. Detailed design and drawing of basket centrifuge.
4. Detailed design and drawing of gravity thickener.
5. Detailed design and drawing of cyclone separator.
6. Detailed design and drawing of crystallizer.
7. Detailed design and drawing of cooling tower.
8. Introduction to computer aided design of equipments.
9. Detailed design and drawing of various types of heat exchangers.
10. Detailed design and drawing of various types of evaporators.
11. Detailed design and drawing of distillation column.
12. Detailed design and drawing of absorber.
13. Detailed design and drawing of rotary dryer.

COURSE OUTCOMES:

- CO1 Estimate the critical parameters for various unit operations
CO2 Design and drawing of mass transfer equipment's
CO3 Design of pressure vessels and heat transfer equipment's
CO4 Design of thickeners and cyclone separators
CO5 Applying the principles of selection & design of supports and enclosures for vessels and columns
CO6 Acquire the knowledge of CAD in design of equipment's

SCHA2703	PROCESS SIMULATION LAB	L	T	P	C	Max. Marks
		0	0	4	2	100

1. Introduction to software (flow sheeting)

2. Simulation of flash drum

3. Simulation of distillation columns

4. Simulation of absorption columns

5. Simulation of Reactors

6. Simulation of Heat Exchangers.

7. Simulation of pumps and compressors.

8. Simulation of mixing

9. Simulation of compressors.

COURSE OUTCOMES:

- CO1. Demonstrate process simulation software
- CO2. Solve chemical engineering problems
- CO3. Analyze mixing problems
- CO4. Develop simulation for heat exchangers
- CO5. Develop simulation for separation process
- CO6. Examine chemical process plant

SCHA3014	PETROLEUM CHEMISTRY	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

Course Objective:

- A discipline which studies the various problems associated with petroleum production.
- To develop greater and better ways of solving associated problems with production of petroleum products.

UNIT 1: INTRODUCTION**9 Hours**

Composition of Petroleum – separation by molecular weight, type; Composition maps; Petroleum analysis and evaluation – ASTM evaluation, spectroscopic methods

UNIT 2: COMPOSITION OF CRUDES**9 Hours**

Metals and heteroatom's in heavy crude oil – heteroatom's concentrations, structure of heteroatom functions; Asphaltenes and structure of petroleum

UNIT 3: HEAVIER DISTILLATES**9 Hours**

Thermal chemistry of petroleum constituents – visbreaking, coking, hydro treating, Hydrocracking

UNIT 4: UPGRADATION PROCESS**9 Hours**

Heavy oil up gradation processes- carbon rejection, hydrogen addition; **Hydrocracking – reactions, catalysts, process configurations**

UNIT 5: REFINING OPERATIONS**9 Hours**

Instability of petroleum products – distillate and residual products; Incompatibility in refining Operations

Total hours: 45**COURSE OUTCOMES:**

- CO1. - Utilize the Composition of Petroleum
 CO2. - Apply the Metals and heteroatoms in heavy crude oil.
 CO3. - Examine Thermal chemistry of petroleum constituents.
 CO4. - Analyze the Heavy oil up gradation processes and its applications
 CO5. - Evaluate Hydro cracking systems
 CO6. - Apply the concept of Instability of petroleum products

TEXT / REFERENCE BOOKS

1. Speight, J.G., The chemistry and technology of petroleum, Marcel Dekker, New York, 1998
2. Speight, J.G., Petroleum chemistry and refining Taylor and Francis, London, 1998
3. Production Chemicals for the Oil & Gas Industry, 2 nd Edition, CRC Press, Malcolm A. Kelland
4. The Chemistry and Technology of Petroleum, by James G. Speight, Fourth Edition, 4th Edition. 2010

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100

PartA:10 Questions of 2marks each-No choice

PartB:2 Questions from each unit of internal choice, each carrying 16marks

Exam Duration: 3Hrs.

20 Marks

80 Marks

SCHA3015	HSE & FE IN PETROLEUM INDUSTRY	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

Course Objective:

- Knowledge of environment issues and all related acts, drilling fluids and its toxic effects with environment..
- Treatment of produced water and makeup water and its disposal as per state pollution control board norms.
- Oil mines regulations and proper implementation in drilling & production mines as per Act.

UNIT 1: INTRODUCTION**9 Hours**

Introduction to environmental control in the petroleum industry: Overview of environmental issues- A new attitude .Drilling and production operations

UNIT 2: Impact of drilling and production operations**9 Hours**

Measuring toxicity- Hydrocarbons- Salt-Heavy metals- Production chemicals- Drilling fluids- Produced water, Air pollution- Acoustic impacts- Effects of offshore platforms- **Risk assessment. Environmental transport of petroleum wastes.**

UNIT 3: Mines regulations**9 Hours**

Introduction>Returns, **Notices and plans- Inspector, management and duties-** Drilling and work over- Production- Transport by pipelines- Protection against gases and fires- Machinery, plants and equipment- General safety provisions.

UNIT 4: RISK ANALYSIS**9 Hours**

Toxicity, physiological, respiratory, **skin effect of petroleum hydrocarbons** and their mixture. Guidelines for occupational health monitoring in oil and gas industry. Corrosion in petroleum industry- Additives during acidizing, sand control and fracturing.

UNIT 5: HAZARDS**9 Hours**

Hazard identification- **Hazard evaluation- Hazop and what if reviews-** Developing a safe process and safety management- Personal protection systems and measures. Guidelines on internal safety audits (procedures and checklist). Work permits systems. Well blowout fires and their control- **Fire fight equipment-Suppression of hydrocarbons fires.**

Total hours: 45**COURSE OUTCOMES:**

- CO1. - Utilize the knowledge of various act related to safety
- CO2. - Apply the concepts involved in drilling operations.
- CO3. - Examine the drilling fluids and their composition
- CO4. - Analyze the oil storage and transportation
- CO5. - Evaluate the risk analysis
- CO6. - Apply the concept safety on petroleum products

TEXT / REFERENCE BOOKS

1. Environmental Control in Petroleum Engineering, John C. Reis, Gulf Publishing Company, 1996.
2. Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries, Dennis P. Nolan, Noyes Publications, 1994.
3. Oil Industry Safety Directorate (OISD) Guidelines, Ministry of Petroleum & Natural Gas, Government of India and Oil Mines Regulations-1984, Directorate General of Mines Safety, Ministry of Labor and Employment, Government of India.
4. Guidelines for Process Safety Fundamentals in General Plant Operations Centre for Chemical Process Safety, American Institute of Chemical Engineers, 1995.
5. Guidelines for Fire Protection in Chemical, Petrochemical and Hydrocarbon Processing Facilities, Centre for Chemical Process Safety, American Institute of Chemical Engineers, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100

PartA:10 Questions of 2marks each-No choice

PartB:2 Questions from each unit of internal choice, each carrying 16marks

Exam Duration: 3Hrs.

20 Marks

80 Marks

SCHA3016	SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

Course Objective:

- To impart knowledge on the nanomaterials
- To understand the methods of synthesizing nanomaterials
- To understand the characterization of nanomaterials

UNIT 1: CLASSIFICATIONS**9 Hours**

Classifications and types of nanomaterials as nano particles and 1D 2D 3D, nanomaterials. Concept of bulk versus nanomaterials and dependence of properties on size. Introduction to 'Top down' vs. 'Bottom up' approach of synthesis with suitable examples.

UNIT 2:SYNTHESIS OF NANOMATERIALS**9 Hours**

Nano synthesis techniques based on liquid and vapor phase as the starting material. The study of wet chemical method like sol-gel method, hydrothermal, micro emulsion technique, chemical reduction, decomposition of organometallic precursors and chemical vapor deposition, metallo-organic chemical vapor deposition.

UNIT 3:MECHANICAL METHODS**9 Hours**

Mechanical milling, laser ablation, microwave and ultrasound assisted synthesis sputtering and microwave plasma, photolysis, radiolysis, surfactant behavior, micelles, self-assembled mono layers (SAM's), Langmuir-Blodget (LB)films.

UNIT 4:QD'S NANOWIRES**9 Hours**

Preparation of quantum dots, nanowires and films, preparation of single walled and multiwalled nanotubes

UNIT 5:CHARATERIZATION**9 Hours**

Techniques of characterization of size of nano powders/ particles using BET method and laser diffraction. Various spectroscopic techniques like optical spectroscopy. UV visible and Infrared spectroscopy. Raman spectroscopy. X-ray photoelectron spectroscopy. Basic understanding of each technique with special emphasis on characterization at nano scale. X-ray Fluorescence (XRF), X-ray diffraction (XRD) and Small Angle X-ray Scattering principles

Total hours: 45**COURSE OUTCOMES:**

- CO1. - Utilize the types of nanomaterials with examples
 CO2. - Apply the techniques used for top down and bottom-up approach.
 CO3. - Examine the production of nanoparticles by different methods.
 CO4. - Analyze the assemblage of nanomaterials
 CO5. - Evaluate the quantum dots, nanowires and films
 CO6. - Apply the characterization of nanomaterials

TEXT / REFERENCE BOOKS

1. Nanomaterials Chemistry by Rao C. N., A. Muller, A. K. Cheetham, WileyVCH, 2007.
2. Nanomaterials and Nanochemistry by Brechignac C., P. Houdy, M. Lahmani, Springerpublication, 2007.
3. Nanoscale materials in chemistry by Kenneth J. Klabunde, Wiley IntersciencePublications,2001.
4. Nanochemistry by Sergeev G.B., Elseiver publication,2006.
5. Nanostructures and Nanomaterials, synthesis, properties and applications by Guozhong Cao, Imperial College Press, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100

PartA:10 Questions of 2marks each-No choice

PartB:2 Questions from each unit of internal choice, each carrying 16marks

Exam Duration: 3Hrs.

20 Marks

80 Marks



Activities : Guest talk By Mr.Stalin on Chemical Process Industries



Activities: Energy Audit – One day workshop



Activities : Lecture series on Environmental Management on account of World environment day