

B.TECH VII SEMESTER CHEMICAL ENGG.

VII SEMESTER COURSE CONTENTS (AICTE SCHEME)

CM-7301	Mass Transfer Equipment Design	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	0	0	3	70	22

OBJECTIVES: To understand advances in the design of Chemical process mass transfer equipments.

UNIT-1: Process design and column sizing of mass transfer distillation equipment both plate as well as packed type. Type of towers, types of plate contractors, Sieve tray layout and hydraulic design, packed towers column internals, Types of packing, general pressure drop correlation, Column diameter and height. Checking of conditions for weeping, down comer flooding, liquid entrainment, etc, tray efficiency, Jet Flooding & down comer Flooding, Different types of weirs & down comers of tray tower, their selection criteria.

UNIT-2: Process design and column sizing of mass transfer Absorption tower both plate as well as packed type. Type of towers, types of plate contractors, Sieve tray layout and hydraulic design, packed towers column internals, Types of packing, general pressure drop correlation, Column diameter and height. Process design & selection criteria of liquid distributors, redistributors & packing support, Process design of Spray chamber or spray tower type absorber, Venturi Scrubber.

UNIT-3: Process design and column sizing of mass transfer extraction columns both plate as well as packed type. Type of towers, types of plate contractors, Sieve tray layout and hydraulic design, packed towers column internals, Types of packing, general pressure drop correlation, Column diameter and height. Process design of counter current multistage extractor, Selection criteria among different types of extractor, Process design of mixer-settler type extractor, Guidelines for the design of other types of extractors

Course Outcomes (CO):

The students will be able to:

1. Design process equipment and modify the design of existing equipment to new process conditions or new required capacity.
2. Build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
3. Create understanding of equipment design.
4. Review the importance of design concepts in process industry.

Text Books:

1. J.M. Coulson and J. Richardson, "Chemical Engineering", Vol. 6, Asian Books Printers Ltd.
2. S.B.Thakore and B.I.Bhatt Introduction to Process Engineering and Design, McGrawHill, 2009
3. Sinnott R.K.; "Coulson and Richardson's Chemical Engineering Series", Vol. VI, 4th Ed., Butterworth-Heinemann.
4. M. S. Peters and K. D. Timmerhaus, Plant Design and Economics for Chemical Engineers, 4 th ed., McGraw - Hill, New York, 1991.

Reference Books:

1. R.H. Perry, "Chemical Engineers' Handbook", McGraw-Hill.
2. Couper, "Chemical process equipment design

B.TECH VII SEMESTER CHEMICAL ENGG.**COURSE CONTENTS (AICTE SCHEME)**

CM-7302	Modeling & Simulation	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	1	2	5	70	22

COURSE OBJECTIVES:

To make the students understand physical systems in chemical engineering and to develop their mathematical models and solutions for these models. The students will also learn to use the commercial process simulators.

Unit I**Introduction to Modelling and Simulation**

Purpose of modeling and simulation .Uses of mathematical modeling in engineering, Classification of models. Process analysis. Steps for process analysis, Development of model. Model evaluation (calibration, verification, validation), Introduction of commercial process simulators and their applications.

Unit II**Modeling of Simple Chemical Engineering System**

Basic models of flow system, modeling of gravity flow tank. Basic model of mixing system, Basic models of Heat and Mass transfer processes.

Unit III**Mathematical Modelling of reactors.**

Batch reactor

CSTR, CSTR in series, Non-isothermal CSTR

Plug Flow reactor

Bio reactors

Unit IV**Mathematical Modeling of Separation Processes**

1) Compartmental modeling of Ideal Binary Distillation column.

2) Stage wise modeling of Ideal Binary Distillation column.

Unit V**Modeling of Vaporization Processes**

Single component Vaporizer

Evaporator - single and multiple effect.

Course Outcomes:

- Understand the important physical phenomena from the problem statement
- Develop model equations for the given system
- Demonstrate the model solving ability for various processes/unit operations
- Demonstrate the ability to use a process simulation

List of Experiments:

1 Modelling equation formulation, calibration and verification with the experimental data of different types of tanks

- Cylindrical Tank (Vertical Axis)
- Cylindrical Tank (Horizontal Axis)
- Cylindrical Tank (Horizontal Axis) Half Cut
- Spherical Tank
- Conical Tank
- Wedge Shape Tank
- Cylindrical Tank with conical bottom
- Cylindrical Tank with Spherical bottom
- Interacting Tank System
- Non interacting Tank System

MICROSOFT EXCEL SOFTWARE

Excel used to solve chemical engineering problems. Use goal seek, regression, solver to solve the problem. Solve differential equation using RunngaKutta method, matrix methods.

POLYMATH

Solving simultaneous equation and differential equation using Polymath. Specific examples with Chemical Reaction Engineering problems, Process control problem.

MATLAB

Solving chemical engineering Problem using Matlab. Simultaneous equation, Differential equation and Partial differential Equation. Simulink tool for chemical process and process control.

ASPEN SOFTWARE

Simulation of simple unit operations equipments Distillation, extraction and absorption. Reactors simulation. Simulation of simple process flow sheets.

CHEMCAD

Solving Design problems, Equipment Sizing , Property calculation

CM-7332 (EL-III)

BE VII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-7023	Fertilizer Technology	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	1	0	4	70	22

Unit- I

Introduction:

Plant nutrients, different types of fertilizers and their production in India. Different feed stocks. Synthesis gas production by steam-naphtha reforming and gas purification. Ammonia synthesis.

Unit- II

Nitrogenous Fertilizers:

Urea manufacturing processes. Manufacture of sulphuric acid and ammonium sulphate. Nitric acid and ammonium nitrate manufacture.

Unit - III

Phosphatic Fertilizers:

Availability and grinding of rock phosphate, manufacturing processes for single and triple super-phosphate and phosphoric acid.

Unit- IV

Mixed Fertilizers:

Availability and manufacture of muriate of potash.

Mixed Fertilizers: Mono and di-ammonium phosphate, urea ammonium phosphates, NPK complex fertilizers, granulation techniques.

Unit-V

Major Engineering Problems:

Fertilizers storage and handling. Corrosion problems in fertilizers industries. Fertilizer plant effluent treatment and disposal.

Suggested Readings:

1. Slack A.V. "Chemistry and Technology of Fertilizers", Wiley Interscience Publishers.
2. Waggaman W.H., "Phosphoric Acid, Phosphates and Phosphatic Fertilizers", Hafner Pub.
3. Austin G.T., "Shreve's Chemical Processes Industries", 5th Ed. McGraw Hill.
4. Rao M.G. and Sittig M., "Dryden's Outlines of Chemical Technology", Affiliated East West Press, Delhi.

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Elective-III

B.TECH VII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (AICTE SCHEME) CM-7331							
CM-7334	Petroleum Process Technology	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	0	2	4	70	22

Course objectives: Studying this subject the students will learn about the extraction and production of oil and gas to meet energy needs, as well as refining of crude oil for a wide spectrum of useful products such as petrochemicals, Chemicals, Plastics.

Unit-I

Origin of Petroleum:

Origin and occurrence of petroleum crude, status of petroleum refining in India. Composition of petroleum, classification and physical properties of petroleum. Evaluation of crude oil and petroleum products, future refining trends.

Unit -II

Distillation of Crude

Crude oil Distillation Process, Pretreatment of crude, atmospheric and vacuum distillation process. Secondary conversion processes: Catalytic reforming, catalytic cracking and deep catalytic cracking.

Unit - III

Heavy Residue Up gradation:

Hydro cracking, Hydro treating, visbreaking and delayed coking alkylation, isomerisation, dehydrogenation processes, polymerization.

Unit - IV

Lubricating Oil, Grease and Bitumen:

Dewaxing and deoiling, deasphalting, lube hydro-finishing, bitumen air blowing, Sweetening and Desulphurization. Hydro-desulphurisation of petroleum products.

Unit - V

Solvent Extraction:

Solvent furfural process, refinery gas utilization: LPG, propylene and hydrogen recovery, Reformulated Gasoline: Present and future requirements.

Course Outcomes:

- ☐ Introduction with the petroleum refinery worldwide
- ☐ Develop knowledge of different refining processes
- ☐ Develop knowledge of safety and pollution control in the refining industries.
- ☐ To find the suitable refining technology for maximizing the gasoline yield

Suggested Readings:

1. Nelson W.L. - PETROLEUM REFINERY ENGINEERING - 4th ed. McGraw Hill . (1987)
2. Hobson G.D. et al. - MODERN PETROLEUM TECHNOLOGY - Part I & II 9th ed. 1986. John Willy & Sons.

B.Tech VII Semester CHEMICAL ENGINEERING							
COURSE CONTENTS							
CM-7335	SUSTAINABILITY ENGINEERING	L	T	P	C	Max . Marks	Min . Marks
Duration	3 Hours	3		2	4	70	22

Course objective: The design of this course is to inculcate the utilization of conventional and non conventional energy sources, green technology to improvise our existing process technologies.

UNIT-

Introduction to Sustainable Engineering- Sustainable development, concepts of sustainable development: three pillar model, egg of sustainability model, Atkisson's pyramid model, prism model, principles of sustainable development, sustainable engineering, threats for sustainability.

UNIT- II

Local Environmental Issues- Solid waste, impact of solid waste on natural resources, zero waste concept and three R concept, waste to energy technology: thermo-chemical conversion, biochemical conversion.

Global Environmental Issues- Resource degradation: deterioration of water resources, land degradation.

UNIT-III

Tools for Sustainability - Environmental management System (EMS), concept of ISO14000, life cycle assessment (LCA): basic components, advantages, disadvantages, case study. Environmental impact assessment (EIA), environmental auditing, bio mimicking, case studies.

UNIT-IV

Sustainable Habitat - Concept of green building, green building materials, green building certification and rating: green rating for integrated habitat assessment (GRIHA) , leadership in energy and environmental design (LEED) rating, energy efficient buildings, sustainable cities, sustainable transport, sustainable pavements.

UNIT-V

Renewable energy resources- Conventional and non- conventional forms of energy, solar energy, small hydro plants, biogas systems, biofuels.

Green technology and Green Business: Sustainable business, green technology, green energy, green construction, green transportation, green chemistry, green computing.

List of Experiments

- 1) To study the bomb calorimeter, boy's calorimeter.



8.8.2023
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B.TECH VII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (AICTE SCHEME)							
CM-7341	Energy Management	L	T	P	C	Max. Marks	Min. Marks
Duration	3 Hours	3	0	-	3	70	22

Course objectives:

- Familiarizing with Energy management, especially with energy sector engineering.
- Fundamentals of product strategy management and Environmental impacts on it.
- Studying methods of energy accounting and energy auditing in energy sector, industry and final consumption.
- Finding Steam section efficiencies especially in electrical units of Pumping system and Refrigeration systems.
- Finding opportunities to increase the rational use of energy and understanding Waste Heat Recovery and Insulation.
- Understanding Energy targeting with its Modeling.

Unit- I

Introduction to Energy Management:

Definition, need and types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel & energy substitution, Energy audit instruments.

Unit – II

Energy and Environment Monitoring:

Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques-energy consumption, production, cumulative sum of differences (CUSUM).

Global environmental concerns: United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), Prototype Carbon fund (PCF).

Unit – III

Energy Efficiency:

Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings.

Energy efficiency in Electrical Utilities: Electrical system, Electric motors, HVAC and Refrigeration System, Fans and blowers, Pumps and Pumping System, Cooling Tower, Lighting System.

Unit – IV

Waste Heat Recovery and Insulation:

Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential. Insulation-types and application, economic thickness of insulation, heat savings & application criteria, Refractory-types, selection and application of refractories, heat loss.

Unit- V

Heat Exchanger Networks and Pinch Technology:

Energy targeting, area targeting, number of units targeting, shell targeting, cost targeting Pinch design methods, Grid diagram, composite curve, problem table algorithm, grandcomposite curve.

Course Outcome

- Understanding basics of demand side management and mechanisms (technical, legal or financial) that influence energy consumption.
- Recognizing opportunities for increasing rational use of energy.
- Learning the basics of energy auditing with application on different sectors.
- Understanding of energy conservation and identification of energy conservation opportunities in various industrial processes
- Knowledge of various tools and components energy auditing
- Ability to evaluate the performance of industrial boilers, furnaces etc. by direct and indirect methods
- Understanding of cogeneration in industry and waste heat recovery techniques and devices

Suggested Readings:

1. Goodall P. M., "The Efficient Use of Steam", Editor: Westbury House
2. Mannan S., "Lee's Loss Prevention in the Process Industries", Vol. I, Vol. II 2nd Ed., Butterworth Heinemann.
3. Kafarov V. V., "Wasteless Chemical Processes", Mir.
4. Shenoy U. V., "Heat Exchanger Network Synthesis", Gulf Publishing Company.
5. Kemp I. C., "Pinch Analysis and Process Integration: A user Guide on Process Integration for the Efficient Use of Energy", 2nd Ed., Butterworth-Heinemann.
6. Henderson S. M., Perry R. L., and Young J. H., "Principles of Process Engineering", 4th Ed., Asae.
7. D.Reay, "Industrial Energy Conservation".

CM-7342

B.Tech VII Semester CHEMICAL Engg.

COURSE CONTENTS (UEC SCHEME)

		L	T	P	C	Max. Marks	Min. Marks
CM-7042	Process Safety & Hazard Management	3	1	0	4	70	22
Duration	3 Hours						

COURSE OBJECTIVE

Large number of activities is observed during the production of different types of chemicals along with the use of latest technology, process control and quality products. In all these work requires step wise procedure and rules to maintain smooth operation and to avoid the chances of accidents and fire. Therefore the basic knowledge of different aspects of safety and the procedures of maintaining smooth operation in the industry, the course has been designed.

Unit- I

Introduction:

Origin of process hazards, Laws Codes, Standards, Case Histories, Properties of Chemicals, and Health hazards of industrial substances.

Unit - II

Toxicology:

Toxic materials and their properties, effect of dose and exposure time, relationship and predictive models for

Unit - III

Fire & Explosion:

Fire and explosion hazards, causes of fire and preventive methods. Flammability characteristics of chemical, fire and explosion hazard, rating of process plant. Propagation of fire and effect of environmental factors, ventilation, dispersion, purifying and sprinkling, safety and relief valves.

Unit- IV

Energy Hazards:

Electrical hazards, noise hazard, radiation hazard in process operations, hazards communication to employees, plant management and maintenance to reduce energy hazards.

Risk Analysis: Component and plant reliability, event probability and failure, plant reliability, risk analysis,

Unit- V

Analysis and Assessment:

HAZOP AND HAZAN, event and consequence analysis (vapour cloud modelling) Designing for safety, measurement and calculation of risk analysis.

Hazard Assessment: Failure distribution, failure data analysis, modeling for safety, safety training, emergency planning and disaster management, case studies.

COURSE OUTCOME

The study of the different rules and regulation and act along with the identification and analysis of hazardous zone may help the man power to avoid accidents simultaneously achieving the production schedule. Familiarization with the safety aspects will save the industry as well as man power

1. Familiar with the different aspects of safety and hazard management.
2. Familiar with the working of safety equipments.
3. Capable of designing safety equipments, hazards identification etc.

Suggested Readings:

1. Crawl D.A. and Louvar J.A., Chemical process safety fundamentals with applications," Prentice Hall of India Delhi.
2. Wentz, C.A., "Safety health and environmental protection," McGraw Hill, 2001.
3. Smith, B.D., "Design of equilibrium state process," McGraw Hill I.
4. Van Winkle, "Distillation," McGraw Hill.