IPS Academy, Indore, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Scheme Based on AICTE Flexible Curricula

VII Semester — Bachelor of Technology (B.Tech.) [Chemical Engineering]

S.No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	CM -701	DC	Process Equipment Design-II	70	20	10	30	20	150	2	1	2	4
2.	CM -702	DE	Departmental Elective	70	20	10	-	-	100	3	1	-	4
3.	CM -703	OE	Open Elective	70	20	10	-	-	100	3	0	0	3
4.	CM -704	D Lab	Energy Lab	-	--	-	30	20	50	-	-	6	3
5.	CM -705	O/E lab	Environmental Engineering Lab	-	-	-	30	20	50	-	-	6	3
6.	CM -706	P	Major Project-I	-	-	-	100	50	150	-	-	8	4
7.	CM -607		Evaluation of Internship -III	-	-	-	-	100	100	-	-	6	3
8.	Additional Credits#	*#Additional credits can be earned through successful completion of credit based MOOC's Courses available on SWAYAM platform (MHRD) at respective U Glevel.*											
			Total	210	60	30	190	210	700	8	2	28	24

Departmental Electives	Open Electives
702(A) Transport Phenomena	703(A) Environmental Engineering
702 (B) Bio-process Technology	703(B) Process Intensification
702 (C) Petrolium Refining Engineering	703(C) Non-conventional energy Sources

1 Hr Lecture	1 Hr Tutorial	2 Hr Practical
Credit	1 Credit	1 Credit

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Chemical Engineering Department
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CM-701 Process Equipment Design-II

Unit I Scale up criteria and scale up of process equipment. Process design calculations for heat exchanges equipment double pipe and shell and tube heat exchangers general description, heat transfer coefficients and pressure drop by Kern's & Bell's methods rating on existing unit.

Unit II Design of a new system having one or more units in series: single effect evaporator, multiple effect evaporator with boiling point elevation.

Unit III Process design calculations for mass exchange equipment plate and packed column for distillation and absorption including column diameter and height.

Unit IV Detailed process and mechanical design, Flash drum , Kettle reboiler, condenser, cooling tower rotary drier, tray drier.

References:

1. Perry, Robert etal; Perry's Chemical Engg. Handbook; TMH
2. Ludwig E; Applied process design in chemical petrochemical plants; Gulf publishing co.
3. Mahajani V V, Umarji SB; Process Eqipment Design; MacMillan Pub.
4. Kern D; Process Heat Transfer; TMH
5. Smith B. D; Design of equilibrium stages.
4. Coulson JM. Richardson JF; Chemical engg. Vol ;. Pergaman process

List of Experiments (Please expand it):

Each student should design a complete chemical process plant with mechanical design details of at least three major equipments.

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Departmental Elective CM- 702 (A) Transport Phenomena

Unit-I Similarity in momentum, heat and mass-transport - Newton's laws of viscosity, Fouriers laws of conduction and Fick's laws of diffusion, Flux-transport property relationships, Estimation of transport properties measurement and correlations, velocity distribution in Laminar flow of falling film. Flow over an inclined plane, a circular tube an annulus and between two parallel plates.

Unit-II Shell balance approach for developing equations of change for momentum, heat and mass transport, Equations of change and their approximations for transport in one dimension.

Unit –III Transport equations in turbulent flow and equations for turbulent fluxes, velocity, temperature and concentration profiles for laminar and turbulent flow conditions, temperature and concentration profiles for conductive and convective transport in solids and fluids.

Unit-IV Macroscopic momentum and heat balance equations, Kinetic energy calculations. Constant area and variable area flow problems. Flow through bends, time determination for emptying of vessels.

References:

1. Bird R.B., Stewart W.E. and Lightfoot EW; Transport phenomena; Wiley tappon
2. Brodkey RS and Hershey -Transport phenomena a unified approach; TMH
3. Geancoplis; Transport processes & separation process principles; PHI learnin

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Chemical Engineering Department

B. Tech. VII-Semester

Departmental Elective CM- 702 (B) Bio-process Technology

Unit I Introduction to Bio-Chemical Engineering: Aspects of microbiology, cell theory structure of microbial cells, classification of microorganism, Essential chemicals of life lipids, Sugars and Polysaccharides, RNA and DNA, Amino acids and proteins.

Unit II Metabolism and Energetic: Assimilatory and dissimilatory process, metabolic mechanism of the cells; Biochemical Kinetics: Simple enzyme kinetics with one or two substrates, modulation and regulation of enzymatic activity, enzyme reactions in heterogeneous systems.

Unit III Growth cycle, phases for Batch cultivation, mathematical modeling of batch growth, roducts synthesis Kinetics, overall kinetics and thermal death kinetics of cells and spores.

Unit IV Unit Operations in Biochemical Process: Agitation and aeration, gas liquid mass transfer, determination of oxygen transfer rates, determination of Kga and KLa scaling of mass transfer equipment, heat balance and heat transfer correlation for biochemical systems, sterilization, filtration and drying.

Unit V Design and Analysis of Bio-Reactors: Classification and characterization of different bioreactors, batch and continuous reactors, tubular, CSTR and tower reactors, aerobic and anaerobic fermentation-process, design and operation of typical aerobic and anaerobic fermentation processes, manufacture of microbial products e.g. antibiotics alcohol/ wine etc; use of immobilized enzyme and whole cells for industrial processes.

References:

1. Baily, J .E. and Ollis D.F; Biochemical Engineering Fundamentals; Mc. Graw Hill
2. Coulson and Richardson; Chemical Engineers;
3. Shuler, Kargi; Bioprocess Engineering basic concepts.; PHI Learning
4. Rao ; Introduction to Biochemical Engineering; TMH

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Departmental Elective CM- 702 (C) Petrolium Refining Engineering

Unit-I Origin of Petroleum: Origin of petroleum crude, status of petroleum refining in India. Composition and classification of petroleum, Properties of petroleum product such as Octane number, Cetane number, API gravity, viscosity, flash point, cloud point, diesel index etc. future refining trends.

Unit –II Distillation of Crude: Crude oil Distillation Process, Pretreatment of crude,, Atmospheric and vacuum distillation process. Catalytic reforming, platforming, hydroforming, catalytic cracking, FCC process,and TCC process.

Unit -III Heavy Residue Up gradation: Hydro cracking, Hydro treating, Visbreaking delayed coking, alkylation, isomerisation, polymerization processes.

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 Refinery gas utilization: LPG, and hydrogen recovery, Reformulated Gasoline, Uses of petroleum products, Pollution from oil refineries, Future refining trends.

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.
3. R. N. Watkins, "Petroleum Refinery distillation" Gulf Publishing Co.
4. Robert A. Mayers, "Hand book of petroleum refining process ".
5. James G Speight, "The chemistry and technology of petroleum ".
6. J.H. Gary and G.E. Handwerk, "Petroleum Refinery Technologies and economics ".

COURSE OUTCOME

1. Ability to understand origin, composition & classification of petroleum
2. Ability to understand crude oil distillation process & to understand the concept of catalytic cracking and reforming processes.
3. Ability to discuss alkylation, isomerization, polymerization processes.
4. Ability to understand the manufacture of lubricating oil & to know sweetening and desulphurization processes.
5. Ability to enhance the knowledge of petroleum products, their properties and characterization and discuss about LPG and hydrogen recovery

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Open Elective CM- 703 (A) Environmental Engineering

Unit I Environmental Management:
Nature of environment, major component of life support system industrial development and environmental degradation, environmental impact assessment, national environmental policies, environmental guidelines for process industries, environmental pollution control through planned industrial development; environmental pollution and its effect on human beings, animal and vegetation system, concept of sustainable development.

Unit - II Air Pollution:
Sources and effect of air pollution, classification of air pollutants, emission standard of air pollution. Meteorological condition influencing air pollution, Chemical inversion, principle, working principle of control equipment for particulate emission and gaseous pollutants like cyclone separator, gravity settling chamber, multi-tray settling chamber, bag filter, scrubber, E.S.P.

Unit -III Water Pollution:
Sources and effect of water pollution, water born diseases, classification of water pollutants, physical, chemical and bacteriological analysis of water; pollution laws and limits, effluent standards;, working principle of waste water and industrial effluent treatment plants (physiochemical and biological), introduction to advanced treatment methods, modern trends in sedimentation and filtration.

Unit - IV Pollution due to solid waste and Noise
Sources and effects of solid waste and Nature of domestic, municipal, agricultural, industrial, Hospital, Nuclear Wastes; collection, treatment and disposal of solids waste; waste recovery system, solid waste management; sources and effects of noise pollution noise pollution, noise measurement and control; noise mitigation measures.

Unit - V Case study with respect to air, water and solid waste:
Fertilizer industry, refinery and petrochemical industries, pulp and paper industries, tanning industry, sugar and alcohol industries, alkali industries, cement and steel industries.

References:
1. Rao C S; Environmental Pollution Control Engineering; New Age India Ltd.
2. Mahajan S P; Pollution Control in Process Industries
3. Canter Lary; Environmental Impact Assessment; TMG
4. Keily; Environmental Engineering; TMG
5. Miller GT Jr; Environmental sciences-working with earth; Cegage Pub

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Open Elective CM- 703 (B) Process Intensification

UNI I

Introduction: Techniques of process Intensification (PI) Applications, The philosophy and opportunities of process Intensification, Main benefits from process intensification, Process-Intensifying Equipment, Process intensification toolbox, Techniques for PI application.

UNITII

Process Intensification through micro reaction technology: Effect of miniaturization on unit operations and reactions, Implementation of Microreaction technology, from basic properties to Technical Design Rules, Inherent Process Restrictions in Miniaturized Devices and Their Potential Solutions, Microfabrication of Reaction and unit operation Devices-Wet and Dry Etching Processes.

UNITIII

Scales of mixing, Flow patterns in reactors, mixing in stirred tanks: Scale up of mixing, Heat transfer, Mixing in intensified equipment, Chemical processing in High-Gravity Fields Atomizer Ultrasound Atomization, Nebulizers, High intensity inline MIXERS reactors Static mixers, Ejectors, Tee mixers, Impinging jets, Rotor stator mixers, Design Principles of static Mixers Applications of static mixers, Higee reactors. Combined chemical reactor heat exchangers and reactor separators: Principles of Operation; Applications, Reactive absorption, Reactive distillation, Applications of RD Processes, Fundamentals of Process Modeling, Reactive Extraction Case Studies: Absorption of NOx Coke Gas Purification.

UNITIV

Compact heat exchangers: Classification of compact heat exchangers, Plate heat exchangers, Spiral heat exchangers, Flow pattern, Heat transfer and pressure drop, Flat tube-and-fin heat exchangers, Microchannel heat exchangers, Phase-change haet changer, selection of heat exchanger technology, Feed/effluent heat exchangers, Integrated heat exchangers in separation processes, Design of compact heat exchanger-example.

UNITV

Enhanced fields: Energy based intensifications, Sono-chemistry, Basics of cavitation, Cavitation Reactors, Flow over a rotating surface, Hydrodynamic cavitation applications, Cavitation reactor

design, Nusselt –flow model and mass transfer, The rotating Electrolytic Cell, Microwaves, Electrostatic fields, Sonocrystallization, Reactive separations, Superctrical fluids.

References:

1. Stankiewicz, A. and Moulijn, (Eds.) Reengineering the chemical Process Plants, Process Intensification, Marcel Dekker, 2003.
2. Reay D., Ramshaw C., Harvey A., Process Intensification Butterworth Heinemann, 2008.

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Open Elective CM- 703 (C) Non-conventional energy Sources

Course Objective

To make the students understand the different non-conventional energy source advancement and their application in worldwide. To gain knowledge on environmental problems due use of conventional energy sources.

Unit- I Introduction:

Energy scenario of supply and demand in India and the world, energy consumption in various sectors, potential of non-conventional energy resources.

Unit- II Solar Energy:

Solar radiation and its measurement, limitations in the applications of Solar Energy, Solar collectors – types, and constructional details. Solar water heating, applications of Solar Energy for heating, drying, space cooling, water desalination, solar concentrators, photovoltaic power generation using silicon cells.

Unit- III Wind Power:

Principle of energy from wind, windmill construction and operational details and electricity generation and mechanical power production. Tidal Power: Its meaning, causes of tides and their energy potential, enhancement of tides, power generation from tides and problems. Principles of ocean thermal energy conversion (OTEC) analysis and sizing of heat exchangers for OTEC.

Unit- IV Geothermal Energy:

Geo technical wells and other resources dry rock and hot aquifer analysis , harnessing geothermal energy resources.

Unit- V Energy Storage and Distribution:

Importance, biochemical, chemical, thermal, electric storage. Fuel cells, distribution of energy.

References:

1. Rai, G.D., “Non-Conventional Energy Sources,” Khanna Publishers, New Delhi, 2001.
2. Twiddle, J. Weir, T. “Renewable Energy Resources,” Cambridge University Press, 1986.
3. Kreith, F. and Kreider, J. F., “Principles of Solar Engineering,” McGraw Hill, 1978.
4. Veziroglu, N., “Alternative Energy Sources,” Volume 5 & 6, McGraw-Hill, 1978.
5. Sarkar, S., “Fuels and Combustion,” 2nd ed., Orient Longman, 1989.