IPS Academy, Indore, Institute of Engineering & Science

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

Scheme Based on AICTE Flexible Curricula

VIII 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 -801	DC	Chemical Process Modeling & Simulation	70	20	10	30	20	150	2	1	2	4
2.	CM -802	DE	Departmental Elective	70	20	10	-	-	100	3	1	-	4
3.	CM -803	OE	Open Elective	70	20	10	-	-	100	3	-	-	3
4.	CM -804	D/O/E Lab	Petrochemical Technology Lab	-	--	-	30	20	50	-	-	6	3
5.	CM -805	P	Major Project-II	-	-	-	70	30	100	-	-	8	4
6.	Additional Credits[#]	*[#]Additional credits can be earned through successful completion of credit based MOOC's Courses available on SWAYAM platform (MHRD) at respective UG level.*											
			Total	210	60	30	130	70	500	8	2	16	18

Departmental Electives	Open Electives
802(A) Process Piping Design	803(A) Process Plant Economics & Management
802 (B) Process safety & Hazards Management	803(B) Petrochemical Technology
802 (C) Fertilizer Technology	803(C) IPR (Intellectual Property Right)

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

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Syllabus Based on AICTE Flexible Curricula

Chemical Engineering Department

B. Tech. VIII-Semester

CM801- Chemical Process Modeling & Simulation

Unit I The role of analysis: chemical engineering problems, basic concepts of analysis; the analysis process, simple example of estimating an order, source of the model equations, conservation equations, constitutive equations, control volumes, dimensional analysis, system of units, dimensional consistency in mathematical descriptions, dimensional analysis and constitutive relationships, final observations.

Unit II Non-Reacting Liquid Systems: Introduction, equation of continuity, simple mass balance, application of the model equations, component mass balances, model behavior: steady state behavior, un-steady state behavior, density assumption, numerical integration methods of ordinary differential equation; Reacting Liquid Systems: Introduction, basic model equations for a tank-type reactor, reaction rate, batch reactor, pseudo first-order reactions, reversible reactions, multiple reactions; consecutive reactions, parallel reactions, complex reactions, constant density assumption, order and stochiometry.

Unit III Treatment of experimental data: Introduction, criteria for Best Fit, Best Slope-I, Best Slope-II, Best straight line, physical property correlations, fitting a quadratic, simulation examples of gravity fluid flow, heat and mass transfer, Monte-Carlo simulation.

Unit IV Dynamic modeling of simple processes, sequential, simultaneous modular and equation oriented approaches, partitioning and tearing.

Unit V Computer programming of various iterative convergence methods such as Newton-Ralphson, false position, Wegstein, Muller methods.

References:

1. Russell TWF; Introduction to Chemical Engineering Analysis - John Wiley & Sons
2. Luyben W.L; Process Modeling, Simulation And Control For Chemical Engineers; TMH
3. Jana ; Chemical process modeling and computer simulation; PHI Learning

List of Experiments (Please Expand It) Process Modeling & Simulation CM 804:

1. Process dynamics experiments like flow of incompressible fluids at a variable flow rate.
2. Dynamics of a tank draining through an orifice in the bottom. Differential equation formulation and verification with the experimental data.
3. Mass balance in a tank filling at certain rate and emptying at another rate. Rectangular and wedge-shaped tank and incompressible fluid.
4. Modeling a batch reactor-verification of 151 and 2nd order rate kinetics.
5. Counter current double pipe heat exchanger modeling-data analysis by iterative methods.
6. Simulation of a distillation column-binary systems, equi-molal overflow, constant relative, volatility.
7. Input-Output response study in non-ideal flow reactors.
8. Simulation of a perfectly mixed reactor with heat transfer. Derivation of a mathematical model and solving for study state heat transfer.

Note: Each student should perform at least six experiments out of the above list.

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Chemical Engineering Department

B. Tech. VIII-Semester

Departmental Elective CM 802 (A) Process Piping Design

Unit I

Classification of Pipes and Tube:

IS & BS codes for pipes used in chemical process industries and utilities. Pipes of circular and non-circular cross section-velocity distribution, average velocity and volumetric rate of flow. Flow through curved pipes (Variable cross sections). Pressure drop for flow of Newtonian fluids through pipes. Resistance to flow and pressure drop. Effect of Reynolds and apparent Reynolds number. Recommended design methods.

Unit II

Non-Newtonian Time Independent/Dependent Fluid Flow:

Flow through Process pipes, Shear stress, Shear rates behavior, apparent viscosity and its shear dependence, Power law index, Yield stress in fluids. Recommended design methods.

Time dependant behavior, Mechanical analogues, and velocity pressure relationships for fluid, line.Recommended design methods.

Unit III

Pipe line Design and Power Losses in vertical Flow:

Flow of gas-liquid, liquid- liquid, gas-solid and liquid-solid mixtures in pipes, flow pattern, holdup, pressure gradients and empirical overall correlations, bubble flow pattern, slug flow pattern, annular mist flow pattern Recommended design methods.

Unit IV

Pipe Line Design and Power Losses in Horizontal Flow:

Flow of gas-liquid, liquid- liquid, gas-solid and liquid-solid mixtures in pipes, flow pattern, holdup, pressure gradients and empirical overall correlations, bubble flow pattern, slug flow pattern, annular mist flow pattern, Lockhart Martinelli relations, Flow pattern regimes. Recommended design methods, Case studies.

Unit V

Introduction to software (Casesuse-II, Caepipe), Case studies in real problem from industries.

Suggested Readings:

1. Govier, G.W. an Aziz K.- THE FLOW OF COMPLEX MISTRUES IN PIPE- Krieger Publication, Florida, 1982.
2. McKetta. John .J ,Piping Design Hand Bood, Marcel Drekker
3. Mohinder L Nayyar, Piping Hand Book, McGraw Hill Book Co.
4. Rip Weaver , Process Piping Design Vol. 1, Gulf Publishing Co.
5. Coulson JM and Richardson J.F. – CHEMICAL ENGINEERING – Vol I, VI Edition, Butterwoth Heinemann, British Library, Publication, Oxford, 1999.

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Chemical Engineering Department
B. Tech. VIII-Semester

Departmental Elective CM 802 (B) Process safety & Hazards Management

Course Objective
To know about Industrial safety programs and toxicology, Industrial laws, regulations and source models. To understand about fire and explosion, preventive methods, relief and its sizing methods. To analyze industrial hazards and its risk assessment.

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 response, Threshold value and its definitions, material safety data sheets, industrial hygiene evaluation.

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 ad disaster management, case studies.

References:

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

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Chemical Engineering Department

B. Tech. VIII-Semester

Departmental Elective CM 802 (C) Fertilizer Technology

Course Objective

To Study of organic process industries involving process technology, raw material availability, production pattern, Engg. problems involving material of construction, Environment pollution, waste utilization and disposal, energy consumption and conservation Equation.

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 Phosphate 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. 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.

References:

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 W Press, Delhi.

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Chemical Engineering Department

B. Tech. VIII-Semester

Open Elective CM 803 (A) Process Plant Economics & Management

Course Objective: To provide the fundamentals of economics, scale up methods and design strategies of plants.

Course Content:

Unit-I Introduction: General design considerations; the hierarchy of chemical process design, the nature of process synthesis and analysis; developing a conceptual design and finding the best flow sheet: input information and batch versus continuous,

Unit-II: Management: Importance Factors for Selection of Plant, Location; Site Selection and Preparation; Plant Layout and Installation,Rate of return, breakeven point (BEP), payback period, discount rate of return, net present worth, internal rate of return, comparing investment alternatives.

Unit-III Cost Analysis: cost estimation. Cash Flows: Time value of money, investment, costs, sales, profits, taxes, Depreciation.

Unit-IV: Process Economics: Economic feasibility of project using order-of magnitude cost estimates, plant and equipment cost estimation, balance sheet, and profit and loss account. financial ratio analysis,

Unit V: Plant Design: Input/output structure of the flow sheet; Recycle structure of the flow sheet; Separation system; Heat Exchanger Networks. Process design development and general design considerations.

Course Outcomes:

1. To study the concepts of chemical process plant design
2. To understand the economics of plant establishment.
3. To understand the cost analysis of products
4. To study the process to check the financial feasibility of plant.
5. To study the overall network design of process plant.

Reference:

1. Douglas, J. M., “Conceptual Design of Chemical Processes,” McGraw-Hill, 1989.
2. Peters, M. S. and Timmerhaus, K. D., “Plant Design and Economics for Chemical Engineers,” 4th ed., McGraw-Hill, 1991.
3. Biegler, L., Grossmann, I. E. and Westerberg, A. W., “Systematic Methods of Chemical Engineering and Process Design,” Prentice Hall, 1997

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Chemical Engineering Department

B. Tech. VIII-Semester

Open Elective CM 803 (B) Petrochemical Technology

Course Objective: To know some selective and important topics of petroleum and petrochemicals and learn various advance techniques of these processes

Course Content :

Unit – I: Introduction-Importance size and scope of petro-chemical industry, principle of raw materials, precursors, intermediate and finished products viz. Chemicals from C1 to C4 compounds.

Unit –II: Feed Stocks- Raw material for organic chemicals – coal, biomass, petroleum and natural gas, evolution of crude oil, petrochemical feed stocks – natural gas LPG, naphtha, kerosene, crude pyrolysis gasoline.

Unit –III: Separation and Reforming-Separation of O- Xylenes, m- Xylenes and p-Xylenes methane and synthesis gas derivatives, steams reforming and partial oxidation formaldehyde, methanol chlorinated methane.

Unit – IV: C4- and C5- Cuts-Treatment and upgrading of C4 and C5 cuts: Up gradation of C4 & C5 streams from crackers, MTBE aromatic production, Catalytic reforming aromatic conversion process, separation of aromatic, production of olefins from steam cracking of naphtha and natural gas.

Unit –V: Specific Intermediates-Ethylene, propylene and butadiene and their derivatives product profiles of ethylene butadiene ethylene oxides, ethylene glycol propylene oxide, glycol and isopropyl alcohol. BTX Derivatives Nitrobenzene aniline, phthalic anhydride, caproiactum terephthalic acid, DMT, Maleic anhydride.

Course Outcomes:

1. To study the fundamental and methodologies in the petroleum refining processes
2. Concepts of petrochemicals, scope of petro-chemical industry, principle of raw materials, precursors, intermediate and finished products
3. Understand the separation and reforming technologies for petrochemical industry.
4. Understand the treatment and upgrading of C4 and C5 cuts
5. Understand the processing of specific Intermediates like ethylene, propylene and butadiene

Reference:

1. Charneal, A and Lafyte, G.L. –Petrochemical Process- Part- I & Ii, 2nd Ed,Rue Ginux (1986)
2. Little, D.M. – Cataytic Reforming – Pen Well Publishing House (1985).
3. Wisemen P.- Petrochemicals – John Willey (1986)

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Chemical Engineering Department

B. Tech. VIII-Semester

Open Elective CM 803 (C) IPR (Intellectual Property Right)

Course Objective

Acquaint the students with the basic concepts of Intellectual Property Rights; and sensitize the students with the emerging issues in IPR and the rationale for the protection of IPR.

UNIT I Introduction

Introduction and Justifications of IPR, Nature of IP, Major forms of IP- Copyright, Patent, Trade Marks Designs, Geographic indication, layout design of Semi conductors, Plant varieties, Concept & Meaning of Intellectual Property.

Major international documents relating to the protection of IP - Berne Convention, Paris Convention, TRIPS. The World Intellectual Property Organization (WIPO).

UNIT II Copyright

Meaning and historical development of copyright , Subject matter , Ownership of copyright, Term of copyright, Rights of owner, Economic Rights, Moral Rights. Assignment and licence of rights, Infringement of copyright, Exceptions of infringement, Remedies, *Civil, Criminal, Administrative*, Registration Procedure.

UNIT III Patents

Meaning and historical development,. Criteria for obtaining patents, Non patentable inventions, Procedure for registration, Term of patent, Rights of patentee, Compulsory licence, Revocation, Infringement of patents, Exceptions to infringement, Remedies, Patent office and Appellate Board.

UNIT IV – Trade Marks, Designs & GI

Trade Marks: Functions of marks, Procedure for registration, Rights of holder, Assignment and licensing of marks, Infringement, Trade Marks Registry and Appellate Board.

Designs: Meaning and evolution of design protection, Registration, Term of protection, Rights of holder, unregistered designs. Geographical Indication: Meaning and evolution of GI, Difference between GI and Trade Marks, Registration, Rights, Authorised user.

UNIT V Contemporary Issues & Enforcement of IPR

IPR & sustainable development, The Impact of Internet on IPR. IPR Issues in biotechnology, E-Commerce and IPR issues, Licensing and enforcing IPR, Case studies in IPR

Course Outcome:

1. Students will be able to understand Primary forms of IPR
2. Students will be able to asses and critique some basic theoretical justification for major forms of IP Protection
3. Students will be able to compare and contrast the different forms of IPR in terms of key differences and similarities.
4. Students will be able understand the registration procedures related to IPR.
5. Students will be exposed to contemporary issues and enforcement policies in IPR.

References:

1. P. Narayanan, Intellectual Property Law, Eastern Law House
2. . Neeraj Pandey and Khushdeep[Dharni, Intellectual Property Rights, PHI, 2014
3. N.S Gopalakrishnan and T.G. Agitha, Principles of Intellectual Property, Eastern Book Co. Lucknow, 2009.
4. Anand Padmanabhan, Enforcement of Intellectual Property, Lexis Nexis Butterworths, Nagpur, 2012.
5. Managing Intellectual Property The Strategic Imperative, Vinod V. Sople, PHI.
6. Prabuddha Ganguli, " Intellectual Property Rights" Mcgraw Hill Education, 2016.