IPS Academy, Institute of Engineering & Science

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

Department of Chemical Engineering

Minor in Chemical Engineering

(To be offered to the students of other departments excluding CM)

List of subjects for minor degree from Semester V to VIII

S. No.	Semester	Subject Code	Subject Name	Contact Hours per week			Total Credits
				L	T	P	
1	V	MICH-501	Chemical Process Flow & Flow Mechanics	4	-	-	4
2	VI	MICH-601	Heat & Mass Transfer	4	-	-	4
3	VII	MICH-701	Chemical Technology	4	-	-	4
4	VIII	MICH-801	Chemical Reaction Engineering	3	-	-	3
			Total	15	-	-	15

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

Note: VII semester subject (Chemical Technology or any other course equivalent to Chemical Technogy) can also be done from MOOC courses (NPTEL, SWAYAM etc.) with minimum credit 4.

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Course Code	Semester	Course Title	Load	Credit
MICH-501	V	Chemical Process Flow & Flow Mechanics	04L:0T: (04 hrs)	Credits:04

Objective

The objective of this course to understand and apply the basics of calculations related to material and energy flow. Understanding the basics concept of fluid and fluid particle flow.

Prerequisite(s): Basic Fundamental of Chemistry, Engineering Mechanics

Module-I **08 hrs**

Basic stoichiometric calculations, material balance with chemical reaction for steady state. Combustion calculation, calorific value, composition of exit gases.

Module-II **08 hrs**

Fundamental of energy balance, Heat capacity, the general energy balance, Calculations of enthalpy changes, calculation of standard heat of reaction, heats of formation, combustion, solution, mixing, Energy balances that account for chemical reactions. Basic problem of energy balance.

Module-III **10 hrs**

Properties and classification of fluids; fluid statics: pressure at a point, pressure variation in static fluid absolute and gauge pressure, manometers, Euler's equation of motion along with a streamline and derivation of Bernoulli's equation, application of Bernoulli's equation, **Module-IV** **07 hrs**

Introduction to laminar and turbulent flow, concept of Reynolds number and friction factor, Fluid Measurements and Machines, velocity measurement, flow measurement ,Pumps, power & head requirement for pumps.

Module-V **08 hrs**

Screen analysis, Standard screens, Standard screens, Capacity and effectiveness of screen, Size reduction, Mechanism of Size reduction, mixing of liquids with liquids, liquids with solids and solids with solids, Transportation, handling and fluidization: Selection of conveying devices for solids

Course outcome- At the end of the course, the students will be able to acquire the knowledge of….

CO1: Material balance for chemical reactions involves in chemical process industries.

CO2: Energy balance including and excluding chemical reaction.

CO3: Understand the basic properties of fluid, Euler's equation and Bernoulli's equation.

CO4: Laminar & turbulent flow, concept of Reynolds number & friction factor, Fluid flow Measurements and working of pump.
CO5: Screen analysis, mechanism of size reduction, mixing and transportation and handling of solids.

Text Books:

1. McCabe W.L., Smith J.C. and Harriott P. (2017) Unit Operations of Chemical Engineering", 7th Ed., McGraw Hill.
2. B. I. Bhatt, S.M. Vora; Stoichiometry; TMH

Reference Books:

1. David M. Himmelblau-Basic Principles and calculations in chemical Engineering –PHI
2. Perry RH & Don WG; (2008) Perry's Chemical Engineering Hand Book (8^{th} Edition); New York Chicago; Mc Graw Hill.
3. Banchero & Badger; (1998) Introduction to Chemical Engineering (6th Reprint); the University of California, Mc Graw Hill.

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Course Code	Semester	Course Title	Load	Credit
MICH-601	VI	Heat & Mass Transfer	4L:0T::P (04 hrs)	Credits:04

Course Objective: To understand the fundamentals of heat and mass transfer fluids and solids and their applications in the process industry

Prerequisite(s) - Chemical Process Flow & Flow Mechanics

Module-I **08 hrs**

Introduction of heat transfer**,** Modes of heat transfer, Fourier's law of heat conduction, thermal conductivity, Convective heat transfer, natural and forced convection, heat transfer coefficient, Radioactive heat transfer, Stefan Boltzmann law, concept of shape factor.

Module-II **08 hrs**

Introduction of boiling and condensation, heat flux temperature diagram for boiling and condensation under vertical and horizontal surfaces, nucleate & pool boiling, Evaporation- Type of evaporators and their applications single and multiple effect evaporators, Heat Exchange equipment- Introduction of double pipe, shell & tube heat exchangers and condensers.

Module-III **08 hrs**

Introduction: Mass transfer operation, Classification of mass transfer operations, choice of separation methods. Molecular diffusion: Fick’s law of diffusion, Interphase mass transfer, mass transfer coefficients, Analogy between momentum, heat and mass transfer, plate and packed column, column internals: types of trays and packing.

Module-IV **08 hrs**

Vapour liquid equilibrium: Introduction, Importance of distillation, Vapor liquid equilibrium diagram, Dalton's, law, Raoult's law, Relative volatility, Methods of distillation-Differential Distillation, Flash Distillation & Continuous distillation. Basic Introduction and principal of absorption and adsorption, crystallization.

Module-V **08 hrs**

Humidification: General Theory, psychometric chart, fundamental concept humidification & dehumidification, construction & working of different types of cooling tower.

Drying:, Equilibrium mechanism of drying, various types of moisture in drying, drying rate curve, time of drying, drying equipments such as tray dryers, rotary dryers, drum and spray dryers.

Course Outcomes:

After completion of this course, the students are able to:

CO1: Knowledge about the modes of heat transfer

CO2: Understand heat transfer under phase change conditions, boiling & condensation and to design forward and backward evaporators.

CO3: Understanding the introduction of mass transfer operations and fundamental concept of diffusion.

CO4:. Describe the basic concept and principal of distillation, absorption, adsorption and crystallization.

CO5: Describe the concept of humidification and dehumidification. Discuss the different type of dryer used in process industries.

Text Books:

1. McCabe W.L., Smith J.C. and Harriott P. (2017) Unit Operations of Chemical Engineering", 7th Ed., McGraw Hill.
2. Holman J.P.9th Ed, 2001, Heat Transfer, New York, McGraw Hill.
3. Treybal R.E., (1981) Mass Transfer Operation (3rd Edition), New York: Mc. Graw Hill
4. Dutta. B.K., (2007) Principles of Mass Transfer and Separation Processes (1st Edition), Delhi:PHI Learning.

Reference Book:

5. Incropera F.P. and Dewitt D.P. Fundamentals of Heat and Mass Transfer. Wiley; 5th Edition John Wiley. 2001
6. Coulson J. Richardson M., (2013) Chemical Engineering (5th Edition) Vol 2; Oxford:Butterworth Heinmann.

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Course Code	Semester	Course Title	Load	Credit
MICH-701	VII	Chemical Technology	4L:0T:0P (05 hrs)	Credits:04

Course Objective: To Study the organic and inorganic process industries, involving process technology, raw material availability, production pattern.

Module-I **08 hrs**

Introduction: General Survey of Chemical Industries, Importance contribution to human life & classification of chemical industries. Carbohydrate Industries Manufacture of sugar and starches. Ethanol from molasses by fermentation.

Module-II **08 hrs**

Chlor-alkali Industries: caustic soda, chlorine, hydrochloric acid and potassium salts.
Phosphorus Industries: Phosphorus, Phosphoric acid, Phosphate fertilizers.
Mixed Fertilizers: SSP, TSP, and DAP.

Module-III **08 hrs**

Industrial gases: Nitrogen, Oxygen, Hydrogen, Helium and Argon,
Sulphur Industries: Sulphur dioxide, Sulphuric acid, Oleum.
Nitrogen Industries: Ammonia, Nitric acid, Urea.

Module-IV **08 hrs**

Oil & Fats Industries: Classification of oil & fats, Extraction of vegetable oil, Hydrogenation of oil, manufacture of soap and detergent, engineering problems of all such industries.

Module-V **08 hrs**

Pulp and Paper Industries Methods of pulp production, manufacture of pulp by Kraft process.
Cement Industries: Types of cement, classification of cement, manufacturing of cement & engineering problems related to cement industries.

Course Outcome

CO1: Ability to understand about various chemical industries
CO2: Ablity to understand general overview about chlor-alkali Industries
CO3: Ablity to understand general overview about Industrial gases.
CO4: Ability to describe the processing of Oil & Fats Industries.
CO5: Ablity to understand general overview about pulp and paper.

Text

1. Dryden's Outline of Chemical Technology for the 21st Century, Third Edition.
2. Shreve's Chemical Process Industry, Fifth Edition.

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Course Code	Semester	Course Title	Load	Credit
MICH-801	VIII	Chemical Reaction Engineering	3L:0T: 0P(04 hrs)	Credits:03

Course Objective: To provide the comprehensive knowledge of reaction engineering and chemical Reactors.

Module I **8 hrs**

Introduction: Definition of reaction rates, variables affecting reaction rates, classification of reactions, order, molecularity. The Reaction Rate Constant, concept of kinetics, Concentration dependent term of a rate equation, temperature dependent term of a rate equation.

Module II **9 hrs**

Introduction to Reactor Design: Ideal reactors for single reaction: Ideal batch reactor, steady state Mixed Flow Reactor, steady state PFR, Holding time and space time for flow systems. Design for single reactions: Size comparison,

Module III **6 hrs**

Interpretation of Batch Reactor Data: Differential Method of Rate Analysis, Integral Method**.** Heterogeneous processes: Classification of catalysts, Preparation of catalysts, Promoters and Inhibitors, poisoning,

Module IV **07 hrs**

Design for Multiple Reactions: Parallel and series reactions, selectivity and yield factors, reactor choice for multiple reactions.

Module V **10 hrs**

Non-ideal Flow: Residence time distribution of fluids, General characteristics, Measurement of RTD, RTD in ideal reactor,

Course Outcomes:

After completion of this course, the students are able to:

CO1: Ability to define the classification of reaction, reaction rate and order of reaction.

CO2: Ability to know classification of reactors and to design isothermal and non-isothermal batch, CSTR, PFR reactors.

CO3: Ability to interpret integral and differential method of kinetic analysis.
CO4: Ability to describe multiple reactions in batch, CSTR, PFR reactors.
CO5: Ability to evaluate RTD characteristics, dispersion model, tank and series model.

Text Book:

1. Levenspiel, O.,"Chemical Reaction Engineering" ,3rd ed.,Wiley & Sons, Singapore, 1999.
2. Fogler, H. S., "Elements of Chemical Reaction Engineering," 3rd ed., Prentice Hall of India, 2003.

Reference Book:

3. Smith, J. M., "Chemical Engineering Kinetics", 3rd ed. McGraw Hill, 1981.
4. Richardson, J.F., and Peacock D.G., "Coulson and Richardson's Chemical Engineering," vol. 3, 3rd ed., Asian Books Pvt. Ltd., New Delhi, 1998.