IPS Academy
Institute of Engineering & Science
(*A UGC Autonomous Institute, Affiliated to RGPV, Bhopal*)
Scheme & Syllabus Based on AICTE Flexible Curricula
B. Tech, Chemical Engineering Department

Semester VIII (Final Year)

S.No.	Course Type	Course Code	Course Title	Hrs./ Week			Credits
				L	T	P	
1	PCC	CH16	Transport Phenomena	3	1	-	3
2	PEC	CH05	Professional Elective-V	3	-	-	3
3	IOC	-	Inter-disciplinary Open Courses -II	2	1	-	3
4	PROJ	CH06	Project Phase-II	-	-	20	10
Total Credits							19

❖ **Professional Elective Course -V**

- Chemical Process Synthesis
- Petrochemical Engineering
- Energy Conservation In Chemical Process Industry
- Fertilizer Technology

❖ **Interdisciplinary Open Course-II**

- Biomedical Instrumentation (offered by EC dept.)
- Non Conventional Energy Sources(offered by EX dept)
- Disaster Management - Forecasting and Mitigation (offered by FT dept)
- Any MOOC Course, Minimum 12 Weeks, (AICTE/SWAYAM/ Other Relevant Online Learning Platform)

Course Code	Semester	Course Title	Load	Credit
PCC-CH 16	VIII	Transport Phenomena	3L:1T:0P (04 hrs)	Credits:03

Prerequisite Course: Fluid mechanics, Heat Transfer, Mass Transfer.

Course objective: Acquire the knowledge about momentum, heat and mass-transport, shell balance, equation of change and macroscopic balance equation.

Module 1: **(06 hrs)**
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..

Module 2: **(08 hrs)**
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.

Module 3: **(10 hrs)**
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.

Module 4: **(09 hrs)**
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.

Course Outcome:
After completion of this course, the students are able to:
CO1: Ability to understand similarity in momentum, heat and mass transport.
CO2: Ability to understand shell balance approach for developing equation of change formomentum, heat and mass transport
CO3 Ability to understand transport equation in turbulent flow and concentration profile forlaminar and turbulent flow condition.
C O4: Ability to understand constant area and variable area flow problems, timedetermination for emptying of vessel.

Text Book
1. Bird, R.B., Stewart, W.E., Lightfoot, E.N. "Transport Phenomena", 2nd Edition, John Wiley & Sons, Revised, 2007.
2. Geankoplis Christie J., "Transport Processes and Separation Process Principles", 4th Edition, Prentice-Hall of India Pvt.Ltd, 2009.

Reference Book:
1. Robert S. Brodkey. Harry C Hershey, "Transport phenomena a unified approach", 2nd Edition, Mcgraw Hill;19

Course Code	Semester	Course Title	Load	Credit
PEC-CH 05(A)	VIII	Chemical Process Synthesis	3L:0T:0P (03 hrs)	Credits:03

Prerequisite Course: Heat Transfer, Mass Transfer, Fluid Mechanics, Chemical Reaction Engineering

Course Objective: The aim of this subject is to expose the students to understand the basic piping design and its application in chemical engineering.

Course Content-

Module 1: **(10 hrs)**

Synthesis of steady state flow sheet: Introduction, Flow sheets, the problem of steady state flow sheeting, general semantic equation of equipment, Generalization of the method of synthesis of process flow sheet, Recycle structure of the flow sheet, separation systems.

Module 2: **(08 hrs)**

Heuristics for process synthesis: Raw materials and Chemical reactions, Distribution of chemicals, Separations, Heat exchangers and furnaces, pumping pressure reduction and conveying of solids.

Module 3: **(07 hrs)**

Optimization Technique for Heat and Mass Transfer in Chemical industries. Algorithmic methods for process synthesis: Reactor design and reactor network synthesis, Synthesis of separation trains, sequencing of ordinary distillation columns Optimization of flow sheet with respect to heat exchanger network.

Module 4: **(08 hrs)**

Safety in Chemical plant design: Introduction, Reliability of equipment, prevention of accidents. Process Hazard analysis.

Module 5: **(07 hrs)**

Economic evaluation: Time value of money, Methods for Profitability evaluation, Rate of return, Net Present Worth, Capitalized cost , Discounted Cash flow analysis.

Course Outcomes

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

CO1: Familiarize with problem of steady state flow sheeting.

CO2: Describe Heuristics for process synthesis.

CO3: Discuss algorithmic methods for process synthesis.

CO4: Understand about Reliability of equipment.

CO5: Analyze the economics of chemical process.

Text Book:

1. Seider W. D., Seader J. D., Lewin D. R., " Product and Process Design Principles: Synthesis, Analysis and Evaluation", 4th Edition, John Wiley & Sons; 2016.
2. Smith R., "Chemical Process Design and Integration", 2nd Edition, John Wiley & Sons, 2016.

Reference Book:

a. Bieglar L.T, Grossman E.I., Westerberg A.W., "Systematic Methods of Chemical Process Design", 1st Edition, Prentice Hall PTR, 1997.
b. Douglas J. M., "Conceptual Design of Chemical Processes", 1st Edition, McGraw Hill International,1988.

Course Code	Semester	Course Title	Load	Credit
PEC-CH 05 (B)	VIII	Petrochemical Engineering	3L:0T:0P (03 hrs)	Credits:03

Prerequisite Course: Fuel Technology, Engineering Chemistry, Chemical Technology.

Course Objective: The aim of this subject is to expose the students to understand the basic of refining process and its application in petrochemical industries.

Course Content-

Module 1: **(10 hrs)**

Feed Stock And Source Of Petrochemicals:-Overview of Petrochemical Industry – The key growth area of India, Economics – Feed stock selections for Petrochemicals, Feedstock derivative, benzene, toluene, xylene and separation techniques of gaseous hydrocarbons, Characteristics and properties of intermediate products, Steam cracking of Gas and Naphtha to produce Olefins, Di-olefins and Production of Acetylene.

Module 2: **(08 hrs)**

Synthesis Gas Production:-Steam reforming of Natural gas – Naphtha and Heavy distillate to produce Hydrogen and Synthesis gas – Production of Methanol – Oxo process.

Module 3: **(07 hrs)**

Primary Unit Processes: - Fundamental and Technological principled involved in Alkylation – Oxidation – Nitration and Hydrolysis, Vis-breaking, reformation, hydro treating process.

Module 4: **(08 hrs)**

Secondary Unit Processes: - Fundamental and Technological principled involved in Sulphonation, Sulfation and Isomerisation.

Module 5: **(07 hrs)**

Tertiary Unit Processes:- Fundamental and Technological principles involved in Halogenation and Esterification

Course Outcomes

After completion of this course, the students are able to:
CO1: U nderstand the principles of various unit processes in the petrochemicalindustry.
CO2: Discuss the Synthesis Gas Production.
CO3: Explain Primary Unit Processes.
CO4: Describe Secondary Unit Processes.
CO5: Analyze the Tertiary Unit Processes.

Text Book:

1. Margaret Wells, "Handbook of Petrochemicals and Processes", 2nd Edition, Ash Gate Publishing Limited, 2002.
2. Matar S.,,. Hatch. L. F., "Chemistry of Petrochemical Processes", 2nd Edition , Gulf Professional Publishing, 2000.
3. Dryden, C.E., "Outlines of Chemical Technology", 2nd Edition, Affiliated East-WestPress, 1993.

Reference Book:

1. Maiti S., "Introduction to Petrochemicals",2nd Edition, Oxford and IBH Publishers, 2002.
2. Williams D.J., "Polymer science&engineering", 3nd Edition, Prentice Hall, 1971.
3. Tadmor Z., Costasg G.,"Principles of Polymer Processing";2nd Edition, John Wiley & Sons,2006.

Course Code	Semester	Course Title	Load	Credit
PEC-CH 05 (C)	VIII	Energy Conservation in Chemical Process Industry	3L:0T:0P (03 hrs)	Credits:03

Prerequisite Course: Chemical Engineering Thermodynamics, Chemical ProcessCalculations.

Module 1:
Energy resources, Energy conversion processes and devices – Energy conversion plants, Conventional, Thermal, Hydro, Nuclear fission , and Non – conventional – Solar, Wind Biomass, Fuel cells, Magneto Hydrodynamics and Nuclear fusion.

Module 2:
Energy Scenario – Global and Indian –Impact of Energy on economy, development and environment, Energy policies, Energy strategy for future.

Module 3:
Analysis of scope and potential for energy conservation, Thermal insulation, Efficiency improvement in boilers, furnaces and heat recovery techniques,

Module 4:
Energy conservation Principles, Energy economics, Energy conservation technologies, Waste heat recovery

Module 5:
Energy Conservation Opportunities, Energy Conservation analysis of pumps, Process integration as a measure of energy conservation, Energy audit.

Course Outcomes
After completion of this course, the students are able to:
CO1: Classify energy conservation process.
CO2: Explain scenario and Energy strategy for future.
CO3: Evaluate the performance of industrial boilers and furnaces.
CO4: Understand the Energy conservation Principles and Waste heat recovery.
CO5. Discuss Energy Conservation Opportunities and Process integration as a measureof energy conservation & Energy Audit.

Text Book:
1. Eastop T. D., Croft D. R., "Energy Efficiency: for Engineers & Technologists", 1st Edition, Longman,1990.
2. Chakrabarti A.,, "Energy Engineering and Management", Prentice Hall India, 2011.
3. Rao S., Parulekar B. B., "Energy Technology (Non Conventional, Renewable and Conventional", 3rd edition, Khanna Publishers", 1994.
4. Rai G. D., "Non-conventional Energy Sources",4th edition, Khanna Publishers, 2019.

Reference Books:

1. Thumann A., Niehus T., Younger W. J., "Handbook of Energy Audits", 9st edition ,Fairmont Press, 2012.
2. Doty S., Turner W. C., "Energy Management Hand book", 8th Edition , Lulu Publication,2013.

Course Code	Semester	Course Title	Load	Credit
PEC-CH 05 (D)	VIII	Fertilizer Technology	3L:0T:0P (03 hrs)	Credits:03

Prerequisite Course: Basics of Chemical Process Industries and Chemical Technology.

Module 1:
Overview of Fertilizer: Synthetic fertilizers, Classification of fertilizers, Role of essential Elements in plant Growth, Macro elements and Micro elements, Application of fertilizers considering Nutrient, Balance and types of crop. Development of fertilizer industry; Fertilizer production and consumption in India; Nutrient contents of fertilizers; Secondary nutrients; Feedstock and raw materials for nitrogenous, phosphatic and potassic fertilizers.

Module 2:
Nitrogenous Fertilizers: Introduction to Ammonia: Physical &chemical properties, applications, Synthesis gas by Catalytic partial oxidation Steam Hydrocarbon reforming, Ammonia converters. Introduction to Nitric acid: Chemical, physical properties and applications, Manufacturing of Nitric Acid by Pressure ammonia oxidation process.

Module 3:
Urea: Physical, chemical properties, Manufacturing of Ammonium nitrate by Prilling process, Ammonium sulphate from Ammonium carbonate and gypsum, Ammonium chloride from Ammonium sulphate and sodium chloride.

Module 4:
Potassium Fertilizers: Physical, chemical properties and uses of Potassium Chloride, Potassium nitrate, Potassium sulphate, Manufacturing of potassium chloride from sylvinite, Preparation of Potassium nitrate, Potassium sulphate.

Module 5:
Miscellaneous Fertilizer and Bio Fertilizers: Manufacturing of NPK, Ammonium Sulphate Phosphate (ASP), Calcium Ammonium Nitrate(CAN), Biofertilizers, Types of Biofertilizers, Nitrogenfixing biofertilizers, Phosphate-solubilizing biofertilizers, Preparation of a biofertilizers.

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

CO1: Describe the Overview of Fertilizer.

CO2: Classify the Nitrogenous Fertilizers.

CO3: Define the Physical, chemical properties of Urea

CO4: Explain Physical, chemical properties of Potassium Fertilizers.

CO5. Understand the concept of mixed fertilizer.

Text Book:
1. Hand book of Fertilizer Association of India, New Delhi, 1998.
2. Slack A.V., “Chemistry & Technology of Fertilizers”, John Wiley & Sons Inc.,1967.

3. Rao M.G., , Dryden's M.S., "Outlines of Chemical Technology", East-West Press, 3rd Edition, New Delhi,1997.

Reference Book:

1. Austin G. T, Shreve's , "Chemical Process Industries", 5th edition, McGraw Hill Publications,2017.
2. Pandey & Shukla, "A Text Book of Chemical Technology,Volume I", 2nd Edition, S Chand,s Company,2018.
3. Subba Rao N. S., "Bio fertilizers in Agriculture",4th Edition, Oxford & IBH Publishing Company,2017.