SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

SCHEME FOR EXAMINATION (NEP 2020) (Effective from Session 2024-25)
B. TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING
THIRD YEAR, FIFTH SEMESTER

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
	Theory					Marks			
			L	T	P	CIA	SEA	Total	
01.	CHUETT1	Heat Transfer	3	1	0	40	60	100	4
02.	CHUETT2	Mass Transfer-I	3	1	0	40	60	100	4
03.	CHUETT3	Chemical Reaction Engineering-I	3	0	0	40	60	100	3
04.	CHUETK1	Petroleum Refinery Engineering	3	0	0	40	60	100	3
	CHUETK2	Organic Chemical Technology							
	CHUETK3	Fuel Combustion Energy Technology							
05.	CHUETK4	Process Equipment Design-I	3	0	0	40	60	100	3
	CHUETK5	Polymer Technology-I							
Practical									
01.	CHUELT1	Heat Transfer Lab	0	0	3	25	25	50	1.5
02.	CHUELT2	Chemical Reaction Engineering Lab	0	0	3	25	25	50	1.5
03.	CHUEPV1	Mini Project-II	0	0	4	25	25	50	2.0
		Total	15	2	10	275	375	650	22

CIA : Continuous Internal Assessment **SEA** : Semester End Assessment	Total Credits : 22 Total Marks : 650	Total Periods / Week 27

The CIA (Theory) will be comprised of two Class Tests (CT) worth 15 marks each, an assignment/surprise test/quiz worth 05 marks, and 05 marks for class attendance throughout the semester.

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SCHEME FOR EXAMINATION (NEP 2020) (Effective from Session 2024-25)
B. TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING
THIRD YEAR, SIXTH SEMESTER

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme (Marks)			Credits
	Theory		L	T	P	CIA	SEA	Total	
01.	CHUFTT1	Mass Transfer-II	3	0	0	40	60	100	3
02.	CHUFTT2	Chemical Reaction Engineering-II	3	0	0	40	60	100	3
03.	CHUFTT3	Process Dynamics and Control	3	1	0	40	60	100	4
04.	CHUFTK1	Process Equipment Design-II	3	0	0	40	60	100	3
	CHUFTK2	Polymer Technology-II							
	CHUFTK3	Project Engineering Economics and Management							
	CHUFTK4	MOOCS-I	-	-	-	-	-		
05.	CHUFTK5	Petrochemical Technology	3	0	0	40	60	100	3
	CHUFTK6	Waste To Energy							
	CHUFTK7	Optimization Techniques in Chemical Engineering							
	CHUFTK8	MOOCS-II	-	-	-	-	-		
06.	CHUFTO1	MOOCS-III	-	-	-	-	-	100	3
Practical									
01.	CHUFLT1	Mass Transfer Lab	0	0	3	25	25	50	1.5
02.	CHUFLT2	Process Dynamics and Control Lab	0	0	3	25	25	50	1.5
03.	CHUFPV1	Project	0	0	6	25	25	50	2.0
		Total	15	1	12	275	375	650	24

CIA : Continuous Internal Assessment SEA : Semester End Assessment	Total Credits : 24 Total Marks : 650	Total Periods / Week 28

The CIA (Theory) will be comprised of two Class Tests (CT) worth 15 marks each, an assignment/surprise test/quiz worth 05 marks, and 05 marks for class attendance throughout the semester.

Program Outcomes

PO 1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering comm Modules and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1	The students of the programme will have a strong foundation in mathematics, basic sciences and chemical engineering to meet the current demands in professional world with cutting-edge research in chemical and allied engineering disciplines.
PSO2	Graduates would be equipped with a working knowledge in professional courses such as process economics, project engineering, industrial safety and sustainable development to work in the conventional as well as frontier area of Chemical Engineering which enables them suitable for chemical industries.
PSO3	Graduates of chemical engineering will be able to communicate in a professional setting, including soft skills, technical writing, presentation, and management skills making them employable to industries.

15/7/24

Minutes of Meeting

A meeting of Board of Studies (BoS) of Department of Chemical Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur was held today (July 15, 2024) in conference hall of UGC - Malaviya Mission Teacher Training Centre, Guru Ghasidas Vishwavidyalaya, for discussion and approval of the scheme and syllabus of third year (V and VI Semester) as per NEP-2020 guidelines. Following members were present in the meeting.

1. Dr. Raghwendra Singh Thakur, Chairman-BoS , Associate Prof. and Head, Dept. of Chemical Engg.
2. Prof. (Mrs) A B Soni, External Expert Member-BoS, Professor, Dept. of Chemical Engg., NIT Raipur
3. Er. Arvind Verma, External Industry Expert, Special Invitee-BoS, Senior Manager-Process, Nu-Vista (NUVOCO Cement), Baloda Bazar (Present online)
4. Prof. Anil Kumar Chandrakar Member-BoS, Professor, Dept. of Chemical Engg.
5. Dr. Saurabh Meshram, Member-BoS, Associate Prof., Dept. of Chemical Engg.
6. Dr. Amit Jain, Invited Member, Associate Prof., Dept. of Chemical Engg.
7. Dr. Anuradha N. Joshi, Invited Member, Associate Prof., Dept. of Chemical Engg
8. Dr. Neeraj Chandraker, Invited Member, Assistant Prof., Dept. of Chemical Engg.
9. Dr. Gautam Prasad Dewangan, Invited Member, Assistant Prof., Dept. of Chemical Engg.
10. Mr. Vishnu Prasad Yadav, Invited Member, Assistant Prof., Dept. of Chemical Engg.
11. Dr. Sandeep Dharmadhikari, Invited Member, Assistant Prof., Dept. of Chemical Engg.
12. Dr. Ghoshna Jyoti, Invited Member, Assistant Prof., Dept. of Chemical Engg.
13. Dr. Pankaj Kumar, Invited Member, Assistant Prof., Dept. of Chemical Engg.
14. Dr. Satyajit Bhattacharjee, Invited Member, Assistant Prof., Dept. of Chemical Engg.

Following are resolved in the meeting.

1. The committee discussed the scheme and syllabi of B. Tech Third year session 2024-25 (V and VI semester) at length and after incorporating the changes, as identified by the BoS members, the final scheme and syllabi is approved by BoS members.
2. New course Polymer Technology-I and Polymer Technology-II was introduced in V and VI Semester, respectively.
3. Mini Project-II of 2 credits was introduced in V semester in succession of Mini Project in IV semester.
4. One project of 2 credits was also introduced in VI Semester.

B. Tech. V Semester

CHUETT1 **Heat Transfer** **[L:3, T:1]**

Objective

To provide a fundamental understanding of heat transfer by conduction, convection and radiation, and heat exchange equipment used in heat transfer with or without phase change.

Contents

Unit I : Introduction to three modes of heat transfer, Derivation of heat balance equation, Steady state one-dimensional solution for conduction heat transfer in cartesian, cylindrical and spherical geometry, Critical insulation thickness, Lumped system approximation and Biot number, Approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

Unit II : Heat transfer by convection, Boundary layers, Forced convection, Natural convection, Dimensionless parameters for forced and free convection heat transfer, Correlations for forced and free convection, Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Unit III : Interaction of radiation with materials, Definitions of radiative properties, Stefan Boltzmann's law, Black and Gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, View factors, Radiosity method.

Unit IV : Types of heat exchangers, General design of parallel and counter-current flow, Double pipe heat exchanger, Shell and Tube heat exchanger, Analysis and design of heat exchangers using LMTD and ε-NTU methods.

Unit V : Evaporation, Types of evaporators, Single and multiple effect evaporators, Heat transfer from condensing vapours, Heat transfer to boiling liquids. Boiling and Condensation heat transfer, Pool boiling curve.

Text Books

1. A Heat Transfer Textbook by John H. Lienhard IV and John H. Lienhard V; Phlogiston Press, Cambridge, Massachusetts, U.S.A.
2. Unit Operations of Chemical Engineering by W. L. McCabe, J. C. Smith and P. Harriot; McGraw-Hill Inc.
3. Process Heat Transfer by D. Q. Kern; McGraw-Hill International Book Company.

Reference Books

1. Fundamentals of Momentum, Heat, and Mass Transfer by J. R. Welty, C. E. Wicks, R. E. Wilson and G. L. Rorrer; John Wiley & Sons.
2. Principles of Heat Transfer by Frank Kreith, Raj M. Manglik and Mark S. Bohn; Global Engineering, Cengage Learning, Stamford, USA.
3. Fundamentals of Heat and Mass Transfer by Frank P. Incropera, David P. Dewitt, Theodore L. Bergman, Adrienne S. Lavine; John Wiley & Sons.
4. Heat Transfer-A Practical Approach by Yunus A. Cengel; McGraw-Hill Inc.

Course Outcome

Students would be able to

1. Evaluate the steady state and unsteady state heat transfer by conduction.
2. Calculate heat transfer rate for forced and natural convection.
3. Understand the mechanism of radiation heat transfer and determine the rate of heat transfer by radiation.
4. Understand the basic design of double pipe and shell and tube heat exchanger and evaluate the area of the heat exchangers.
5. Analyse the phase change heat transfer equipment operations.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	1	1	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	3	1	-	-	-	-	-	-	3	2	-
CO5	1	1	1	-	-	1	-	-	-	-	-	-	-	-	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. V Semester

CHUETT2 **Mass Transfer - I** **[L:3, T:1]**

Objective

To provide the understanding of mass transfer operations and impart the understanding of separation processes such as diffusion, distillation and absorption.

Contents

Unit I : Constitutive laws of diffusion, Molecular diffusion in gases and liquids, Diffusion velocities, Convective mass transfer, Interphase mass transfer and mass transfer coefficients, Theories of mass transfer, Correlations for the convective mass transfer coefficient.

Unit II : Vapor-liquid equilibria, Volatility, Enthalpy-concentration diagrams, Solubility of gases, Principles of Equilibrium stage operation, Determination of number of ideal stages for two-component systems by graphical and absorption factor methods.

Unit III : Flash distillation, Differential distillation, Steam distillation, Continuous distillation with rectification, Reflux ratio, Minimum reflux ratio, Calculation of number of plates – McCabe Thiele method, Lewis sorel method.

Unit IV : Fenske equation, Optimum reflux ratio, Analysis of fractionating column by enthalpy concentration diagram method, Plate efficiencies, Azeotropic distillation, Extractive distillation.

Unit V : Design of packed towers, Principles of absorption, Rate of absorption, HTU method.

Text Books

1. Unit Operations of Chemical Engineering by W. L. McCabe, J. C. Smith and P. Harriot; McGraw-Hill Education.
2. Principles of Mass Transfer and Separation Processes by B. K. Dutta; PHI Learning Pvt. Ltd.
3. Mass Transfer Operations by R. E. Treybal; McGraw-Hill Education.
4. Transport Processes and Unit Operations by C. J. Geankoplis; PHI Learning Pvt. Ltd.

Reference Books

1. Diffusion - Mass Transfer in Fluid Systems by E. L. Cussler; Cambridge University Press.
2. Principles of Unit Operations by A. S. Foust, L. A. Wenzel, C. W. Clump, L. Maus and L. B. Andersen; John Wiley & Sons.

Course Outcome

Students would be able to

1. Describe the basic theories and mechanism of diffusion and convective mass transfer.
2. Identify the concepts of phase equilibrium in mass transfer as well as equilibrium stage operations.
3. Understand binary separation principles of distillation and classify various distillation operations.
4. Design plate column for distillation operation.
5. Understand binary separation principles of absorption operation and design packed column for adsorption operation.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	-	-	-	-	-	-	-	-	3	2	-
CO2	3	1	1	1	-	-	-	-	-	-	-	-	3	1	-
CO3	3	1	2	1	-	-	-	-	-	-	-	-	3	1	-
CO4	3	1	3	1	-	-	-	-	-	-	-	-	3	2	-
CO5	3	1	3	1	-	-	-	-	-	-	-	-	3	2	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. V Semester

CHUETT3 **Chemical Reaction Engineering - I** **[L:3, T:0]**

Objective

To impart the knowledge of the kinetics and thermodynamics of single and multiple reaction and the effect of temperature and pressure on reaction systems.

Contents

Unit I : Kinetics and thermodynamics of chemical reactions, Kinetics of homogenous reactions, Rate theories, Analysis of rate equations.

Unit II : Interpretation of batch reactor data, Irreversible reactions, Total pressure method of kinetic studies, Analysis of complex rate equations, Complex reactions, Chain reactions, Variable volume reactions, Rate constants and equilibrium.

Unit III : Ideal batch reactors, Steady state mixed flow reactor, Steady state plug flow reactor, Size comparison of single reactors, Multiple-reactor system.

Unit IV : Introduction to multiple reaction, Qualitative treatment of product distribution and reactor size for parallel reactions, Reversible first order reactions in series.

Unit V : Temperature and pressure effects on single reaction, General graphical design procedure, Optimum temperature progression, Heat effects on adiabatic and non-adiabatic operations.

Text Books

1. Chemical Reaction Engineering by O. Levenspiel; John Wiley & Sons.
2. Elements of Chemical Reaction Engineering by H. S. Fogler, PHI Learning Pvt. Ltd.

Reference Books

1. Reaction Kinetics for Chemical Engineers by S. M. Walas; Butterworths Publishers.
2. Chemical and Catalytic Reaction Engineering by J. J. Carberry; Dover Publications.
3. Chemical Reactor Analysis and Design by G. F. Froment, K. B. Bischoff and J. D. Wilde; John Wiley & Sons.

Course Outcome

Students would be able to

1. Develop rate of reaction for homogeneous reactions.
2. Interpret batch reactor data and analyse rate equations.
3. Design ideal reactors for single reactions.
4. Describe different aspects of design for multiple reactions.
5. Explain the effect of temperature and pressure on reaction rate.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	1	-	-	-	-	-	2	1	-
CO2	3	2	3	2	1	-	1	-	-	-	-	-	3	2	-
CO3	3	2	3	2	1	1	-	-	-	-	-	-	3	2	-
CO4	3	1	3	1	1	-	1	-	-	-	-	-	3	2	-
CO5	3	2	2	1	1	-	1	-	-	-	-	-	2	1	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. V Semester

CHUETK1 **Petroleum Refinery Engineering** **[L:3, T:0]**

Objective

To impart knowledge of petroleum refining, hydrocarbon processing, and derived petrochemicals.

Contents

Unit I : Formation of petroleum crude, Origin & occurrence composition, Classification & physical properties of petroleum crude, Conversion of organic matter into petroleum crude, Different sources of petroleum oil, Refining of crude oil, Type of refineries, Planning for operation of oil refinery.

Unit II : Physical and physico-chemical properties, Testing methods of Petroleum products as per API / ASTM / BIS specifications.

Unit III : Treatment of crude, Atmospheric and vacuum distillation of crude, Distillation & equilibrium, Degree of separation, Type of trays of distillation column & its efficiencies, Types of distillation in petroleum industries.

Unit IV : Cracking, Type of cracking, Thermal cracking reaction, Dubbs process & tube still process of thermal cracking, Vis-breaking, Delayed coking & fluidized coking, Catalytic cracking, Fixed & moving bed catalytic cracking, Thermal reforming, Catalytic reforming processes.

Unit V : Chemical treatment of petroleum products, Caustic soda treatment, Treatment with H_2SO_4 & H_2, Mercaptan removal & oxidation process, Sulphur removal from petroleum products, Doctor's treatment, Hydro de-sulphurization, Dewaxing and refining of lubricating oils.

Text Books

1. Modern Petroleum Refining Processes by B. K. Bhaskara Rao; Oxford & IBH Publishing.
2. Petroleum Refining : Technology and Economics by J. H. Gary and G. E. Handwark; Marcel Dekker, Inc.

Reference Books

1. Petroleum Refinery Engineering by W. L. Nelson; McGraw-Hill Education
2. Petroleum Refining and Petrochemicals by N. K. Sinha; Umesh Publications.
3. Petroleum Refining Technology by I. D. Mall; CBS Publishers & Distributors Pvt. Ltd.
4. Chemistry of Petrochemical Processes by S. Matar and L. F. Hatch; Gulf Professional Publishing.
5. Handbook of Petrochemicals Production Processes by R. A. Meyers; McGraw-Hill Education.

Course Outcome

Students would be able to

1. Explain the origin, formation, classification, physical properties, different sources and refining of crude oil.
2. Gain knowledge of properties of various petroleum products and their testing methods.
3. Understand crude oil processing like treatment and refining by atmospheric and vacuum distillation.
4. Explain about the thermal cracking, catalytic cracking, and catalytic reforming processes of petroleum refinery in detail.
5. Apply knowledge of refinery treatment processes for sulphur removal from petroleum products, dewaxing, refining of lubricant and some other like caustic soda treatment.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	-	1	-	-	-	-	-	-	-	3	2
CO2	1	1	1	2	-	1	-	-	-	-	-	-	-	3	2
CO3	1	1	1	2	-	1	-	-	-	-	-	-	-	3	2
CO4	1	1	1	2	-	1	-	-	-	-	-	-	-	3	2
CO5	1	1	1	2	-	1	-	-	-	-	-	-	-	3	2

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. V Semester

CHUETK2 **Organic Chemical Technology** **[L:3, T:0]**

Objective

To apply fundamentals of unit operations and unit processes in various organic process industries such as oil, soap, polymer, and cellulose.

Contents

Unit I : Oils & Fats : Status and scope, Major oils seeds production in India, Solvent extraction, Energy & solvent requirements, Mineral, seeds and other oil bearing materials, Hydrogenation of oils, Corrosion problems, Materials of construction.

Unit II : Soaps & Detergents : Raw materials, Manufacture of detergents, Active detergent matter, Biodegradability, Fat splitting, Purification of fatty acids, Soap manufacture, Total fatty matters (TFM), Glycerin manufacturing, Materials of construction.

Unit III : Sugar : Cane production & varieties, Manufacturing equipment & technology, Cane sugar refining, Bagasse utilization, Energy requirements and conservation, Environmental considerations, Khandsari technology, Starch production from maize, Molasses based industries, Ethanol Manufacturing by fermentation, Materials of construction.

Unit IV : Polymers : Status and scope, Applications, Classification of polymers, Degree and modes of polymerization, Molecular weight, and its distribution, Selected industrial polymerization including plastics, Synthetic rubber, and polymeric foams, Synthetic fibers, Elastomers, Manufacturing process, Scope and applications.

Unit V : Regenerated Cellulose : Growth of industry, Raw materials, Pre-treatment, Pulping, Manufacturing of paper, Recovery of chemicals, Environmental considerations, Viscose rayon, **Varnishes and Paints :** Scope and applications, Types of coatings, General manufacturing procedure, Environmental considerations.

Text Books

1. Shreve's Chemical Process Industries by G. T. Austin; Tata McGraw-Hill Publications.
2. Dryden's Outlines of Chemical Technology- For the 21st Century by M. G. Rao and M. Sittig, East-West Press.

Reference Books

1. Handbook of Oil & Colour; Oil & Colour Chemists' Association.
2. Chemical Process Technology by J. A. Moulijn, M. Makkee and A. E. van Diepen; John Wiley & Sons.
3. Unit Processes in Organic Synthesis by P. H. Groggins; Tata McGraw-Hill Publications.

Course Outcome

Students would be able to

1. Describe the processes involved in oil and fat production.
2. Explain the manufacturing process with flow sheets of Soap and Detergent industries.
3. Analyze important process parameters such as raw materials, MoC, and major engineering problems associated with sugar crystal and ethanol production.
4. Describe the raw materials, involved reactions, and manufacturing process of different types of polymers.
5. Explain the important process parameters such as raw materials, MOC, process description, and major engineering problems of pulp and paper industry and paint and varnish industry.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	-	1	-	-	-	-	-	-	3	2	-
CO2	1	1	1	2	-	1	-	-	-	-	-	-	3	2	-
CO3	1	1	1	2	-	1	-	-	-	-	-	-	3	2	-
CO4	1	1	1	2	-	1	-	-	-	-	-	-	3	2	-
CO5	1	1	1	2	-	1	-	-	-	-	-	-	3	2	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. V Semester

CHUETK3 **Fuel Combustion Energy Technology** **[L:3, T:0]**

Objective

To understand the basics of various types of solid, liquid and gaseous fuels, basic principles of their combustion processes, its appliances, the fundamentals of the applied sciences dealing with various types of conventional and non-conventional energy resources.

Contents

Unit I : Solid Fuel : Origin, Composition, Classification, Properties & characterization of coal, Coal washing & storage, Carbonization, Briquetting, Gasification.

Liquid Fuel : Origin, Composition and classification, Properties & characterization of liquid fuels from petroleum.

Gaseous Fuel : Classification of gaseous fuel, Natural gas, LPG, Refinery gas, Producer gas, Water gas.

Unit II : Combustion Process and Calculations : General Principles of combustion, Flame, Draught, Limits of inflammability, Types of combustion Process like surface, submerged, pulsating, slow combustion, Fundamentals of various combustion calculations with numerical examples.

Unit IV : Energy Conservation and Biomass energy: Energy consumption pattern in various sectors, Various ways of energy conservation in various process industries, Energy efficient conversion devices, General principles with applications and technology of Biomass energy.

Unit V : Non – Conventional Energy Technologies : General principles with applications and technology of Geothermal energy, Wind energy, Nuclear energy, Hydal energy, Tidal energy, Ocean energy.

Text Books

1. Elements of Fuel Combustion & Energy Engineering by S. N. Saha; Dhanpat Rai Publishing Company.
2. Fuels and Combustion by S. Sarkar; Universities Press.

Reference Books

1. Elements of Fuel & Combustion Technology by O. P. Gupta; Khanna Publishing.
2. Fundamentals of Thermal Radiation for Energy Utilization in Fuel Combustion by S. Shan, Z. Zhou and Y. Zhang; Zhejiang University Press, Springer.

Course Outcome

Students would be able to

1. Analyze solid liquid and gaseous fuels and their characterization.
2. Compute fuel combustion calculation in industries with recommendation of better combustion processes in relation to better efficiency and pollution control technologies.
3. Study and recommend suitable combustion devices and emerging technology.
4. Analyze how to prevent energy losses in industry.
5. Study and recommend the alternative source of energies including renewable energies in view of energy conservation to utilize them efficiently.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	1	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	2	1	-	3	1	-	-	-	-	-	3	-	-
CO5	3	1	2	1	-	1	1	-	-	-	-	-	1	-	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. V Semester

CHUETK4 **Process Equipment Design - I** **[L:3, T:0]**

Objective

To understand the mechanical and process design methods for various process vessels, head and shells used in process or chemical industries

Contents

Introduction : Concept of design pressure, Design temperature and allowable stress, Different types of welding joints, Joint efficiency.

Design of Pressure Vessel : Design of shell and head subjected to internal and external pressure, Design of various heads like flat plates, flanged, dished, hemispherical, ellipsoidal and conical, Shell design for external pressure with & without stiffening rings, Tall vessels

Design of Reaction Vessel : Design of jacketed and non-jacketed pressure vessel.

Design of Storage Tank and Various Supports : Types of storage tanks and their capacity, Design of various types of roofs, Leg support, Skirt support, Saddle support.

Text Books

1. Introduction to Chemical Equipment Design : Mechanical Aspects by B. C. Bhattacharya; CBS Publishers & Distributors Pvt. Ltd.
2. Process Equipment Design by L. E. Brownell and E.H. Young; John Wiley & Sons.
3. Process Equipment Design by M. V. Joshi and V. V. Mahajani; MacMillan India Ltd.
4. Chemical Engineering by J. M. Coulson and J. F. Richardson, Vol.-I; MacMillan, New York.
5. Process Equipment Design Volume 1 by S. D. Dawande; Dennet & Co.

Reference Books

1. Perry's Chemical Engineers' Handbook by D. W. Green and R. H. Perry, McGraw Hill Publication.
2. IS Codes.

Course Outcome

Students would be able to

1. Understand the basics of pressure vessel design.
2. Design the shell and head of pressure vessel.
3. Design the reaction vessel, storage vessels and their supports.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	1	3	-	-	-	-	-	-	-	3	2	-
CO3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. V Semester

CHUETK5 **Polymer Technology - I** **[L:3, T:0]**

Objective

Identification, characterization and synthesis techniques of different polymer along with understanding their thermodynamics, thermal transitions and environmental effects.

Contents

Unit I : Introduction, Classification of polymer, Polymer structure, Molecular weight distribution, Molecular weight averages of polymer.

Unit II : Synthesis of polymers, Polymerization techniques, Polymer reactivity, Preparation of polymer derivatives.

Unit III : Thermodynamics of polymer solution, Flory Huggins theory, Modified Flory Huggins theory, Molecular weight measurement.

Unit IV : Amorphous state, Glass transition temperature, Crystalline state, Crystalline melting temperature, Thermal transitions and related property change.

Unit V : Effect of polymer on environment, Polymer degradation and stability.

Text Books

1. Polymer Science & Technology by J. R. Fried; PHI Learning Pvt. Ltd.
2. Outlines of Polymer Technology : Manufacture of Polymers by R. Sinha; PHI Learning Pvt. Ltd.

Reference Books

1. Polymer Science by V.R. Gowariker, New age International Ltd.

Course Outcome

Students would be able to

1. Characterize different polymer types and be aware of the need for polymers in broader areas of life.
2. Understand different polymer synthesis techniques and related health and cultural issues while maintaining engineering ethics and responsibilities.
3. Acquire knowledge about thermodynamic principles of polymers and be able to communicate through presentations on specific problems related to engineering community.
4. Develop understanding of the involved thermal transitions in polymers while maintaining engineering ethics and responsibility.
5. Acknowledge about environmental concerns related to polymers, their sustainability and ethical issues.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	2	1	-	-
CO2	2	-	-	-	-	2	-	2	-	-	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	1	-	-	3	-	1
CO4	3	-	-	-	-	-	-	2	-	-	-	-	2	-	-
CO5	2	-	-	-	-	-	3	3	-	-	-	-	1	-	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. V Semester

CHUELT1 **Heat Transfer Lab** **[P:3]**

Objective

To provide the knowledge of working of heat transfer equipment and the application of heat transfer correlations.

Contents

1. Determination of dirt factor of a parallel and counter flow double pipe heat exchanger.
2. Determination of dirt factor of a shell and tube heat exchanger.
3. Study of thermal conductivity of a metal bar.
4. Calculation and comparison of heat transfer coefficient for drop-wise and film-wise condensation.
5. Measurement of heat transfer through composite wall.
6. Measurement of emissivity of a given test plate.
7. Study of unsteady state heat transfer.

Course Outcome

Students would be able to

1. Handle the heat transfer equipment and calculate the heat transfer coefficients and dirt factor.
2. Apply the heat transfer correlations for calculating the heat transfer rate.
3. Analyze the heat transfer by different modes of heat transfer.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	1	-	-	1	-	1	-	-	-	2	1	-
CO2	2	2	-	1	-	-	1	-	1	-	-	-	2	1	-
CO3	2	2	-	1	-	-	1	-	1	-	-	-	2	1	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

15/7/24

B. Tech. V Semester

CHUELT2 **Chemical Reaction Engineering Lab** **[P:3]**

Objective

To impart knowledge on kinetics and design of reactors.

Contents

1. Study the saponification reaction in a batch reactor.
2. Kinetics in a batch reactor for equimolar feed.
3. Kinetics in a batch reactor for non-equimolar feed.
4. Find activation energy for a chemical reaction using batch reactor.
5. Kinetics studies in a PFR.
6. Kinetics studies in a CSTR.
7. Study of temperature dependence and concentration dependency of reaction rate in a PBR.
8. RTD study in a PFR.
9. RTD study in a CSTR.
10. Comparative study of batch reactor, CSTR and PFR in terms of conversion.

Course Outcome

Students would be able to

1. Get a sound working knowledge of different types of reactors.
2. Understand the kinetics of different reactions in various reactors.
3. Use the batch reactor data to determine the order of reactions.
4. Use the relevant parameters for the design of reactors based on conversion.
5. To understand the RTD in various reactors to find the best reactor for various applications.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	1	-	-	-	-	-	-	2	1	-
CO2	3	2	1	1	-	1	-	-	-	-	-	-	2	1	-
CO3	3	2	1	1	-	1	-	-	-	-	-	-	2	1	-
CO4	2	2	2	1	-	1	-	-	-	-	-	-	2	1	-
CO5	3	3	2	1	1	1	-	-	-	-	-	-	2	1	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

15/2/24

B. Tech. VI Semester

CHUFTT1 **Mass Transfer - II** **[L:3, T:0]**

Objective

To provide basic knowledge of mass transfer operations and understand the mass transfer in LLE, leaching, drying, crystallization, adsorption and humidification operation.

Contents

Unit I : Humidification operations, Humidity chart and its use in measurement of humidity, Calculations of humidification operations, Adiabatic humidification, Design of cooling towers.

Unit II : Leaching, Equipment, Principles of leaching, Calculation of number of ideal stages, Stage efficiency.

Unit III : Liquid- Liquid Extraction, Principles of extraction, Panchon-Savorit method, Counter-current extraction using reflux, Application of McCabe method.

Unit IV : Crystallization, Yield of crystals, Heat effects in crystallization process, Supersaturation, Nucleation and crystal growth, Applications.

Unit V : Principles of drying, Mechanism and theory of drying, Calculation of drying time.

Text Books

1. Principles of Mass Transfer and Separation Processes by B. K. Dutta; PHI Learning Pvt. Ltd.
2. Mass Transfer Operations by R. E. Treybal; McGraw Hill Education.
3. Transport Processes and Unit Operations by C. J. Geankoplis; PHI Learning Pvt. Ltd.

Reference Books

1. Principles of Unit Operations by A. S. Foust, L. A. Wenzel, C. W. Clump, L. Maus and L. B. Andersen; John Wiley & Sons.

Course Outcome

Students would be able to -

1. Understand the humidification operation and cooling tower design.
2. Solve the problems related to leaching and have acquaintance with the leaching equipment.
3. Explain the basics of extraction, and solve related problems.
4. Demonstrate the principle of crystallization and calculations.
5. Identify the basics mechanisms of drying and drying time.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	-	-	-	-	-	-	-	-	3	1	-
CO2	3	1	1	1	-	-	-	-	-	-	-	-	3	2	-
CO3	3	1	1	1	-	-	-	-	-	-	-	-	3	2	-
CO4	3	1	1	1	-	-	-	-	-	-	-	-	3	1	-
CO5	3	1	2	1	-	-	-	-	-	-	-	-	3	2	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. VI Semester

CHUFTT2 **Chemical Reaction Engineering - II** **[L:3, T:0]**

Objective

To impart fundamental knowledge of non-ideal flow pattern, age distribution, fluid-particle reaction, fluid-fluid reaction behaviour and basics of catalyst and their method of synthesis.

Contents

Unit I : Basics of non-ideal flow, Age distribution of fluid, RTD, Conversion in non-ideal flow reactors, Models for non-ideal flow, Chemical reaction and dispersion, Tank in series.

Unit II : Mixing of fluids, Self-mixing of single fluid, Degree of segregation, Early and late mixing, Mixing of two miscible fluids.

Unit III : Fluid particle reactions, Unreacted core model, Diffusion through gas film, Ash layer control, Chemical reaction control, Shrinking core model for spherical particles and their rate controlling steps.

Unit IV : Fluid-fluid reactions, Kinetic study of various regimes like mass transfer and reaction, Film conversion parameter, Application of reactive and extractive system.

Unit V : Catalysis, Properties of catalysts including homogeneous and heterogeneous catalysts, Preparation of catalyst, Adsorption on solid surface, Steps in catalytic reactions synthesizing.

Text Books

1. Elements of Chemical Reaction Engineering by H. S. Fogler; PHI Learning Pvt. Ltd.
2. Principles of Reaction Engineering by S.D. Dawande; Central Techno Publications.
3. Chemical Reaction Engineering by O. Levenspiel; John Wiley & Sons.

Reference Books

1. Chemical Engineering Kinetics by J. M. Smith; McGraw Hill Education.
2. Chemical Engineering by J. M. Coulson and J. F. Richardson, Vol.-4; MacMillan, New York.

Course Outcome

Students would be able to

1. Understand the fundamental of non-ideal flow pattern and RTD.
2. Learn the fundamentals of mixing of fluids.
3. Understand the various models used in fluid particle system.
4. Understand the kinetics of fluid-fluid particle system.
5. Learn the fundamental of catalyst synthesis and their applications.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	-	-	-	-	-	-	3	2	-
CO2	3	2	2	1	-	1	-	-	-	-	-	-	3	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
CO4	2	2	2	1	3	1	-	-	-	-	-	-	3	-	-
CO5	3	3	2	2	3	1	-	-	-	-	-	-	3	2	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. VI Semester

CHUFTT3 Process Dynamics and Control **[L:3, T:1]**

Objective

To provide a comprehensive understanding of process control principles, techniques, and applications in chemical engineering.

Contents

Unit I : Laplace transform technique used to convert functions, facilitating the analysis and design of control systems.

Unit II : Linear open loop system, The first and second order systems and their transient response Interacting and non-interacting systems, Linearization, Transportation lag.

Unit III : Linear closed loop system-control system, block diagram, closed loop transfer function, Controllers, Transient response of closed loop systems.

Unit IV : Pneumatic controller mechanism, baffle nozzle, proportional controller mechanism, Proportional integral control, Proportional derivative control value, PID control, Final control element, Control valve, Feed forward control, Controller tuning.

Unit V : Stability concept, Routh stability criterion, Nyquists stability criterion, Root locus technique, introduction to frequency response, Bode diagram, Bode stability criterion, Gain and phase margins, Fuzzy Logic Control.

Text Books

1. Process Systems Analysis and Control by D. R. Coughanowr and S. E. LeBlanc; McGraw-Hill Education.
2. Chemical Process Control: An Introduction to Theory and Practice by G. Stephanopoulos Pearson Education.

Reference Books

1. Process Dynamics and Control by D. E. Seborg, T.F. Edgar, D. A. Mellichamp and F. J. Doyle III; John Wiley & Sons.

Course Outcome

Students would be able to

1. Demonstrate an understanding of the importance of process control in chemical plants and different control systems.
2. Apply Laplace transformations and transfer functions to analyze simple systems, including linearization and response of systems with dead time.
3. Analyze and evaluate the response of linear open loop and closed loop systems, including stability and transient response.
4. Utilize root locus and stability criteria to determine system stability and transient response characteristics.
5. Design and tune control systems using frequency response techniques, and understand the basics of advanced controllers and artificial intelligence.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-	-	2	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO4	-	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	-	-	2	3	3	-	-	-	-	-	-	-	-	2	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. VI Semester

CHUFTK1 **Process Equipment Design - II** **[L:3, T:0]**

Objective

To understand the Chemical Engineering Principles applicable to design heat transfer equipment with the help of standard codes.

Contents

Design of Heat Transfer Equipments : Double Pipe Heat Exchanger, Shell and Tube Heat Exchanger, Vertical & Horizontal Condensers and Evaporators.

The candidates will be allowed to use the following reference book in the examination hall:

- Hand book of Chemical Engineering J. H. Perry
- Tubular Heat Exchange Manufacture Association Manual
- Process Heat Transfer by D.Q. Kern
- ISI Codes.

Candidates have to bring their own copies of the above books and they will be not supplied by the vishwavidyalaya or the examination centre.

Text Books

1. Process Heat Transfer by D. Q. Kern; McGraw-Hill International Book Company.

Reference Books

1. Heat Transmission by W. H. McAdams; McGraw-Hill Inc.
2. Unit Operations of Chemical Engineering by W. L. McCabe, J. C. Smith and P. Harriot; McGraw-Hill Inc.
3. Chemical Engineering by J. M. Coulson and J. F. Richardson, Vol.-I; MacMillan, New York.

Course Outcome

Students would be able to

1. Design double pipe heat exchanger.
2. Calculate pressure drop and heat transfer surface for shell and tube heat exchanger.
3. Design condensers and calculate the area, economy and capacity of evaporators.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	-	-	-	-	-	-	3	1	-
CO2	3	3	3	2	1	1	-	-	-	-	-	-	3	1	-
CO3	3	3	3	2	1	1	-	-	-	-	-	-	3	1	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. VI Semester

CHUFTK2 **Polymer Technology - II** **[L:3, T:0]**

Objective

To comprehend the viscoelasticity of polymer materials and understand the different polymer types along with basic manufacturing steps of a polymer and a brief introduction to naturally occurring polymers.

Contents

Unit I : Viscoelasticity, mechanical models of viscoelastic behaviour, viscoelastic properties of polymer solutions and melts, rubber elasticity.

Unit II : Additives, plasticizers, Fillers and reinforcements, polymer blends, block co-polymers, polymer composites.

Unit III : Engineering thermoplastics, Polyolefins, Vinyl polymers, Polyamides, Polysulphone, Polycarbonates, Fluoropolymers, epoxies.

Unit IV : Polymer Processing & its Manufacturing: Basic processing operations, Extrusion, Modeling, Calendering, Coating, Injection moulding. Compression moulding, Transfer moulding, Blow moulding, Die casting. Rotation casting. Film casting.

Unit V : Naturally occurring polymers and biopolymers, cellulose and its derivatives, non-cellulosic.

Text Books

1. Polymer Science & Technology by J. R. Fried; PHI Learning Pvt. Ltd.
2. Outlines of Polymer Technology : Manufacture of Polymers by R. Sinha; PHI Learning Pvt. Ltd.

Reference Books

1. Polymer Science by V. R. Gowariker, N. V. Viswanathan and J. Sreedhar; New age International Publishers.

Course Outcome

Students would be able to

1. Comprehend viscoelasticity in polymer and analyse related problems.
2. Acquire knowledge of additives, plasticizers and such polymer related products and apply the same for addressing societal responsibilities.
3. Develop a detailed understanding of different industrial polymers while accessing safety and environment sustainability.
4. Develop an understanding towards the production line for polymer and be able to communicate the engineering community via proper reports, presentations on the manufacturing process.
5. Acknowledge about knowledge on biopolymers and be able to apply the same on societal concerns and sustainability.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-		-	-		-	-	-	-	-	3		
CO2	2		-		-	2	2	-	-	-	-	-	2		
CO3	2		-		-	2	2	-	-	-	-	-	2		
CO4	3							2		2			1		1
CO5	2					1	2						1		

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. VI Semester

CHUFTK3 Project Engineering Economics and Management [L:3, T:0]

Objective

This course is required for the future professional career for engineering related industrial economics and management.

Contents

Unit I : Concept of project and project management, Characteristics of project, Introduction to project engineering, Role of a project leader, General design considerations, Plant layout and site selection, Flow diagram, Concept of scale-up, Concepts of techno-economic feasibility report.

Unit II : Technical analysis, Financial analysis, Significance of financial analysis, Elementary knowledge of book of accounts- Journal, Ledger, Balance sheet, Profit and loss account. Cost estimation, Cash flow investment, Production cost, Capital investment, Cost indices, Production and overhead cost.

Unit III : Meaning and importance of project finance, Means of finance and sources of project in India, Financial institution structure and financial assistance, Norms of finance and term loan procedure, Concept of value engineering, its Function, aims and procedure.

Unit IV : Importance and kinds of capital expenditure, Depreciation and its calculation methods, Methods of calculating profitability, Alternative investments, Break Even analysis.

Unit V : Introduction of project network, Network scheduling, Critical Path Method, Program Evaluation & Review Technique, Gantt chart.

Text Books

1. Plant Design & Economics for Chemical Engineers by M. S. Peters, K. D. Timmerhaus and R. E. West; McGraw-Hill Book Company Inc.
2. Projects: Planning, Analysis, Selection, Financing, Implementation and Review by Prasanna Chandra; McGraw-Hill Book Company Inc.
3. Product and Process Design Principles : Synthesis, Analysis, and Evaluation by W. D. Seider, J. D. Seader, D. R. Lewin and S. Widagdo; John Wiley & Sons.

Reference Books

1. Project Engineering of Process Plants by H. F. Rase and M. H. Barrow; John Wiley & Sons.
2. Pilot Plants, Models and Scale-up Methods in Chemical Engineering by R. E. Johnstone and M. W. Thring; McGraw-Hill Book Company Inc.

Course Outcome

Students would be able to

1. Select a site for the project from given alternatives.
2. Calculate working capital requirement for a given project.
3. Determine total project cost including cost of the equipments used in a plant.
4. Determine the depreciation and break-even point.
5. Understand the various milestones related to project concept to commissioning.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	1	1	-	-	-	-	-	-	3	-
CO2	3	1	3	1	-	-	-	-	-	-	-	-	-	3	-
CO3	3	1	2	-	-	2	1	-	-	-	-	-	-	3	-
CO4	3	1	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	3	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. VI Semester

CHUFTK5 **Petrochemical Technology** **[L:3, T:0]**

Objective

To impart knowledge of petroleum refining, hydrocarbon processing, and derived petrochemicals.

Contents

Unit I : Survey of Petrochemical Industries : Petrochemical industries in India, Plastic and synthetic fiber industries, Product of petroleum industries, Feed stocks for petrochemical production, Purification and separation of feed stocks.

Unit II : C1 and C2 Hydrocarbons : Chemicals from methane, ethane, ethylene and acetylene, Synthesis gas as a feed stock for chemical industries, Naphtha cracking and reforming, Hydrogen from reforming of hydrocarbons.

Unit III : Chemicals from C3, C4 and Higher Fractions : Carbon compound, Dehydrogenation of hydrocarbon and higher paraffins, Greases and lubricants, Polymers and their properties, Polymers from olefins- polyethylene (HDPE, LDPE), Polypropylene, Vinyl polymers.

Unit IV : Aromatic Hydrocarbons : Production of BTX, Benzene derivatives, Products from toluene, Oxidation products of toluene, Synthetic fibers and their production, Synthetic rubber and its production.

Unit V : Plastics : Classifications of plastics, Different types of resin and their production, ABS plastics, Poly carbonates (PC), Poly urethanes, Polyimides, Polystyrene, Synthetic detergents and their production.

Text Books

1. A Textbook on Petrochemicals by B. K. Bhaskararao; Khanna Publishers.
2. Chemistry of Petrochemical Processes by S. Matar and L. F. Hatch; Gulf Professional Publishing.
3. Petroleum Refining and Petrochemicals by N. K. Sinha; Umesh Publications.

Reference Books

1. Modern Petroleum Technology by G. D. Hobson and W. Pohl; Applied Science Poblishers.
2. Handbook of Petrochemicals Production Processes by R. A. Meyers; McGraw-Hill Education.

Course Outcome

Students would be able to

1. A brief overview of the petrochemical industries like plastic, polymer, synthetic fibres in India.
2. Knowledge of chemical synthesis from C1 and C2 hydrocarbons.
3. Understanding of dehydrogenation of hydrocarbons (C3, C4, and higher hydrocarbons) for chemical production.
4. A detailed understanding on BTX production from various hydrocarbons.
5. Knowledge of plastic and resin manufacturing with their classifications.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	-	1	-	-	-	-	-	-	-	3	2
CO2	1	1	1	2	-	1	-	-	-	-	-	-	-	3	2
CO3	1	1	1	2	-	1	-	-	-	-	-	-	-	3	2
CO4	1	1	1	2	-	1	-	-	-	-	-	-	-	3	2
CO5	1	1	1	2	-	1	-	-	-	-	-	-	-	3	2

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. VI Semester

CHUFTK6 **Waste to Energy** **[L:3, T:0]**

Objective

Students will learn the types of waste, its characterization techniques, and conversion process from waste to energy.

Contents

Unit I : Introduction to energy from waste, Characterization and classification of wastes, Availability of agro based, forest, industrial, municipal solid waste in India vis-a-vis world.

Unit II : Proximate & ultimate analyses waste, Heating value determination of solid liquid and gaseous fuels, and Combustion calculations.

Unit III : Incineration, Pyrolysis, Gasification, Hydrogen production, Storage and utilization, Anaerobic digestion, Composting, Gas generation and collection in landfills.

Unit IV : Industrial liquid effluents and their energy potential, Anaerobic reactor configuration for fuel gas production, Separation of methane and compression.
Biodiesel: Biodiesel production from waste/discarded oils, Characterization of biodiesel.

Unit V : Densification of agro and forest wastes, technological options, combustion characteristics of densified fuels, usage in boilers, brick kilns and lime kilns.

Text Books

1. Biomass Conversion and Technology by C. Y. WereKo-Brobby and E. B. Hagan; John Wiley & Sons.
2. Food, Feed and Fuel from Biomass by D. S. Chahal; IBH Publishing Company.

Reference Books

1. Nonconventional Energy by A. V. Desai; New Age Publishers.
2. Biogas Technology - A Practical Hand Book by K. C. Khandelwal and S. S. Mahdi; Tata McGraw-Hill Publishing Co.

Course Outcome

Students would be able to

1. Classify the waste for fuel and identify the devices for conversion of waste to energy.
2. Characterize the waste.
3. Implement the Pyrolysis and gasification techniques for waste.
4. Apply bio-chemical conversion process.
5. Produced densified fuel for combustion.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	1	1	-	-	-	-	-		-	
CO2	3	2	3	2	-	1	1	-	-	-	-	-	1	-	
CO3	3	2	3	2	-	1	1	-	-	-	-	-	1	-	
CO4	3	2	3	2	-	1	1	-		-	-	-	1	-	
CO5	3	2	3	2	-	1	1	-		-	-	-	1	-	

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. VI Semester

CHUFTK7 Optimization Techniques in Chemical Engineering [L:3, T:0]

Objective

To make the student understand the fundamentals of optimization methods, formulate the optimization problem with and without constraint, identify and apply the optimization techniques and software tools for solving optimization problems.

Contents

Unit I : Introduction : Introduction to systems analysis and modelling, Formulation of various process optimization problems and their classification, Basic concepts of optimization-convex and concave functions, Necessary and sufficient conditions for stationary points, Differential method for solving one and two variable problems with and without constraints, Lagrangian multiplier method, Karush-Kuhn-Tucker (KKT) conditions.

Unit II : Linear Programming : Formulation of linear programming problem, Graphical method, Single phase simplex method, Two phase simplex method, Duality. Solution of linear programming problem using MS Excel.

Unit III : Optimization of One-Dimensional Functions : Sequential search methods - Golden section method, Dichotomous search method, Interval halving method, Fibonacci method; Newton-Raphson method, Quasi-newton's method, Secant method, Root finding using optimization techniques.

Unit IV : Geometric Programming : Posynomial function, Optimization problem with degree of difficulty equal to zero and one, with and without constraints.

Unit V : Non-Traditional Optimization Problem and Software Tools : Introduction to dynamic programming as applied to discrete multistage problems.
Non-Traditional Optimization Techniques : Genetic algorithm, Simulated annealing, MS Excel software for solving linear and non-linear optimization problems with and without constraints, MATLAB for optimization.

Text Books

1. Engineering Optimization : Theory and Practice by S. S. Rao; John Wiley & Sons.
2. Problems in Operations Research : Principles and Solutions by P. P. Gupta and D. S. Hira; S. Chand and Company Ltd.
3. Optimization of Chemical Processes by T. F. Edgar, D. M. Himmelblau and L. S. Lasdon; McGraw-Hill Publishing Company.

Reference Books

1. Optimization for Engineering Design by K. Deb; PHI Learning Pvt. Ltd.
2. Engineering Optimization : Methods and Applications by A. Ravindran, K. M. Ragsdell and G. V. Reklaitis; John Wiley & Sons.

Course Outcome

Students would be able to

1. Understand the basic concepts of optimization.
2. Analyse and formulate the optimization problems.
3. Identify various types of optimization problem.
4. Apply linear/non-linear programming techniques to solve optimization problems with and without constraint.
5. Apply non-traditional optimization techniques and make use of software tools for problem solving.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	3	2	2	1	2	1	1	2	2	2	1	2
CO2	3	3	1	3	2	2	1	2	1	1	1	2	2	1	2
CO3	3	3	3	2	1	2	1	2	1	1	1	2	2	1	2
CO4	3	3	3	2	1	2	1	2	1	1	1	2	2	1	2
CO5	3	3	3	2	3	2	1	2	1	1	1	2	2	1	2

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. VI Semester

CHUFLT1 **Mass Transfer Lab** **[P:3]**

Objective

To provide the knowledge of working of mass transfer equipment's and the application of mass transfer operations.

Contents

1. Determination of diffusion coefficient of organic vapour in air.
2. Determination of the vapour liquid equilibrium (VLE).
3. Study of the characteristics of steam distillation.
4. To Verify Rayleigh equation for distillation.
5. Determination of absorption of CO, in a packed column.
6. Study of the solid-liquid extraction method.
7. Study of the liquid-liquid extraction method.
8. Study of the operation of a fluidized bed dryer.
9. To plot the drying rate curve of the given material.
10. Determination of yield of crystal.

Course Outcome

Students would be able to

1. Handle the mass transfer equipment's.
2. Understand molecular diffusion and Apply mass transfer operations for separation of mixture.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1									2	1	-
CO2	3	1	1	1									2	1	-

Weightage : 1-Weak, 2-Moderate, 3-Strong

B. Tech. VI Semester

CHUFLT2 **Process Dynamics and Control Lab** **[P:3]**

Objective

To provide knowledge of the core concepts, challenges, techniques, and applications of process control for managing various processes.

Contents

1. Study the dynamic response of liquid level in two tanks interacting liquid level system.
2. Study the dynamic response of liquid level in two tanks non-interacting liquid level system.
3. Study of the step response characteristics of a mercury manometer.
4. Determine the time constant of mercury glass thermometer.
5. Introduction to the dynamics and control of processes, focusing on temperature control trainers.

Course Outcome

Students would be able to

1. Understand and apply core concepts, challenges, techniques, and applications of process control in managing various processes.
2. Address complex control problems using modern methodologies.

CO-PO Mapping

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2		1			1		1				2	1	
CO2	2	2		1			1		1				2	2	

Weightage : 1-Weak, 2-Moderate, 3-Strong