Minutes of Meeting

The scheduled meeting of members of Board of Studies (BoS) of Department of Chemical Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur was held today (June 28, 2023) in blended mode (online and offline). The agenda of the meeting was as follows:-

1. Approval of Scheme & Syllabus of B.Tech. Final Year (VII & VIII Semester) of Chemical Engineering (w.e.f. Session 2023-24).
2. Approval of Departmental Vision and Mission.
3. Review of COs of B.Tech. Chemical Engineering Subjects, as required.
4. Review of Scheme & Syllabus of M.Tech. (All Semester) of Chemical Engineering (w.e.f. Session 2023-24)

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, Prof., 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
4. Dr. Anil Kumar Chandrakar Member-BoS, Associate Prof., Dept. of Chemical Engg.
5. Dr. Saurabh Meshram, Member-BoS, Assistant Prof., Dept. of Chemical Engg.
6. Dr. Amit Jain, Invited Member, Associate Prof., Dept. of Chemical Engg.
7. Dr. Neeraj Chandraker, Invited Member, Assistant Prof., Dept. of Chemical Engg.
8. Dr. Anuradha N. Joshi, 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.

Following decision has been made in the meeting.

1. The committee discussed the scheme and syllabi of B. Tech Fourth year (VII and VIII semesters) at length and after incorporating the changes, as identified by the BoS members, the final scheme and syllabi is to be sent to the external BoS members for their formal consent.

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2. Two open elective courses, Waste To Energy (CH207TOE02) in B.Tech. VII Semester and Project Engineering Economics and Management (B.Tech. CH208TOE03) in B.Tech. VIII Semester, are to be offered by the department of chemical engineering.
3. Vision and Mission of the Department was finalized after discussion in the meeting.
4. Discussion was made on M. Tech. Scheme and Syllabus to modify and implement the changes in next BoS likely to be held in August 2023.

Dr. Raghwendra Singh Thakur

Prof. (Mrs) A B Soni

Er. Arvind Verma

Dr. Anil Kumar Chandrakar

Dr. Amt Jain

Dr. Saurabh Meshram,

Dr. Neeraj Chandraker

Dr. Anuradha N. Joshi

Dr. Gautam Prasad Dewangan

Mr. Vishnu Prasad Yadav

Dr. Sandeep Dharmadhikari

Dr. Ghoshna Jyoti

Dr. Pankaj Kumar

Department of Chemical Engineering
School Of Studies of Engineering & Technology
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

Vision and Mission

Department Vision

The vision of the department is to establish itself as one of the best study centers of Chemical Engineering education to produce proficient, entrepreneurs, and researchers to serve the needs of the industry and society.

Department Mission:

- To produce career-ready Chemical Engineers with high standards of ethical and social values and entrepreneurial skills.
- To develop the research culture in fundamental and application-oriented problems to cater the societal and industrial needs.
- To build strong relationship between academia, industry and other institute of repute.

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

SCHEME FOR EXAMINATION (Effective from Session 2023-24)

B.TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

FOURTH YEAR, SEVENTH SEMESTER (AICTE-NEW)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
						Sessional			
	THEORY		L	T	P	IA	ESE	TOTAL	
01.	CH407TPC14	Process Equipment Design-II	3	0	0	30	70	100	3
02.	CH407TPC15	Transport Phenomena	3	0	0	30	70	100	3
03.	CH407TPE4X	Professional Elective-IV	3	0	0	30	70	100	3
04.	CH407TPE5X	Professional Elective-V	3	0	0	30	70	100	3
05.	XX207TOEXX	Open Elective-II	3	0	0	30	70	100	3
	PRACTICAL								
01.	CH407PPC09	Vocational Training Viva cum Seminar	0	0	4	30	20	50	2
02.	CH407PPC10	Minor Project	0	0	6	30	20	50	3
		Total	15		10	210	390	600	20

IA – Internal Assessment

Total Marks – 600

ESE - End Semester Examination

Total Periods / Week – 25

Total Credits – 20

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SCHEME FOR EXAMINATION (Effective from Session 2023-24)

B.TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

FOURTH YEAR, EIGHTH SEMESTER (AICTE-NEW)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
						Sessional			
	THEORY		L	T	P	IA	ESE	TOTAL	
01.	CH408TPC16	Process Equipment Design-III	3	1	0	30	70	100	4
02.	CH408TPE6X	Professional Elective-VI	3	0	0	30	70	100	3
03.	XX208TOEXX	Open Elective-III	3	0	0	30	70	100	3
	PRACTICAL								
01.	CH408PPC11	Major Project	0	0	12	120	80	200	6
		Total	9	1	12	210	290	500	16

IA – Internal Assessment

ESE - End Semester Examination

Total Credits – 16

Total Marks – 500

Total Periods / Week - 22

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SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
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DEPARTMENT OF CHEMICAL ENGINEERING

List of Professional Elective Courses (Seventh and Eighth Semester)

S.No.	Semester	Course No.	Subjects
01.	VII	CH407TPE41	New Separation Processes
02.		CH407TPE42	Water Conservation and Management
03.		CH407TPE43	Process Modeling and Simulation
01.	VII	CH407TPE51	Petroleum Refinery Engineering
02.		CH407TPE52	Process Utilities and Safety
03.		CH407TPE53	Design and Development of Catalyst
01.	VIII	CH408TPE61	Environmental Engineering
02.		CH408TPE62	Optimization Techniques
03.		CH408TPE63	Petrochemical Technology

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List of Open Elective Courses (Seventh and Eighth semester)

S.NO.	SEMESTER	COURSE NO.	SUBJECTS	DEPARTMENT CODE
01.	VII	CH207TOE02	WASTE TO ENERGY	CH
02.		ME207TOE02	PRINCIPLES OF MANAGEMENT	ME
03.		EC207TOE02	CMOS DIGITAL VLSI DESIGN	EC
04.		CE207TOE02	GREEN BUILDING AND SUSTAINABLE MATERIALS	CE
05.	IT207TOE01	~~IT207TOE02~~	MACHINE LEARNING	IT
06.	CS207TOE01	~~CS207TOE02~~	GIS & REMOTE SENSING	CS
07.	IP207TOE02	~~IP207TOE21~~	MANUFACTURING PROCESSES-I	IP
01.	VIII	CH208TOE03	PROJECT ENGINEERING ECONOMICS AND MANAGEMENT	CH
02.		ME208TOE03	SUPPLY CHAIN MANAGEMENT	ME
03.		EC208TOE03	INTRODUCTION TO IOT	EC
04.		CE208TOE03	INFRASTRUCTURE PLANNING AND MANAGEMENT	CE
05.	IT208TOE01	~~IT208TOE03~~	SOFT COMPUTING	IT
06.	CS208TOE01	~~CS208TOE03~~	ARTIFICIAL INTELLIGENCE	CS
07.	IP208TOE03	~~IP208TOE41~~	ADVANCED MANUFACTURING PROCESSES	IP

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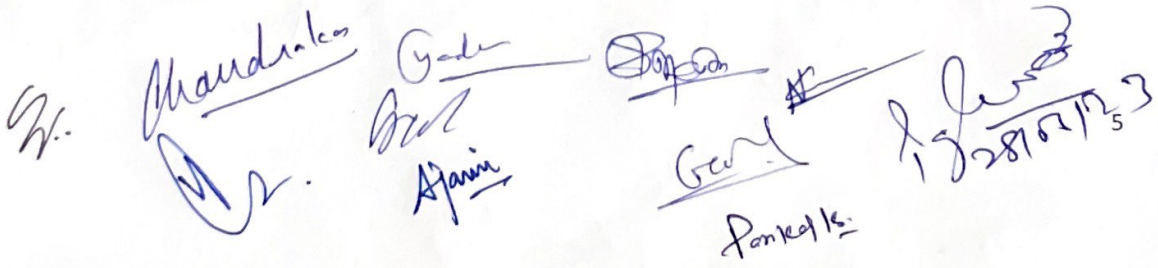
Program Outcomes

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 modeling 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.



B.Tech. VII Semester

CH407TPC14 **Process Equipment Design - II** [L:3, T:0, P:0]

Objectives

1. To understand the Chemical Engineering Principles applicable to design heat transfer equipment.
2. To apply standard codes for design of heat transfer equipment.
3. To justify the suitable heat transfer equipment for the particular heat duty.

Contents

Design of Heat Transfer Equipment's: 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:

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

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

Suggested Text Books

1. Process Heat Transfer by D. Q. Kern
2. Heat Transmission by McAdams
3. Unit Operations of Chemical Engineering by McCabe Warren, L Smith Julian and Harriot Peter, Fifth Edition, McGraw Hill Inc.
4. Chemical Engineering by J. M. Coulson and Richardson, Volume-1

Course Outcomes

Students would be able to

1. Ability to process design of double pipe heat exchanger.
2. Ability to process design of shell and tube heat exchanger.
3. Ability to process design of condensers and evaporators.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	-	-	-	-	-	-	3	2	-
CO2	3	3	3	2	2	1	-	-	-	-	-	-	3	2	-
CO3	3	3	3	2	2	1	-	-	-	-	-	-	3	2	-

B.Tech. VII Semester

CH407TPC15 **Transport Phenomena** [L:3, T:0, P:0]

Objectives

To impart knowledge about individual and simultaneous momentum, heat and mass transfer, model development along with appropriate boundary conditions.

Contents

Unit-I: Introduction to Transport Phenomena: Similarity between momentum, heat and mass transfer, The continuum hypothesis, Basic laws of fluid motion, Newton's second law of motion, Principle of balance between momentum, Heat and mass transfer, Principles of conservation of momentum, mass and energy

Unit-II: Momentum Transport Phenomena: Momentum transport in laminar flow: Newton's law of viscosity, Science of rheology, Prediction of viscosity and its dependence on temperature, pressure and composition, Boundary conditions, Shell balance approach for stress distribution and velocity profiles, Introduction to time derivatives and vector analysis, Equation of continuity and equation of motion and their application in fluid flow problems.

Unit-III: Unsteady State Momentum Transport: Flow near a wall suddenly set in motion, Momentum transport phenomena in turbulent flow, Definitions of friction factors, friction factor for flow in tubes, around spheres and through packed bed column.

Unit-IV: Energy Transport Phenomena: Energy transport in laminar flow: Fourier's law of heat conduction, Prediction of thermal conductivities and its dependence on temperature, Pressure and composition, Boundary conditions, Shell balance approach, Types of heat sources, Principle of extended surfaces, Types of cooling fans, Free and forced convection. Unsteady state heat transport, Unsteady state heat conduction in solids, Heating of semi-infinite slab, Heating of finite slab, Application.

Unit-V: Mass Transport Phenomena: Definitions of concentration, Velocities and mass fluxes, Fick's law of diffusion, Prediction of diffusivity and its dependence on temperature, pressure and composition, Boundary conditions, Shell balance approach for mass transfer problems. Problems of diffusion with homogeneous and heterogeneous chemical reaction, Diffusion and chemical reaction in porous catalyst the effectiveness factor, Equation of continuity for multicomponent mixtures

Suggested Text Books

1. Transport Phenomena by R.B. Bird, W.E. Stewart and E. W. Lighfoot, John Wiley & Sons
2. Transport Phenomena by R. S. Brodkey and H. C. Hershey, McGraw-Hill
3. Fundamentals of Momentum Heat and Mass Transfer by J.R. Welty, C.W. Wicks, R.E. Wilson and G. Rorrer, John Wiley & Sons.

Course Outcomes

Upon completion of this course, the students will be able to:

1. analyze heat, mass, and momentum transport in a process;
2. formulate and solve momentum heat and mass transport problems along with appropriate boundary conditions using shell balance approach.;
3. develop model equations and solve steady and transient state problems involving heat, mass, and momentum transport.
4. estimate the friction factor for various flow situations.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1									2	1	1
CO2	3	3	1	1									2	1	1
CO3	3	3	1	1									2	1	1
CO4	3	1	1	1									2	1	1

B.Tech. VII Semester

CH407TPE41 **New Separation Processes** [L:3, T:0, P:0]

Objectives

This is a course further built up on and in continuation with Chemical Engineering operations. It forms the basis Chemical Engineering principles and hence it is required in almost all the courses and throughout the professional career of a Chemical Engineer.

Contents

Unit-I: Overview of Separation Processes: Basic concepts of separation processes; Physico-chemical properties and other factors controlling separation; Limitations of Conventional separation processes and new separation processes; Equilibrium and rate governed separation processes and their characteristics.

Unit-II: Membrane based Separation Processes: Principle of membrane separations process, advantages and disadvantages; classification, membrane materials, general methods of preparation and characterization of membranes; Membrane modules, Concentration polarization.

Unit-III: Porous Membrane Based Processes: Reverse osmosis, Ultrafiltration, Microfiltration, Nano-filtration, Dialysis, Ion-selective membranes and electro-dialysis; Industrial applications of porous membrane-based processes.

Unit-IV: Non-porous Membrane Based Processes: Gas separation, Pervaporation, Liquid Membranes and their Industrial Applications, Medical Applications of Membranes, Miscellaneous Membrane Processes, Membrane Distillation, Membrane Reactors.

Unit-V: Other Non-conventional Separation Processes: Foam and Bubble Fractionation, Pressure and Temperature Swing Adsorption, Cloud Point Extraction, Centrifugal Separation Processes, Super Critical Fluid Extraction.

Suggested Text Books

1. Separation Process Principles by J.D. Seader and E.J. Henley, John Wiley & Sons, Inc
2. Separation Processes by C. J. King, McGraw-Hill, Inc.
3. Membrane Separation Processes by K. Nath, PHI, New Delhi
4. Membrane Technology and Applications by R.W. Baker, , John Wiley and Sons UK
5. Handbook of Industrial Membrane Technology by M.C. Porter, Crest Publishing House.

Course Outcomes

Explain membrane processes in terms of the membrane, feed, sweep, retentate, permeate, and solute membrane interactions. Distinguish among microfiltration, ultrafiltration, Nano filtration, virus filtration, sterile filtration, filter-aid filtration, and reverse osmosis in terms of average pore size. Explain common idealized flow patterns in membrane modules.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1				1						2	2	
CO2	1	1	1				1						2	2	
CO3	1	1	1				1						2	2	

B.Tech. VII Semester

CH407TPE42 **Water Conservation & Management** [L:3, T:0, P:0]

Objectives

1. To understand the importance of water resources and their role in sustainable development. 2. To identify and analyse various water conservation techniques and strategies. 3. To evaluate the environmental, social, and economic impacts of water management practices. 4. To apply mathematical and statistical methods to analyse water-related data and make informed decisions. 5. To demonstrate effective communication skills in presenting water conservation plans and projects.

Contents

Introduction: water cycle, water storage, water quality; water conservation in homes; water conservation in the work place; water management-water quality, controlling use and quality of water, water flow measurement, water quality control, testing water salinity, preserving water quality, minimising evaporation, water sanitation, water audits; water conservation in agriculture; water conservation in process industry; water conservation in construction industry; water conservation in service industry.

Suggested Text Books

1. Water Conservation, Management and Analysis by V. Madireddi and Subba Rao, Read worthy Publications (Pvt) Ltd
2. Protection and Conservation of, Water Resources by Hadrian F. Cook, John Wiley & Sons Inc.
3. Water Resources, Conservation and Management by S.N. Chatterjee, Atlantic Publishers & Dist.

Course Outcomes

Upon completion of this course, the students will be able to:

1. Apply scientific knowledge and principles to solve real-world problems. 2. Demonstrate understanding of environmental, social, and ethical responsibilities in professional practice. 3. Analyze and evaluate the impacts of engineering solutions in a global and societal context. 4. Apply research methods and tools to investigate complex problems. 5. Communicate effectively with diverse audiences.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2				2	2						3		
CO2	3	2	2			2	2						3		
CO3		2	2	2		2	2						3		
CO4	3		2	2		2	2						3		
CO5		2			2	2	2						3		

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B.Tech. VII Semester

CH407TPE43 **Process Modelling & Simulation** **[L:3, T:0, P:0]**

Objectives

Graduates shall be able to (a) understand chemical engineering system in term of modelling principle; (b) distinguish simulation from design of equipment; (c) apply software tools such as UNISIM to model chemical processes; (d) develop algorithm for modelling & solve the model.

Contents

Unit-I: Introduction: Uses of Mathematical Models, Scope of Coverage, Principles of Formulations. Mathematical Modeling in Chemical Reaction Engineering: CSTR, PFR, Batch Reactor, Semi batch Reactor, Series of Isothermal CSTR, Constant Hold-Up CSTR's, CSTR's with Variable Hold Ups, Gas Phase Pressurized CSTR, Non-Isothermal CSTR, Bioreactor, Trickle Bed Reactor.

Unit-II: Mathematical Modeling in Mass Transfer: Ideal Binary Distillation Column, Multi- Component Non-ideal Distillation Column, Batch Distillation with Hold Up, Steam Distillation, Multi-Solute Batch Liquid- Liquid Extraction, Continuous Extraction, Multistage Countercurrent Extraction, Plug Flow Type Liquid- Liquid Extraction, Reactor with Mass Transfer, Absorption, Adsorption.

Unit-III: Mathematical Modeling in Heat Transfer: Two Heated Tanks, Single Component Vaporizer, Double Pipe Heat Exchanger, Shell and Tube Heat Exchanger, Multicomponent Flash Drum, Cooling Towers.

Unit-IV: Mathematical Modeling of Other Chemical Processes: Interacting and Non-Interacting Systems with and without Heaters, Isothermal Hydraulic System, Forward and Backward Feed Triple Effect Evaporator.

Unit-V: Introduction of MATLAB and Use of Language, Simulation, Program Development and Numerical Solutions of Above Processes.

Suggested Text Books

1. Process Modeling, Simulation and Control for Chemical Engineers by W. L. Luyben, McGraw Hill, 1990.
2. Process Plant Simulation by B. V. Babu, Oxford University Press, 2004.
3. Optimisation Techniques for Chemical Engineers by A. Hussain and K. Gangaiah, Macmillan, 2001.
4. Process Control: Modeling, Design and Simulation by B. W. Bequette. Prentice-Hail India, 2006.
5. Elements of Chemical Reaction Engineering by Fogler, Prentice Hall of India.

Course Outcomes

Students would be able to

1. explain detail importance of ODE and PDE;
2. develop model equations for the given system;
3. solve structural, thermal, fluid flow problems;
4. demonstrate the model solving ability for various processes/unit operations;
5. demonstrate the ability to use a process simulation.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--
CO2	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--
CO3	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--
CO4	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--
CO5	3	3	3	3	3	--	--	--	--	--	--	3	3	3	--

B.Tech. VII Semester

CH407TPE51 **Petroleum Refinery Engineering** [L:3, T:0, P:0]

Objectives

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

Contents

Unit-I: Petroleum Crude and Refining: 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 petroleum crude, Type of refineries, Planning for operation of oil refinery.

Unit-II: Physical Properties and Testing Methods of Petroleum Products: Physico-chemical properties of various petroleum products as per API / ASTM / BIS specifications.

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

Unit-IV: Cracking & Reforming Operation: 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 & Refining Operation: 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.

Suggested Text Books

1. Petroleum Refinery Engineering by W.L. Nelson
2. Petroleum Refining by Gary and Handwarke, Marcel Dekker
3. Petroleum Refining & Petrochemicals by N.K. Sinha, Umesh Publications New Delhi.
4. Petroleum Refining Technology by I.D. Mall, CBS Publishers & Distributors Pvt. Ltd. New Delhi.

Course Outcomes

Students would be able to

1. Explain the origin, formation, classification, and physical properties of petroleum crude.
2. Gain knowledge of physical properties of various petroleum products and their testing methods.
3. Understand crude oil refining and conversion processes such as thermal, catalytic cracking and catalytic reforming.
4. Apply knowledge of LPG, gasoline, diesel, kerosene, jet fuel, lubricating oil production from petroleum crude and their storage and transportation.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	1	3						3		3
CO2	3	1	2	3	3	1							3		3
CO3	3	3	3	3	3	3							3		3
CO4	3	1	1	2	3	3							3		3

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B.Tech. VII Semester

CH407TPE52 **Process Utilities and Safety** **[L:3, T:0, P:0]**

Objectives

To understand the basic knowledge about various process utilities applied in the chemical process industry and problems related to hazards & safety.

Contents:

Unit-I: Introduction: Role and types of process utilities in process industries. Heat Transfer Media: Characteristics properties, Classification, Selection and their industrial application.

Unit-II: Steam System: Generation and application in chemical process plants, Design of efficient steam heating systems, Condensate utilization, Flash steam. Steam Traps: Types and characteristics.

Unit-III: Water: Characteristic and conditioning for process industries e.g., steam piping, boiler feed, cooling etc., Recycling of process water.

Unit-IV: Introduction to process safety: Accidents and loss statistics, Nature of the accidents / hazardous process. Toxicology: Toxic material and biological response, Dose responses relationship and models, Threshold dose and its definition, Material safety data sheets and industrial hygiene evaluation.

Safety Devices: Personal safety devices and general hygiene management, Storage and ventilation.

Unit-V: Fire and Explosion: Definition, Flammability characteristics and explosion, Design to prevent fires and explosions by inverting, purring, ventilation, sprinkler systems, Static electricity controls, Relief and relief sizing in vapour/gas, Liquid and runway reaction services.

Suggested Text Books :

1. High Temperature Heat Carrier by A. V. Chechetckin, Pergammon Press.
2. Efficient use of Steam by P. M. Goodal, Guilford
3. Chemical Process Safety: Fundamentals with applications by A. Crowl Daniel and F.L.Joseph, PHI Publications.

Reference Book:

1. Handbook of Heat Transfer Media by P. L. Geiringer, Van Nostrand Reinhold Inc.,U.S.

Course Outcome:

Students would be able to

1. Evaluate the requirements of process utilities in process industries.
2. Calculate the steam requirement and its applications as utility.
3. Explain fire and explosion and its prevention methods.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2		3	1	1	1	1	2	1	3		3
CO2	1	1	1	1		1			1			1	3		3
CO3	1	2	1	1		1		1	1	1	1	1	3		3

B.Tech. VIII Semester

CH407TPE53 **Design and Development of Catalyst** [L:3, T:0, P:0]

Objectives

To gain the knowledge of catalyst preparation methods, characteristics, mechanism of catalytic reactions, and design of catalytic reactors.

Contents

Structure of Solid Surfaces, Chemisorption and Physisorption, Thermodynamics and Kinetics of Surface Processes, Principles of Heterogeneous Catalysis, Preparation, Characterization and Classification, Kinetics of Heterogeneous Reactions, Physical, Chemical and Mathematical Description of Catalyst Deactivation, Deactivation by Fouling, Poisoning and Sintering, Deactivation and Regeneration of Catalyst Pellets, Deactivation and Regeneration of Fixed Beds, Electro catalysis and Photocatalysis, Mechanism and Kinetics of Some Typical Heterogeneous Catalytic Reactions, Applications in Fertilizer, Petroleum, Petrochemical Industries and Pollution Control. Modern characterization techniques such XRD, SEM FTIR etc.

Suggested Text Books

1. Preparation of Catalyst VI: Scientific bases for the preparation of Haterogeneous Catalysts by G. Poncelet,J. Martens, B. Delmon, Elseveir
2. Catalyst Preparation: Science and Engineering by John Regalbuto, CRC Press

Course Outcomes

Upon completion of this course, the students will be able to understand the:

1. Application of catalyst in various industries
2. Development of various type of catalyst and catalytic reaction mechanisms.
3. Effects of external heat and mass transfer in heterogeneous catalysis
4. Design of different types of reactors for catalytic reactions
5. Understand the various characterization techniques.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	1	2	2						3	2	
CO2	3	3	3	3	2	2	1						3	2	
CO3	3	2	3	2	1	2	1						3	2	
CO4	3	3	3	2	1	2	1						3	2	
CO5	3	3	3	2	3	3	1						3	2	

28/5/22

B.Tech. VIII Semester

CH408TPC16 **Process Equipment Design- III** **[L:3, T:1, P:0]**

Objectives

Chemical Engineers should have knowledge about Design of mass transfer Equipments such as absorption, Distillation Columns, dryer etc. This will also be useful for using Design software which is widely used in chemical industries.

Contents

Mass Transfer Equipment design of: Absorption tower, Distillation tower, Tunnel and rotary dryers.

Suggested Text Books

1. Hand Book of Chemical Engineering J. H. Perry
2. Coulson & Richardson Vol.- VI
3. Mass Transfer by R. E. Treybal
4. ISI Codes

Candidates have to bring their own copies of ISI Code book and they will be not be supplied by the university or the examination centres.

Course Outcomes

Upon completion of this course, the students will be able to:

1. Design mass transfer equipment's for chemical process.
2. Analyze working of various mass transfer equipments.
3. Prepare drawing for chemical process equipment's.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3				1	1			1	3		
CO2	1	3	1	3		1			2		1	1	3		3
CO3	1	1	1	2		1			2		1		1		

28/12/22

B.Tech. VIII Semester

CH408TPE61 **Environmental Engineering** [L:3, T:0, P:0]

Objectives

To understand the significant issues of environmental pollution and their control principals.

Contents

Unit I: Environmental Pollution and Its Effect: Environment and its components, Sources and type of pollutants, General effects on man, animal, vegetation and property.

Unit II: Air Pollution: Air quality criteria and standards, Ambient air sampling and analysis, Stack emission standards, Stack sampling and analysis, Meteorology and dispersion of air pollutants, Atmospheric lapse rate and stability, Plume behavior, Control of gaseous and particulate pollutants from mobile and stationery sources, air pollution acts.

Unit III: Water Pollution: Water quality criteria and effluent discharge standards, Domestic and industrial sources of waste water, Waste water sampling and analysis methods as per BIS specifications, Physico-chemical and biological methods of waste water treatment, Recovery of material from process effluents, water pollution acts.

Unit IV: **Pollution Due to Hazardous Industrial Waste**: Nature of hazardous waste materials from various chemical and allied Industries, Methods of disposal, destruction and reuse, nuclear wastes and their management. Solid waste from commercial, domestic and industrial sectors-composition and characterization, recycle, resource recovery and disposal.

Unit V: **Environmental Pollution Management**: Case studies of air and water pollution control in chemical industries.

Suggested Text Books:

1. Environmental Pollution Control Engineering by C. S. Rao, New Age International Ltd.
2. Environmental Engineering by N. N. Basak, Tata McGraw-Hill Pub. Co. Ltd.
3. Essentials of Environmental Studies by K. Joseph and R. Nagendran, Pearson Education (Singapore) Pvt. Ltd.

Course Outcome:

The students will be able

1. To explain environmental pollution and its effect.
2. To develop the understanding of air pollution and to describe methods of controlling of air pollution.
3. To analyze water quality, evaluate water pollution, and describe the control methods.
4. To analyze the characteristics of hazardous industrial waste and understand its handling and management.
5. To understand the application part through case studies.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1										3		
CO2	3	2	1	2		2							3		
CO3	3	2	1	2		2							3		
CO4	3	2	1	2		2							3		
CO5	3	2	2	1		2							3		

CH408TPE62

B.Tech. VIII Semester
Optimization Techniques

[L:3, T:0, P:0]

Course Objectives

(1) Understanding the concept of optimization methods
(2) Formulate the optimization problem with and without constraint
(3) Introduction to software tools of optimization
(4) Identify and apply the optimization techniques to optimize the process.

Contents

Unit-I: Introduction: Introduction to systems analysis and modelling with reference to chemical engineering problems, Process optimization, 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: 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-III: Multi-Variable Optimization: Multivariable optimization methods without constraints, such as steepest descent, Newton's method and unidirectional search method. Solving two-variable optimization problems using above methods.

Unit-IV: Linear Programming: Modelling, graphical method, single phase simplex method, two phase simplex method, duality.

Unit-V: Special Optimization Techniques: Introduction to dynamic programming as applied to discrete multistage problems like cascade of CSTR, Train of heat exchanger etc. Non-Traditional Optimization Techniques: Genetic Algorithm, Simulated Annealing
Soft tools MS Excel Solver and MATLAB applied to optimization.

Course Outcomes: Upon Completion of the course the students will be able to

(1) Formulate the optimization problems.
(2) Solve single and multivariable optimization problem
(3) Use different optimization techniques for problem solving.
(4) Use non-traditional optimization Techniques for problem solving
(5) Solve optimization problem using software tools

Suggested Text Books:

1. Edgar, T. F., Himmelblau, D. M. and Lasdon, L.S. Optimization of Chemical Processes, McGraw-Hill (2001).
2. S. S. Rao, Engineering Optimization Theory & Practice, Foruth Edition, John Wiley & Sons Inc (2009).
3. Prem Kumar Gupta and D.S.Hira, Problems in Operations Research (Principles and Solutions), S.Chand and company Ltd. New Delhi, India

Reference Books:

1. Kalyanmoy Deb "Optimization for Engineering Design", Prentice Hall, India,2005.
2. Ravindran. A., and Ragsdell, K.M., Reklaitis, G.V., "Engineering Optimization-Methods and Applications", 2nd Edition, Wiley, New York, 2006
3. Babu, B.V., Process Plant Simulation, Oxford University Press (2004).

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	2	1	1	1	1	2	--	2	1	2
CO2	3	3	2	2	-	2	1	1	1	1	2	--	2	1	2
CO3	3	3	2	2	-	2	1	1	1	1	2	--	2	1	2
CO4	3	3	2	2	-	2	1	1	1	1	2	--	2	1	2
CO5	3	3	2	2	-	2	1	1	1	1	2	--	2	1	2

B.Tech. VIII Semester

CH408TPE63 **Petrochemical Technology** **[L:3, T:0, P:0]**

Objectives

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.

Suggested Text Books

1. Modern Petroleum Technology by G.D. Hobson and W Pow.
2. A Textbook on Petrochemical Technology by Bhaskara Rao.

Course Outcomes

Upon completion of this course, the students will be able to:

1. select the appropriate characterization parameters;
2. specify the properties of petroleum products;
3. attain knowledge of various separation & conversion processes involved in petroleum refining;
4. attain knowledge of manufacturing of various petrochemical products.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	1	3						3		3
CO2	3	1	2	3	3	1							3		3
CO3	3	3	3	3	3	3							3		3
CO4	3	1	1	2	3	3							3		3

Open Elective (Offered for other departments)

B.Tech. VIII Semester

CH207TOE02 **Waste to Energy** [L:3, T:0, P:0]

Contents

Unit I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit II: Biomass Pyrolysis: Pyrolysis – Types, slow, fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

- Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course outcomes:

At the end of the course, students will be able to

1. Classify the waste for fuel and identify the devices for conversion of waste to energy.
2. Implement the Biomass Pyrolysis
3. Evaluate the methods of Biomass Gasification and implement their applications.
4. To design, construct and operation the Biomass Combustion devices.
5. Classify biomass, apply the bio energy systems design and construction.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	0	-	1	1	-	-	-	-	-	1	-	-
CO2	3	2	2	1	-	1	1	-	-	-	-	-	3	-	-
CO3	3	2	2	1	-	1	1	-	-	-	-	-	3	-	-
CO4	3	2	2	1	-	1	1	-		-	-	-	3	-	-

Open Elective (Offered for other departments)

B.Tech. VIII Semester

CH208TOE03 **Project Engineering Economics & Management** [L:3, T:0, P:0]

Objectives

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

Contents

Unit I: Nature and Importance of Project and Project Engineering: 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 and Financial Analysis: 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, Interest and Taxes.

Unit III: Project Financing and Value Engineering: 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, Value Engineering – Function, Aims and Procedure.

Unit IV: Capital Expenditure, Profitability & Alternative Investments: Importance and Kinds of Capital Expenditure Decision, Capital Budgeting Process, Criteria of Capital Budgeting, Depreciation and its Calculation Methods, Methods of calculating profitability, Alternative investments, Break Even Analysis.

Unit V: Network Techniques For Project Management: Introduction, Development of Project Network, Network Scheduling, Critical Path Method, Program Evaluation & Review Technique, Planning and Scheduling of Activity Networks, Time Analysis, Gantt Chart.

Suggested Text Books

1. Plant Design & Economics for chemical Engineers by M.S. Peters & K. D. Timmerhaus.
2. Projects: Planning, Analysis, Selection, Financing, Implementation and Review by Prasanna Chandra.
3. Project Engineering of Process Plants by H. F. Rase
4. Pilot Plants and Models and Scale up Methods in Chemical Engineering by R. E. Johnston.

Course Outcomes

Upon completion of this course, the students will be able to: (a) select a site for the project from given alternatives, (b) calculate working capital requirement for a given project, (c) calculate cost of equipment used in a plant total project cost, (d) calculate cash flow from a given project, (e) understand the break-even analysis; (f) calculate depreciation; (g) list out various milestones related to project concept to commissioning.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1	1	1	1						2		2	1	
CO2	2	1	1	1	1						2		2	1	
CO3	2	1	1	1	1						2		2	1	
CO4	2	1	1	1	1						2		2	1	