ANNEXURE –I

Syllabus of III and IV Semester Courses for Four-Year Multidisciplinary Undergraduate B.Tech. Degree Programme in Chemical Engineering

(In view of NEP-2020)

For students admitted in academic session 2025-26 and onwards



03/09/2026

SHRI JAWAHARLAL DARDA EDUCATION SOCIETY'S
JAWAHARLAL DARDA
INSTITUTE OF ENGINEERING AND TECHNOLOGY, YAVATMAL
AN AUTONOMOUS INSTITUTE
Affiliated to Sant Gadge Baba Amravati University, Approved by AICTE, New Delhi and DTE Maharashtra
93VP+PWF: P6, MIDC Area, Lohara, Yavatmal - 445 001, Maharashtra (www.jdiet.ac.in)

1. Vision

To become an epicentre of cultivating creative minds in Chemical Engineering education and research for sustainable development of the region and mankind.

2. Mission

1. To develop technically proficient chemical engineers by providing quality resources, updated teaching learning processes and research acumen.
2. To train technocrats to handle industrial, environmental and societal problems through eco-friendly solutions.
3. To groom technocrats with strong basics to cater the needs of industries and research areas of the nation.
4. To make graduates capable to serve the society better with innovative and economical techniques.

3. Programme Education Objectives

PEO1 - Graduates will be able to fulfil the technical manpower requirements of the chemical engineering sector locally and globally.

PEO2 - Graduates will be able to apply mathematical, scientific and technical concepts to solve problems in chemical engineering and allied sectors.

PEO3 - Graduates will be able to adopt a multidisciplinary and research-based approach to develop cutting-edge chemical technologies and products to meet changing needs.

PEO4 - Graduates will be able to pursue lifelong learning in the domains of chemical, environmental, energy, economics and management.

PEO5 - Graduates will be able to work effectively in teams and demonstrate communication skills, leadership, entrepreneurship, moral ethics and social values through participation in co-curricular activities.

4. SDG of United Nation

1. **No Poverty:** End poverty in all its forms everywhere.
2. **Zero Hunger:** End hunger, achieve food security, improve nutrition, and promote sustainable agriculture.
3. **Good Health and Well-being:** Ensure healthy lives and promote well-being for all at all ages.
4. **Quality Education:** Ensure inclusive and equitable quality education and promote lifelong learning opportunities.
5. **Gender Equality:** Achieve gender equality and empower all women and girls.
6. **Clean Water and Sanitation:** Ensure availability and sustainable management of water and sanitation for all.

7. **Affordable and Clean Energy:** Ensure access to affordable, reliable, sustainable, and modern energy.
8. **Decent Work and Economic Growth:** Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work.
9. **Industry, Innovation, and Infrastructure:** Build resilient infrastructure, promote sustainable industrialization, and foster innovation.
10. **Reduced Inequalities:** Reduce inequality within and among countries.
11. **Sustainable Cities and Communities:** Make cities and human settlements inclusive, safe, resilient, and sustainable.
12. **Responsible Consumption and Production:** Ensure sustainable consumption and production patterns.
13. **Climate Action:** Take urgent action to combat climate change and its impacts.
14. **Life Below Water:** Conserve and sustainably use oceans, seas, and marine resources.
15. **Life on Land:** Protect, restore, and promote sustainable use of terrestrial ecosystems, forests, and biodiversity.
16. **Peace, Justice, and Strong Institutions:** Promote peaceful and inclusive societies, provide access to justice, and build effective, accountable institutions.
17. **Partnerships for the Goals:** Strengthen the means of implementation and revitalize the global partnership for sustainable development.

5. WK: Washington Accord Knowledge Profile-Attributes for engineering program

WK1:A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

6. Programme Outcomes (NBA, Jan 2025)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and

leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

7. Programme Specific Indicators

Oil & Gas Industry

1. Apply material and energy balances for process design.
2. Select appropriate unit operations and equipment for process requirements.
3. Ensure process safety and chemical handling practices.
4. Optimize chemical processes for efficiency and cost-effectiveness.
5. Simulate chemical processes using software tools.
6. Implement safety protocols for handling hydrocarbons and toxic materials.
7. Develop processes minimizing environmental emissions.
8. Identify properties of materials used in equipment design with respect to IS Codes.
9. Selection of material of construction (MOC), equipment sizing.
10. Estimate cost of project, budgeting and Billing process.
11. Examine quality of work to ensure processes meet required specification, standards and regulations.
12. Interpret contracts, terms, project specifications and legal requirements in projects.
13. Apply principles of chemical engineering (thermodynamics, fluid mechanics, reaction engineering, geology).
14. Identify, formulate, and analyze complex problems with consideration for safety and sustainability.
15. Design and develop processes considering health, safety, environment, and cost.
16. Conduct experimental investigations using modern laboratory and analytical techniques.
17. Use modern engineering tools and software (Matlab, Aspen HYSYS, PetroSim, OLGA, CFD, GIS tools) for design and optimization.
18. Evaluate environmental and societal impacts applying sustainability strategies of wastewater treatment and carbon capture.
19. Follow professional ethics, industry standards, and legal industrial frameworks.
20. Work effectively in multidisciplinary teams for project execution.
21. Communicate technical reports effectively with regulators, industry professionals, and society.
22. Apply project management principles for it's development and execution.
23. Practice lifelong learning by upgrading skills in multi-disciplinary fields.
24. Exhibit leadership, time management, decision-making, and problem-solving abilities.

25. Demonstrate adaptability and resilience to work in challenging environments.
26. Exhibit cultural sensitivity and inclusiveness while working in multinational teams.
27. Design competency in Plant Layout and Piping Design with efficient operation, maintenance, and safety.

Pharmaceutical Industry

28. Apply catalytic process design in petrochemical industries.
29. Prepare PIDs, Flowsheets related to process
30. Develop structural plans/drawings and safety documents.
31. Identify process failures or production, analysing causes and suggest improvements to prevent future occurrence.
32. Perform material testing including corrosive, pressure for design and analysis as per IS and boiler Codes.
33. Proficiency in Transport Phenomena, momentum, heat, and mass transfer for the design and optimization of equipment.
34. Apply Chemical Reaction Engineering knowledge to ensure optimal yield and selectivity.
35. Apply principles of Thermodynamics to analyze energy transformations and evaluate the feasibility and efficiency of chemical processes.
36. Apply advanced knowledge for the development of processes and products.
37. Evaluate waste minimization, circular economy practices in industry.
38. Food and Beverage Industry
39. Apply chemical engineering, microbiology, and food science principles in food preservation, processing, and beverage manufacturing.
40. Analyze food composition, nutritional content, and process impacts to ensure product quality, safety, and compliance with global food standards.
41. Design and optimize unit operations in food industries with focus on hygiene, safety, and efficiency.
42. Conduct investigations on shelf life, food spoilage, contamination control, and sensory evaluation using and statistical analysis.
43. Evaluate sustainable food processing methods such as green packaging, waste-to-energy conversion, by-product utilization, and energy-efficient technologies.
44. Apply ethical practices and follow food safety standards in food processing and beverage manufacturing.

Environmental and Water Treatment Industry

45. Apply principles of chemical & biochemical engineering in design and operation of wastewater treatment, desalination, and effluent treatment plants.
46. Apply pollution control technologies and sustainable practices.
47. Apply skills in Separation Processes, purifying products and recycling unreacted materials.
48. Analyze industrial wastewater discharge, heavy metal contamination, air pollution, and solid waste management.

49. Evaluate sustainable strategies such as zero-liquid discharge & resource recovery.

Renewable Energy and Fuels

50. Apply principles of chemical engineering engineering in the production of biofuels, hydrogen, syngas, and synthetic fuels.
51. Analyze renewable energy conversion processes for techno-economic feasibility.
52. Design and optimize renewable energy systems.
53. Conduct investigations on fuel properties, combustion behavior, emission analysis, and lifecycle assessment of renewable fuels.
54. Evaluate carbon capture, carbon trading, and circular economy strategies for integrating renewables with conventional energy systems.

Materials Polymer Industry

55. Apply principles of polymer chemistry, material science, and rheology for development and processing of plastics, elastomers, fibers, composites, and advanced materials.
56. Analyze structure–property relationships of materials.
57. Design and optimize polymer processing operations.

Basic Science

58. Apply mathematical techniques such as algebra, trigonometry, calculus, differential equations, linear algebra, probability and statistics to solve problems.
59. Apply physical principles such as motion, forces, energy and materials to solve problems.
60. Apply knowledge of chemical properties and reactions for construction material and environment (Corrosion, polymer, electrochemistry etc.)

Engineering Science Courses

61. Demonstrate proficiency in basic workshop operations (fitting, carpentry, welding, sheet metal, plumbing and machining etc.)
62. Apply the principles of engineering mechanics to analyse and solve problems involving forces, moment, equilibrium, friction, centred and MOI etc.
63. Apply the principles electrical engineering to analyse and maintain electrical systems, circuits, machines and power systems.
64. Demonstrate ability to interpreted and create drawings using geometric constructions, orthographic projections, isometric projections and CAD tools.
65. Demonstrate ability to apply fundamental principals of algorithms, programming, data structures and computing system to solve conceptual problems.

Generic Competencies (Chemical Engineering)

A. Problem-Solving Skills

66. Analytical Thinking: Ability to analyze complex problems, break them down into smaller components, and find effective solutions.
67. Critical Thinking: Ability to evaluate multiple solutions to a problem and choose the best course of action based on available data, safety, and cost-efficiency.

B. Communication Skills

68. Oral Communication: Ability to communicate complex technical information clearly to a variety of audiences, including clients, stakeholders, contractors, and team members.
69. Written Communication: Proficiency in drafting reports, proposals, technical specifications, and documentation that are clear, concise, and accurate.
70. Interpersonal Communication: Ability to collaborate effectively with multidisciplinary teams, clients, and project stakeholders.

C. Project Management

71. Time Management: Efficiently managing time and prioritizing tasks to meet deadlines in a dynamic project environment.
72. Resource Management: Ability to plan, allocate, and manage resources such as labour, materials, and equipment to ensure project efficiency.
73. Budgeting and Cost Control: Skills in estimating project costs, monitoring budgets, and ensuring projects are completed within financial constraints.
74. Risk Management: Ability to identify, assess, and mitigate risks during the planning and execution of engineering projects.

D. Teamwork and Leadership

75. Team Collaboration: Working effectively as part of a team, contributing to the success of the project through collaboration, open communication, and respect for others' expertise.
76. Leadership Skills: Leading and motivating a team of engineers, contractors, and other stakeholders to meet project goals and deadlines.
77. Conflict Resolution: Ability to resolve conflicts between team members, clients, or contractors, ensuring that project objectives are still achieved.

E. Attention to Detail

78. Accuracy: Ensuring all engineering calculations, designs, and project plans are accurate and align with building codes, regulations, and standards.
79. Quality Assurance: Ensuring that the materials and processes used in construction adhere to high standards of quality and safety.

F. Ethical and Professional Integrity

80. Ethical Decision Making: Adhering to a strict code of ethics, ensuring public safety, environmental protection, and transparency in all dealings.
81. Accountability: Taking responsibility for the success or failure of a project, being proactive in addressing issues, and delivering results.

G. Adaptability and Flexibility

82. Openness to Change: Being able to adapt to new technologies, tools, and methods, as well as evolving project requirements or environmental conditions.
83. Learning and Development: Actively seeking opportunities for professional growth, staying current with industry trends, and acquiring new skills to remain competitive.

H. Technical Competency

84. Understanding of Engineering Principles: A strong foundation in the core principles of chemical engineering, including structural, geotechnical, environmental, transportation, and water resources engineering.
85. Technology Proficiency: Proficiency in using engineering software, such as AutoCAD, Chemical 3D, and BIM tools, to design, model, and manage projects.
86. Data Analysis: Ability to analyze large amounts of technical data and make informed decisions based on this information.

I. Creativity and Innovation

87. Creative Problem Solving: Thinking outside the box and coming up with novel solutions to engineering challenges.
88. Innovative Design: Contributing new ideas for designs and processes that can improve efficiency, reduce costs, or make better use of resources.

J. Cultural and Environmental Awareness

89. Sustainability Awareness: Knowledge of sustainable construction methods, green building practices, and the importance of reducing the environmental impact of engineering projects.
90. Cultural Sensitivity: Understanding and respecting cultural differences when working in diverse teams or international projects.
91. Environmental Impact Understanding: Considering the environmental consequences of engineering decisions and striving to minimize negative impacts through design and construction methods.

K. Decision-Making Skills

92. Data-Driven Decisions: Using available data, facts, and technical analysis to make informed decisions about the design, execution, and management of projects.
93. Prioritizing Decisions: Knowing which decisions need immediate attention and which can be deferred, especially in a high-pressure environment.

L. Regulatory and Legal Knowledge

94. Familiarity with Building Codes and Standards: Understanding and ensuring compliance with local, national, and international building codes, safety regulations, and legal standards.
95. Health and Safety: Knowledge of safety regulations and best practices for ensuring the health and safety of workers, the public, and the environment throughout the project lifecycle.

M. Client-Focused Mindset

96. Client Management: Building and maintaining strong relationships with clients, understanding their needs, and ensuring their expectations are met throughout the project.
97. Customer Service Orientation: Ensuring that client concerns are addressed promptly, and working toward providing value-added solutions that meet their goals.

8. Scheme of Chemical Engineering Department

Jawaharlal Darda Institute of Engineering & Technology, Yavatmal (Autonomous Institute)

Curriculum Structure (Scheme) for Four Year Multidisciplinary B. Tech in Chemical Engineering Degree Programme

Semester - I (First Year) [Group - A/B]

Sr. No.	Course Name	Course Category	Course Code	Course Plan per Week (Hrs.)					Credits	Theory Evaluation		Theory (Total)		Practical/Term Work Evaluation		Practical/Term Work Evaluation (Total)		Total Max Marks	Theory Exam Time (Hrs.)
										SEE	CIA			EE	PA				
				L	T	P	SL	Total		Max Marks	Max Marks	Max Marks	Min Marks	Max Marks	Max Marks	Max Marks	Min Marks		
1	Mathematics - I	BSC	1SH101BS1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
2	Applied Physics	BSC	1SH102BS1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
3	Programming for Problem Solving	ESC	1CS103ES1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
4	Engineering Mechanics	ESC	1CE104ES1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
5	Applied Physics Lab	BSC	1SH105BS1	0	0	2	0	2	1					25	25	50	25	50	
6	Programming for Problem Solving Lab	ESC	1CS106ES1	0	0	2	0	2	1					25	25	50	25	50	
7	Engineering Mechanics Lab	ESC	1CE107ES1	0	0	2	0	2	1					25	25	50	25	50	
8	Workshop	ESC	1ME108ES1	0	0	2	0	2	1					25	25	50	25	50	
9	Chemical Engineering Processes	VSC	1CH109VS1	1	0	2	1	4	2						50	50	25	50	
10	Communication Skills	AEC	1SH110AE1	1	0	2	1	4	2					25	25	50	25	50	
11	Sports & Yoga	CC	1SH111CC1	0	0	4	0	4	2						50	50	25	50	
Total				**14**	**0**	**16**	**14**	**44**	**22**			**400**				**350**		**750**	

Notional Learning Hours: [Workload (teaching/guidance/practicum) 30x15 = 450 Hrs] + [Learner-engaged time 14x15 = 210 Hrs]

Jawaharlal Darda Institute of Engineering & Technology, Yavatmal (Autonomous Institute)
Curriculum Structure (Scheme) for Four Year Multidisciplinary B. Tech in Chemical Engineering Degree Programme

Semester - II (First Year) [Group - A/B]

Sr. No.	Course Name	Course Category	Course Code	Course Plan per Week (Hrs.)					Credits	Theory Evaluation		Theory (Total)		Practical/Term Work Evaluation		Practical/Term Work Evaluation (Total)		Total Max Marks	Theory Exam Time (Hrs.)
										SEE	CIA			EE	PA				
				L	T	P	SL	Total		Max Marks	Max Marks	Max Marks	Min Marks	Max Marks	Max Marks	Max Marks	Min Marks		
1	Mathematics - II	BSC	2SH112BS1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
2	Applied Chemistry	BSC	2SH113BS1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
3	Basic Electrical Engineering	ESC	2EE114ES1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
4	Engineering Graphics	ESC	2ME115ES1	2	0	0	2	4	2	60	40	100	40					100	4 Hrs.
5	Elements of Chemical Engineering	PCC	2CH116PC1	1	0	2	1	4	2						50	50	25	50	
6	Traditional Indian Chemical Engineering Practices	IKS	2CH117IK1	1	0	2	1	4	2						50	50	25	50	
7	Applied Chemistry - Lab	BSC	2SH118BS1	0	0	2	0	2	1					25	25	50	25	50	
8	Basic Electrical Engineering - Lab	ESC	2EE119ES1	0	0	2	0	2	1					25	25	50	25	50	
9	Engineering Graphics/CAD Lab	ESC	2ME120ES1	0	0	2	0	2	1					25	25	50	25	50	
10	Universal Human Values	SEC	2SH121VS1	1	0	2	1	4	2						50	50	25	50	
11	Digital Wellness	CC	2SH122CC1	1	0	2	1	4	2						50	50	25	50	
Total				**15**	**0**	**14**	**15**	**44**	**22**			**400**				**350**		**750**	

Notional Learning Hours: [Workload (teaching/guidance/practicum) 29x15 = 435 Hrs] + [Learner-engaged time 15x15 = 225 Hrs]

Exit Option (Level 4.5) for Undergraduate Certificate in Odd Semester of next Academic Year as approved by BOS																			
12	Material and Energy Balances	EC	3CH123EC1	2	0	4	2	8	4	30	20	50	20	25	25	50	25	100	2 Hrs.
13	Numerical Methods in Chemical Engineering	EC	3CH124EC1	2	0	4	2	8	4	30	20	50	20	25	25	50	25	100	2 Hrs.
OR																			
14	Internship / Apprenticeship in Industry	EI	3CH125EI1	0	0	16	0	288	8					100	100	200	100	200	
OR																			
15	Two MOOC/NPTEL Courses	EC	3CH126OC_	8	0	0	8	16	8										

Jawaharlal Darda Institute of Engineering & Technology, Yavatmal (Autonomous Institute)

Curriculum Structure (Scheme) for Four Year Multidisciplinary B. Tech in Chemical Engineering Degree Programme

Semester - III (Second Year)

Sr. No.	Course Name	Course Category	Course Code	Course Plan per Week (Hrs.)					Credits	Theory Evaluation		Theory (Total)		Practical/Term Work Evaluation		Practical/Term Work Evaluation (Total)		Total Max Marks	Theory Exam Time (Hrs.)
										SEE	CIA			EE	PA				
				L	T	P	SL	Total		Max Marks	Max Marks	Max Marks	Min Marks	Max Marks	Max Marks	Max Marks	Min Marks		
1	Chemical Engineering Thermodynamics	PCC	3CH201PC1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
2	Chemical Engineering Analysis	PCC	3CH202PC1	2	0	0	2	4	2	60	40	100	40					100	3 Hrs.
3	Process Instrumentation	PCC	3CH203PC1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
4	Multidisciplinary Minor - I	MDM	3__204MD_	2	0	0	2	4	2	30	20	50	20					50	2 Hrs.
5	Open Elective - I	OE	3__205OE_	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
6	Chemical Engineering Thermodynamics Lab.	PCC	3CH206PC1	0	0	2	0	2	1					25	25	50	25	50	
7	Chemical Engineering Analysis Lab.	PCC	3CH207PC1	0	0	2	0	2	1					25	25	50	25	50	
8	Process Instrumentation Lab.	PCC	3CH208PC1	0	0	2	0	2	1					25	25	50	25	50	
9	Engineering Economics	EEM	3CH209EM1	2	0	0	2	4	2						50	50	25	50	
10	Constitutional Values and Fundamental Duties	VEC	3SH210VE1	2	0	0	2	4	2						50	50	25	50	
11	Field Project	FP	3CH400FP1	0	0	4	0	4	2					25	25	50	25	50	
12	Disaster Management and Preparedness	NC	3AL001NC1	2	0	0	0	2	-						50	50	25	50	
Total				**19**	**0**	**10**	**17**	**46**	**22**			**450**				**300**		**750**	

Notional Learning Hours : [Workload (teaching/guidance/practicum) 29x15 = 435 Hrs] + [Learner-engaged time 17x15 = 255 Hrs]

Optional Course for Double Minor / Honours Degree																			
13	Double Minor / Honours Course - I	DH	3__211DH_	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.

Jawaharlal Darda Institute of Engineering & Technology, Yavatmal (Autonomous Institute)
Curriculum Structure (Scheme) for Four Year Multidisciplinary B. Tech in Chemical Engineering Degree Programme
Semester - IV (Second Year)

Sr. No.	Course Name	Course Category	Course Code	Course Plan per Week (Hrs.)					Credits	Theory Evaluation		Theory (Total)		Practical/Term Work Evaluation		Practical/Term Work Evaluation (Total)		Total Max Marks	Theory Exam Time (Hrs.)
										SEE	CIA			EE	PA				
				L	T	P	SL	Total		Max Marks	Max Marks	Max Marks	Min Marks	Max Marks	Max Marks	Max Marks	Min Marks		
1	Fluid Flow Operation[1]	PCC	4CH212PC1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
2	Chemical Engineering Mechanical Operations	PCC	4CH213PC1	2	0	0	2	4	2	60	40	100	40					100	3 Hrs.
3	Process Calculation	PCC	4CH214PC1	2	0	0	2	4	2	60	40	100	40					100	3 Hrs.
4	Multidisciplinary Minor - II	MDM	4__215MD_	2	0	0	2	4	2	30	20	50	20					50	2 Hrs.
5	Open Elective - II	OE	4__216OE_	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
6	Fluid Flow Operation Lab	PCC	4CH217PC1	0	0	2	0	2	1					25	25	50	25	50	
7	Chemical Engineering Mechanical Operations Lab	PCC	4CH218PC1	0	0	2	0	2	1					25	25	50	25	50	
8	Computer Application in Chemical Engineering	VSC	4CH219VS1	0	0	4	0	4	2						50	50	25	50	
9	Technical Writing	AEC	4SH220AE1	1	0	2	1	4	2						50	50	25	50	
10	Fundamentals of Book Keeping and Accounting	EEM	4SH221EM1	1	0	2	1	4	2						50	50	25	50	
11	Environmental Science	VEC	4CE222VE1	2	0	0	2	4	2	30	20	50	20					50	2 Hrs.
Total				**16**	**0**	**12**	**16**	**44**	**22**			**500**				**250**		**750**	
Optional Course for Double Minor / Honours Degree																			
12	Double Minor / Honours Course - II	DH	4__223DH_	4	0	0	4	8	4	60	40	100	40					100	3 Hrs.
Exit Option (Level 5) for Undergraduate Diploma in Odd Semester of next Academic Year as approved by BOS																			
13	Fluidization Engineering	EC	5CH224EC1	2	0	4	2	8	4	30	20	50	20	25	25	50	25	100	2 Hrs.
14	Chemical Process Utilities	EC	5CH225EC1	2	0	4	2	8	4	30	20	50	20	25	25	50	25	100	2 Hrs.
OR																			
15	Internship / Apprenticeship in Industry	EI	5CH226EI1	0	0	16	0	288	8					100	100	200	100	200	
OR																			
16	Two MOOC/NPTEL Courses	EC	5CH227OC_	8	0	0	8	16	8										

Notional Learning Hours: [Workload (teaching/guidance/practicum) 28x15 = 420 Hrs] + [Learner-engaged time 16x15 = 240 Hrs]

[1] Course sequence amended considering order of learning as on 02/09/2026

Jawaharlal Darda Institute of Engineering & Technology, Yavatmal (Autonomous Institute)

Curriculum Structure (Scheme) for Four Year Multidisciplinary B. Tech in Chemical Engineering Degree Programme

Semester - V (Third Year)

Sr. No.	Course Name	Course Category	Course Code	Course Plan per Week (Hrs.)					Credits	Theory Evaluation		Theory (Total)		Practical/Term Work Evaluation		Practical/Term Work Evaluation (Total)		Total Max Marks	Theory Exam Time (Hrs.)
										SEE	CIA			EE	PA				
				L	T	P	SL	Total		Max Marks	Max Marks	Max Marks	Min Marks	Max Marks	Max Marks	Max Marks	Min Marks		
1	Heat Transfer Operation	PCC	5CH228PC1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
2	Chemical Reaction Engineering-I	PCC	5CH229PC1	3	1	0	4	8	4	60	40	100	40					100	3 Hrs.
3	Industrial Waste Treatment	PCC	5CH230PC1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
4	Programme Elective Course - I	PEC	5CH231PE_	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
5	Multidisciplinary Minor - III	MDM	5__232MD_	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
6	Open Elective - III	OE	5__233OE_	2	0	0	2	4	2	30	20	50	20					50	2 Hrs.
7	Heat Transfer Operation Lab.	PCC	5CH234PC1	0	0	2	0	2	1					25	25	50	25	50	
8	Industrial Waste Treatment Lab.	PCC	5CH235PC1	0	0	2	0	2	1					25	25	50	25	50	
9	Programme Elective Course - I - Lab	PEC	5CH236PE_	0	0	2	0	2	1					25	25	50	25	50	
10	Multidisciplinary Minor - III - Lab	MDM	5__237MD_	0	0	2	0	2	1					25	25	50	25	50	
Total				**17**	**1**	**8**	**18**	**44**	**22**			**550**				**200**		**750**	
Optional Course for Double Minor / Honours Degree																			
11	Double Minor / Honours Course - III	DH	5__238DH_	4	0	0	4	8	4	60	40	100	40					100	3 Hrs.

Notional Learning Hours: [Workload (teaching/guidance/practicum) 26x15 = 390 Hrs] + [Learner-engaged time 18x15 = 270 Hrs]

Jawaharlal Darda Institute of Engineering & Technology, Yavatmal (Autonomous Institute)
Curriculum Structure (Scheme) for Four Year Multidisciplinary B. Tech in Chemical Engineering Degree Programme
Semester - VI (Third Year)

Sr. No.	Course Name	Course Category	Course Code	Course Plan per Week (Hrs.)					Credits	Theory Evaluation		Theory (Total)		Practical/Term Work Evaluation		Practical/Term Work Evaluation (Total)		Total Max Marks	Theory Exam Time (Hrs.)
										SEE	CIA			EE	PA				
				L	T	P	SL	Total		Max Marks	Max Marks	Max Marks	Min Marks	Max Marks	Max Marks	Max Marks	Min Marks		
1	Chemical Reaction Engineering-II	PCC	6CH239PC1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
2	Process Dynamics & Control	PCC	6CH240PC1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
3	Mass Transfer -I	PCC	6CH241PC1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
4	Programme Elective Course - II	PEC	6CH242PE_	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
5	Programme Elective Course - III	PEC	6CH243PE_	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
6	Multidisciplinary Minor - IV	MDM	6__244MD_	2	0	0	2	4	2	30	20	50	20					50	2 Hrs.
7	Chemical Reaction Engineering-II Lab.	PCC	6CH245PC1	0	0	2	0	2	1					25	25	50	25	50	
8	Process Dynamics & Control Lab.	PCC	6CH246PC1	0	0	2	0	2	1					25	25	50	25	50	
9	Programme Elective Course - II - Lab	PEC	6CH247PE_	0	0	2	0	2	1					25	25	50	25	50	
10	Personal Skills (GD& PI)	SEC	6CH248VS1	1	0	2	1	4	2						50	50	25	50	
Total				**18**	**0**	**8**	**18**	**44**	**22**			**550**				**200**		**750**	
Notional Learning Hours: [Workload (teaching/guidance/practicum) 26x15 = 390 Hrs] + [Learner-engaged time 18x15 = 270 Hrs]																			
Optional Course for Double Minor / Honours Degree																			
11	Double Minor / Honours Course - IV	DH	6__249DH_	4	0	0	4	8	4	60	40	100	40					100	3 Hrs.
Exit Option (Level 5.5) for B. Voc in Odd Semester of next Academic Year as approved by BOS																			
12	Optimization of Chemical Processes	EC	7CH250EC1	2	0	4	2	8	4	30	20	50	20	25	25	50	25	100	2 Hrs.
13	Computer Aided Process Synthesis	EC	7CH251EC1	2	0	4	2	8	4	30	20	50	20	25	25	50	25	100	2 Hrs.
OR																			
14	Internship / Apprenticeship in Industry	EI	7CH252EI1	0	0	16	0	288	8					100	100	200	100	200	
OR																			
15	Two MOOC/NPTEL Courses	EC	7CH253OC_	8	0	0	8	16	8										

Jawaharlal Darda Institute of Engineering & Technology, Yavatmal (Autonomous Institute)
Curriculum Structure (Scheme) for Four Year Multidisciplinary B. Tech in Chemical Engineering Degree Programme
Semester - VII (Final Year)

Sr. No.	Course Name	Course Category	Course Code	Course Plan per Week (Hrs.)					Credits	Theory Evaluation		Theory (Total)		Practical/Term Work Evaluation		Practical/Term Work Evaluation (Total)		Total Max Marks	Theory Exam Time (Hrs.)
										SEE	CIA			EE	PA				
				L	T	P	SL	Total		Max Marks	Max Marks	Max Marks	Min Marks	Max Marks	Max Marks	Max Marks	Min Marks		
1	Transport Phenomena[2]	PCC	7CH301PC1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
2	Mass Transfer -II	PCC	7CH302PC1	2	0	0	2	4	2	60	40	100	40					100	3 Hrs.
3	Programme Elective Course - IV	PEC	7CH304PE_	2	0	0	2	4	2	60	40	100	40					100	3 Hrs.
4	Programme Elective Course - V	PEC	7CH304PE_	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
5	Multidisciplinary Minor - V	MDM	7__305MD_	2	0	0	2	4	2	30	20	50	20					50	2 Hrs.
6	Mass Transfer -II Lab.	PCC	7CH306PC1	0	0	2	0	2	1					25	25	50	25	50	
7	Programme Elective Course - IV Lab	PEC	7CH307PE1	0	0	2	0	2	1					25	25	50	25	50	
8	Research Methodology	RM	7CH401RM1	2	0	4	2	8	4	30	20	50	20		50	50	25	100	2 Hrs.
9	Project	PR	7CH402PR1	0	0	8	0	8	4					50	100	150	75	150	
Total				**14**	**0**	**16**	**14**	**44**	**22**			**500**				**300**		**800**	
Notional Learning Hours: [Workload (teaching/guidance/practicum) 30x15 = 450 Hrs] + [Learner-engaged time 14x15 = 210 Hrs]																			
Optional Course for Double Minor / Honours Degree																			
10	Double Minor / Honours Course - V	DH	7__308DH_	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
Optional Course for Honours with Research Degree																			
11	Research Project	RP	7CH403RP1	0	0	18	0	18	9	0	0	0	0	100	100	200	100	200	

[2] Amended to align with emerging engineering domains as on 02/09/2026

Jawaharlal Darda Institute of Engineering & Technology, Yavatmal (Autonomous Institute)
Curriculum Structure (Scheme) for Four Year Multidisciplinary B. Tech in Chemical Engineering Degree Programme
Semester - VIII (Final Year)

Sr. No.	Course Name	Course Category	Course Code	Course Plan per Week (Hrs.)					Credits	Theory Evaluation		Theory (Total)		Practical/Term Work Evaluation		Practical/Term Work Evaluation (Total)		Total Max Marks	Theory Exam Time (Hrs.)
										SEE	CIA			EE	PA				
				L	T	P	SL	Total		Max Marks	Max Marks	Max Marks	Min Marks	Max Marks	Max Marks	Max Marks	Min Marks		
1	Novel Separation Processes (Online)	PCC	8CH309PC1	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
2	Programme Elective Course - V (Online)*	PEC	8CH310PE_	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.
3	Multidisciplinary Minor - VI (Online)	MDM	8__311MD_	2	0	0	2	4	2	30	20	50	20					50	2 Hrs.
4	On Job Training (Internship/Apprenticeship)	OJT	8CH404IN1	0	0	24	0	24	12					100	100	200	100	200	
Total				**8**	**0**	**24**	**8**	**40**	**20**			**250**				**200**		**450**	

Notional Learning Hours: [Workload (teaching/guidance/practicum) 32x15 = 480 Hrs] + [Learner-engaged time 8x15 = 120 Hrs]

Optional Course for Honours with Research Degree																			
5	Research Project	RP	8C405RP1	0	0	18	0	18	9	0	0	0	0	100	100	200	100	200	

9. List of Programme Elective Courses

Students will have an option to choose the PEC offered by their respective Major Discipline offered during semester V to VIII

Programme Elective Courses offered by Chemical Engineering

b	Semester	Programme Elective Course/Subjects Name	Course Code
1	V	Computational Techniques in Chemical Engineering (PEC-I)	5CH231PE1
2		Computational Techniques in Chemical Engineering-Lab (PEC-I Lab)	5CH236PE1
		OR	
3		Fluid Particle Mechanics (PEC-I)	5CH231PE2
4		Fluid Particle Mechanics -Lab (PEC-I Lab)	5CH236PE2
5	VI	Chemical Process Technology (PEC-II)	6CH242PE1
6		Chemical Process Technology -Lab (PEC-II Lab)	6CH247PE1
		OR	
7		Biochemical Engineering (PEC-II)	6CH242PE2
8		Biochemical Engineering-Lab (PEC-II Lab)	6CH247PE2
9		Process Equipment Design & Drawing (PEC-III)	6CH243PE1
		OR	
10		System Modelling (PEC-III)	6CH243PE2
11	VII	Petrochemical Technology (PEC-IV)	7CH303PE1
12		Petrochemical Technology-Lab (PEC-IV Lab)	7CH307PE1
		OR	
13		Industrial Pollution Abatement (PEC-IV)	7CH303PE2
14		Industrial Pollution Abatement Lab (PEC-IV Lab)	7CH307PE2
15		AI & ML in Chemical Engineering (PEC-V)	7CH304PE1
		OR	
16		Introduction to Molecular Simulation[6] (PEC-V)	7CH304PE2
17	VIII	Carbon Capture, Utilization and Storage (PEC-VI)	8CH310PE1
		OR	
18		Nanotechnology for Chemical Engineering[16] (PEC-VI)	8CH310PE2

10. Syllabus for Semester III & IV

Level: **5**	Course Code: **3CH201PC1**		Course Category: **PCC**		
Course Name	**Chemical Engineering Thermodynamics**				
Credits	**03**	Total L:T:P Hours	3:0:0 **45 Hrs**	Total SL Hours	**45 Hrs**
Total Credit Hours	**90 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:
Subject Code 3CH201PC1 Chemical Engineering Thermodynamics is a compulsory Program Core Course for Second Year B.Tech. Chemical Engineering.

Course Objectives:
The objective of this course is to understand and apply thermodynamic principles to analyze system behaviour, energy transformations, phase and mixture properties, flow processes, and chemical equilibrium in chemical engineering systems.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH201PC1.1	Apply fundamental thermodynamic principles including system classification, process variables, equilibrium criteria, and the First Law with Cp–Cv relations to analyze and quantify energy interactions in chemical engineering systems**.**	C-3
3CH201PC1.2	Evaluate thermodynamic systems using entropy concepts**,** Second-Law statements, Carnot efficiency limits, and Third-Law implications to assess the feasibility and performance of engineering processes**.**	C-5
3CH201PC1.3	Analyze the behavior of pure substances using P–V–T relations, real-gas equations of state, compressibility factors, and phase-rule applications to predict phase behavior in single- and multi-component systems**.**	C-4
3CH201PC1.4	Evaluate colligative property variations and steady-flow energy interactions in throttling devices, compressors, nozzles, and diffusers to perform energy balance calculations for practical engineering equipment**.**	C-5
3CH201PC1.5	Interpret thermodynamic behavior of mixtures through partial molar properties, pressure–temperature effects, and vapor–liquid equilibrium models to design and analyze separation and mixing processes**.**	C-2

3CH201PC1.6	Use thermodynamic equilibrium relations and Gibbs free-energy criteria to determine equilibrium constants, predict reaction direction, and evaluate reaction extent in chemical processes**.**	C-3

Course Contents:

Unit 1	**Introduction to Thermodynamics and First Law of Thermodynamics:** Categorization of systems, Thermodynamics variables and processes, point and path Function, State of equilibrium and its types, First law of thermodynamics, Relation between C_p and C_v, Application of first law to different processes and systems, limitations of the first law, Numerical.	7 Hrs
Unit 2	**Second Law of Thermodynamics:** Statement of Second Law, equivalence between Kelvin-Plank and Clausius Statement, Concept of entropy, Entropy and Irreversibility, Heat Engines heat pumps, and refrigerators, Carnot Cycle, Limitations of Second law of thermodynamics, Numerical. Third law of thermodynamics.	8 Hrs
Unit 3	**Thermodynamics of Pure Substances:** Introduction of pure substance, P-V-T Behaviour of Pure substances, Equation of state, Ideal Gas and Real gas EOS: Vander Waals, Redlich-Kwong, Peng- Robinson, Beattie-Bridgeman and virial equation of state, Compressibility factor, Law of Corresponding State, Numerical. Phase Rule: Derivation, Use, One- Component System, Two Component system, partially miscible system (LCST and UCST), Three Component system	08 Hrs
Unit 4	**Colligative Property and thermodynamics to flow processes:** Elevation in boiling point, depression in freezing point, Lowering of Vapour Pressure, Osmotic Pressure, Numerical. Steady-flow processes and devices, Throttling Device, Compressor, Nozzles and Diffusers, Numerical.	07 Hrs
Unit 5	**Solution Thermodynamics and Properties:** Partial Molar Properties, Effect of pressure and temperature, Chemical Potential, fugacity, fugacity coefficient, Chemical Potential in Ideal Gas Mixture, Thermodynamic functions of mixing, Activity and Activity Co-efficient, Gibbs Duhem equation, Vapour pressure, Raoult's Law and Henry's Law, Numerical.	08 Hrs
Unit 6	**Chemical Equilibria:** Concept of equilibrium, formulation of Equilibrium law, Equilibrium law for Ideal Gases and other form of equilibrium constant, Relation between K_p, K_c and K_x, Free energy change in chemical reaction, Chemical Affinity, Calculation of Equilibrium constant, LeChatlier's Principle, Numerical.	07 Hrs

Text Books:

1. J.M. Smith and H.C. Van Ness, Introduction to Chemical Engineering Thermodynamics, McGraw Hill, 1998
2. Denbigh,K.,`The Principles of Chemical Equilibria with Applications in Chemistry and Chemical Engineering, Cambridge University Press (1968)
3. K.V.Narayanan, A textbook of Chemical Engineering Thermodynamics, Prentice Hall of India Ltd., 2001
4. R.P.Rastogi and R.R. Mishra, An Introduction of Chemical Thermodynamics
5. Houghen and Watson, Chemical Engineering Process
6. Stanley Sandler, Chemical, Biochemical, and Engineering Thermodynamics

Reference Books:

1. Sadler S. I., J, Chemical and Engineering Thermodynamics, John Wiley and Sons, Inc. New York, 3rd Ed.,1999.
2. Elliot J. R. and Lira C.T., Introductory Chemical Engineering Thermodynamics, Prentice Hall, 1999.
3. Eastop T. D. and McConkey A., Applied Thermodynamics for Engineering Technologists, Addison Wesley Longman Ltd., England, 5th Ed., 1999
4. J. M. Smith and H. C. Vauhess, Introduction to Chemical Engineering Thermodynamics
5. H. C. Weber and J. P. Meissner, Thermodynamics for Chemical Engineering

E- Resources:

1. https://nptel.ac.in/courses/103101004
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCHA1202.pdf
3. https://studylib.net/doc/27115283/a-textbook-ofchemical-engineering-thermodynamics-kv-narayan
4. https://thermodynamicsbook.com/thermodynamics-free-textbook.pdf
5. https://cdn.bookey.app/files/pdf/book/en/thermodynamics-by-enrico-fermi.pdf

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CH201PC1.1	3	2	-	-	2	-	-	-	-	-	2	3	2	-
3CH201PC1.2	3	3	-	2	2	2	-	-	-	-	3	3	3	-
3CH201PC1.3	3	2	-	2	2	-	-	-	-	-	2	3	3	-
3CH201PC1.4	3	2	2	2	3	2	-	-	-	-	2	3	3	2
3CH201PC1.5	3	3	-	2	3	2	-	-	-	-	3	3	3	2
3CH201PC1.6	3	3	-	2	2	2	-	-	-	-	3	3	3	2
3CH201PC1CO	3	3	2	2	2	2	-	-	-	-	3	3	3	2

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **3CH202PC1**		Course Category: **PCC**		
Course Name	**Chemical Engineering Analysis**				
Credits	**02**	Total L:T:P Hours	2:0:0 **30 Hrs**	Total SL Hours	**30 Hrs**
Total Credit Hours	**60 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:

Subject Code 3CH202PC1 Chemical Engineering Analysis is a compulsory Program Core Course for Second Year B.Tech. Chemical Engineering.

Course Objectives:

The objective of this course develops a comprehensive understanding of reaction kinetics, surface phenomena, catalysis, and modern analytical techniques. It enables students to apply advanced chromatographic, spectroscopic, photochemical, and electro analytical methods.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH202PC1.1	Analyze reaction rates, molecularity, order and integrated rate laws for determining kinetic parameters and predicting chemical reaction behavior.	C-4
3CH202PC1.2	Illustrate adsorption types, isotherms and catalytic characteristics to interpret surface phenomena and optimize heterogeneous and enzymatic catalytic processes.	C-3
3CH202PC1.3	Apply chromatographic principles, classifications and GC-HPLC instrumentation for selecting effective separation techniques in chemical engineering applications.	C-3
3CH202PC1.4	Apply photochemical laws, Lambert-Beer principles and quantum yield concepts to analyze photochemical reactions and evaluate light-induced processes.	C-3
3CH202PC1.5	Analyze UV-Vis, IR and NMR spectroscopic principles, instrumentation and applications to characterize molecular structure and determine chemical properties.	C-4
3CH202PC1.6	Examine electrochemical concepts, cell types and pH metric methods for obtaining analytical measurements and interpreting chemical system behavior.	C-3

Course Contents:

Unit 1	**Fundamentals of Chemical Reaction Kinetics:** Introduction, Rate of reaction, Concept of Molecularity and Order of reaction, Integrated rate expressions for zero, first and second order reaction, Half life period of reaction, Energy of activation and its determination, Numerical	5 Hrs
Unit 2	**Surface Phenomena and Catalysis:** Adsorption, Types of adsorptions, Factors affecting Adsorption, Adsorption isotherms, Langmuir theory of adsorption, BET adsorption isotherm, Criteria-characteristics of catalyst, homogeneous and heterogeneous catalysis, Theory of heterogeneous catalysis, Auto and Enzyme catalysis	5 Hrs
Unit 3	**Advanced Chromatographic Techniques:** Introduction, Classification of chromatographic techniques, Industrial and Chemical Engineering Applications, Principles, Instrumentation and application of Gas Chromatography (GC), High performance liquid chromatography (HPLC)	5 Hrs
Unit 4	**Fundamentals of Photochemistry:** Introduction, Photochemical Reaction, Applications, Lambert and Beer' Law, Photochemical Laws, quantum efficiency and its determination, low & high quantum yield reaction,	5 Hrs
Unit 5	**Advanced Instrumental Spectroscopy:** Introduction to Advanced Spectroscopy, Classification of Spectroscopy, Principle, Instrumentation of and applications of UV-VI Spectroscopy, Infrared (IR) Spectroscopy, Nuclear Magnetic Resonance (NMR) Spectroscopy, Expression for moment of Inertia of rigid rotator of diatomic molecule	5 Hrs
Unit 6	**Electro analytical Techniques:** Introduction, Basic concepts in electrochemistry, Types of electrochemical Cells, Applications, Types of electro analytical methods- Conductometry, pH metry	5 Hrs

Text Books

1. Douglas A, Donald M, James F, Stanley R, Cengage, Fundamentals of Analytical Chemistry, Cengage, 10th Ed.
2. Skoog Douglas A, F James Holler, Stanley R, Principles of Instrumental Analysis, , Cengage 7th Ed
3. Banwell, Fundamentals of spectroscopy , , Tata McGraw-Hill, 4th Ed

Reference Books

1. P.W. Atkins and J.D. Paula, Physical Chemistry, , Oxford University Press.
2. K.J. Laidler and J.M. Meiser, Physical Chemistry, CBS Publisher
3. R. J. Masel, Chemical kinetics and catalysis, John Wiley publications
4. Arthur W. Adamsons, Alice P. Gast, Physical chemistry of surfaces, John Wiley publications

E- Resources

6. http://www.rnlkwc.ac.in/pdf/studymaterial/chemistry/Spectroscopy.pdf
7. https://web.iitd.ac.in/~sdeep/Spectroscopy_lecture_1_2.pdf
8. https://www.bcebhagalpur.ac.in/wpcontent/uploads/2020/03/Spectroscopic-Techniques-and-Applications.pdf
9. http://digimat.in/nptel/courses/video/104106122/L54.html

Mapping of COs with POs and PSO's

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CH202PC1.1	3	3	-	2	2	-	-	-	-	-	-	3	2	-
3CH202PC1.2	3	2	2	2	2	2	-	-	-	-	-	3	3	-
3CH202PC1.3	3	2	2	2	3	-	-	-	-	-	-	3	2	-
3CH202PC1.4	3	2	-	2	2	-	-	-	-	-	-	2	2	-
3CH202PC1.5	3	2	-	2	3	-	-	-	-	-	-	3	2	-
3CH202PC1.6	3	3	-	2	3	-	-	-	-	-	-	3	2	-
3CH202PC1CO	3	2	2	2	3	2	-	-	-	-	-	3	2	-

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **3CH203PC**		Course Category: **PCC**		
Course Name	**Process Instrumentation**				
Credits	**03**	Total L:T:P etc. Hours	3:0:0 **45 Hrs**	Total SL Hours	**45 Hrs**
Total Credit Hours	**90 Hrs**				
SEE Marks	**60**	SEE Time	**03 Hr**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description: Subject Code3CH201PCProcess Instrumentation is a Programme Core Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:
The objective of this course is to acquaint students with basic Operating principles of Instruments in chemical engineering, and develop practical understanding of process variable measurements in chemical industry.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH201PC1.1	Understand basic measurement methods, types of errors, transducers, and instrument characteristics to ensure accurate and reliable industrial measurements.	C-2
3CH201PC1.2	Apply temperature measurement techniques using RTDs, thermistors, thermocouples, and infrared sensors to monitor and control thermal processes.	C-3
3CH201PC1.3	Analyze pressure sensing methods and low-pressure measurement instruments to measure and regulate process pressure effectively.	C-4
3CH201PC1.4	Evaluate fluid-flow measurement systems such as differential pressure and positive displacement methods to determine flow rates in process industries.	C-5
3CH201PC1.5	Select and compare appropriate level measurement techniques for different liquids and applications to achieve safe and efficient level control.	C-5
3CH201PC1.6	Measure and interpret pH, humidity, and concentration using electrochemical and physical sensing methods to assess process quality and environmental conditions.	C-2

Course Contents:

Unit 1	**Basic method of measurements:** Direct and indirect measurements with examples. Errors in measurements: Types of Errors: Human error, instrument error. Elements of Instruments: Primary and secondary. Transducers: definition, classification primary and secondary. Static characteristics of instruments and Dynamic characteristic. Transmitter: definition different types.	8Hrs
Unit 2	**Temperature measurements**: Introduction to different temperature scale. Resistance Thermometer Detector (RTD): Unbalanced Wheatstone Bridge Direct conversion. Thermistors: Temperature sensing using thermistor. Thermocouple: Basics of thermocouple, Thermocouple types. Solid expansion thermometer: Bimetallic thermometer. Liquid filled thermometer: Hg filled thermometer. High temperature measurement: Pyrometer (Radiation based temperature measurement).	7 Hrs
Unit 3	**Pressure measurements**: Introduction: Units of pressure Types of pressure measurement: Elastic deformation type: Bourdon tube and bellows., Low pressure measurement: McLeod gauge, pirani gauge. Thermocouple gauge: Ionization gauge. Heads measurement: Manometer, its type. Dead weight pressure measurement as a pressure gauge tester.	8 Hrs
Unit 4	**Basics of fluid flow**: Derivation of basic fluid flow equation, Flow meter, flow measurements, Differential pressure measurement Principle of the differential pressure flow meter, Orifice Venturi meter. Positive displacement Flow meters, Different type of ultrasonic Flowmeter. , Pitot tube. Variable area flow meter: Magnetic Flow meter, Head flow meters: Hg manometer and its type	8 Hr
Unit 5	**Level Measurements Introduction**: Industrial application of Level measurement. Direct level measurement: Sight glass method, Hook auge method, Differential pressure method: Air purge method, Displacement type level sensor: Ultrasonic type level sensor, Gamma ray level sensor. Electric method: capacitance type	7 Hrs

Unit 6	**pH measurements**: Basic ideas of pH value, Measurement of electrode potentials: Glass electrode, Reference electrode, Calomel electrode, Humidity Sensing: Basic ideas of humidity sensing, Humidity measurement by dew point sensing, Humidity measurement using Lithium Chloride. Measurement for Concentration: Obtaining concentration of solution by conductivity and conductivity titration, determination of concentration by density meter, hydrometer, refract meter, measurement of concentration of ion and colored solution. (7Hrs)	7 Hrs

Text Books:

1. Padmanaban, R., Instrumentation: Principles and Design, Springer, Tattamangalam, 2000.
2. Eckman, Donald P., Industrial Instrumentation, CBS Publishers, New Delhi, 2002.

Reference Books:

1. Jain, R. K., Mechanical and Industrial Measurements, Khanna Publishers, 1999.
2. Patranabis, D., Principles of Industrial Instrumentation, Tata McGraw-Hill Publishing Ltd., 1999.
3. Johnson, C. D., Process Control Instrumentation Technology, Prentice Hall Inc., Year not specified.
4. Sawhney, A. K., A Course in Electrical and Electronics Measurement and Instrumentation, Dhanpat Rai and Sons, 1999.

E-Resources:

1. https://nptel.ac.in/courses/103105130

Mapping of COs with Pos and PSO's:

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CH201PC1.1	3	2	1	2	-	-	-	-	-	2	1	3	2	1
3CH201PC1.2	3	2	2	2	2	-	-	-	-	2	1	3	2	1
3CH201PC1.3	3	3	2	2	2	-	-	-	-	2	2	3	2	2
3CH201PC1.4	2	3	3	2	2	-	-	-	1	2	2	2	3	2
3CH201PC1.5	2	2	2	2	2	-	-	-	1	2	2	2	3	1
3CH201PC1.6	3	2	2	2	2	-	-	-	-	2	2	3	2	1

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **3CH204MD1**		Course Category: **MDM**		
Course Name	**Environmental Pollution: Policies and Regulations**				
Credits	**02**	Total L:T:P Hours	2:0:0 **30 Hrs**	Total SL Hours	**30 Hrs**
Total Credit Hours	**60 Hrs**				
SEE Marks	**30**	SEE Time	**2 Hrs**	CIA Marks	**20**
EE Marks	**--**	PA Marks	**--**	Total Marks	**50**

Course Description:

Subject Code 3CH204MD1 Environmental Pollution: Policies and Regulations is a compulsory Multidisciplinary Minor course offered by the department of Chemical Engineering for other Second Year B.Tech. major disciplines.

Course Objectives:

The course provides a comprehensive understanding of major environmental pollutants, their impacts, and key control measures. It also equips students with knowledge of national environmental policies, regulatory frameworks, and governance essential for sustainable development.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH204MD1.1	Apply pollution control strategies and waste management techniques to propose feasible solutions for common environmental problems.	C-3
3CH204MD1.2	Interpret the principles of sustainable development, SDGs, and the precautionary principle for the context of environmental management.	C-2
3CH204MD1.3	Interpret the updated waste management rules and evaluate their contribution to improved compliance and sustainability.	C-2, C-5

Course Contents:

Unit 1	**Environmental Pollution:** Introduction, Categorisation of pollutants and pollution, Definition, Causes, Effects and Control Measures of: a) Air Pollution b) Water Pollution c) Soil Pollution d) Noise Pollution e) Thermal Pollution Solid Waste Management: Principles, methods and significance.	10 Hrs

Unit 2	**Introduction to Environmental Policy & Governance:** Introduction to Environmental Policy, Need and importance of environmental policy, Evolution of environmental regulations, Sustainable development, SDGs & precautionary principle, Preventive Environmental Policy (PEP), Environmental Impact Assessment (EIA)	10 Hrs
Unit 3	**Pollution Control Laws and Regulations in India:** Major Environmental Acts: Environment (Protection) Act, 1986, Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981, Forest Conservation Act, 1980, Wildlife Protection Act, 1972 Pollution-specific Rules (Latest Amendments Included) Solid Waste Management Rules, 2016, Plastic Waste Management Rules, 2016, E-Waste Management Rules, 2022	10 Hrs

Text Books

4. Dr. Anand S. Bal, An introduction to Environmental Management
5. Pandey G.N. and Camey G.C.; Environmental Engineering, Tata McGraw Hill Book Co., New Delhi (1989).
6. Mahajan S.P. Pollution Control in Process Industries, Tata McGraw Hill Book Co.
7. Dr. Azad Kumar Dr. Vartika Singh Dr. Nirupama Singh Dr. Jitendra Singh Tomar, Environmental pollution and their impact on climate change: challenges and restoration, Blue Rose Publishers

Reference Books

5. S.C.Bhatia, Environmental Pollution and control in Chemical Process Industries, , Khanna Publishers (1 January 2001)
6. Rao C.S.; Environmental Pollution Control Engineering, New Age International Publishers, 3rd Edition
7. Justice T S Doabia, Environmental & Pollution Laws in India,Lexis Nexis, Ed 4th

E- Resources

10. https://www.bbau.ac.in/dept/UIET/TCE033%20%20epdf.pub_environmental-pollution-and-control.pdf
11. https://cpcb.nic.in/7thEditionPollutionControlLawSeries2021.pdf
12. https://vardhaman.org/wp-content/uploads/2021/03/ENVIRONMENTAL-SCIENCE-1.pdf

Mapping of COs with POs and PSO's

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CH204MD1.1	2	3	3	2	2	3	2	-	-	2	-	2	3	-
3CH204MD1.2	2	2	2	-	-	3	2	-	-	-	-	2	3	-
3CH204MD1.3	2	3	2	-	-	3	3	-	-	-	-	2	3	-
3CH204MD1CO	2	3	2	2	2	3	2	-	-	2	-	2	3	-

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level:	**5**	Course Code:	**3SH205OE1**	Course Category:	**OE**
Course Name	**Soft Skills & Profile Building**				
Credits	**03**	Total L:T:P Hours	3:0:0 **45 Hrs**	Total SL Hours	**45 Hrs**
Total Credit Hours	**90 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:
Subject Code 3SH205OE1Soft Skills & Profile Buildingis a compulsory Open Elective Course forSecond Year B. Tech All Branch Students.

Course Objectives:
The objective of this course is to focus on developing advanced communication skills, leadership qualities and professional etiquette among engineering graduates. The course emphasizes workplace communication, interview preparedness, personal branding, and employability skills aligned with industry expectations. It integrates emotional intelligence, digital professional identity, and strategic career planning for holistic professional development.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3SH205OE1.1	Apply advanced interpersonal, analytical, and persuasive communication techniques in professional contexts for effective professional interactions.	C-3
3SH205OE1.2	Demonstrate professional workplace etiquette, business communication, and group discussion skills to enhance employability.	C-3 A-3
3SH205OE1.3	Analyze leadership styles, emotional intelligence, and team dynamics for effective collaboration.	C-4 A-3
3SH205OE1.4	Design a structured and realistic career plan aligned with industry expectations and personal goals for professional growth.	C-6
3SH205OE1.5	Create ATS-friendly résumés, professional portfolios, and digital profiles for personal branding.	C-6 P-4
3SH205OE1.6	Perform effectively in interviews, workplace simulations, and job-search processes with professional confidence for enhanced employability.	C-3 P-3 A-3

Course Contents:

Unit 1	**Advanced Communication Dynamics:** Advanced interpersonal communication strategies; speech articulation; structuring thoughts and fluency techniques; analytical and critical communication; storytelling techniques for impactful presentations; persuasive communication models.	7Hrs
Unit 2	**Global Workplace Etiquettes, Email Writing & GD–PI Perspective:** Professional greetings and workplace conduct; giving and receiving feedback; handling criticism and adaptability issues; professional values such as punctuality and attire; types of handshakes and significance; effective business email writing; types of Group Discussions, purpose of GDs; mock GDs (video-based); interview strategies and techniques.	8Hrs
Unit 3	**Leadership, Team Dynamics & Corporate Skills:** Personality types using 9/9 matrix; leadership styles; emotional intelligence and leadership relationship; conflict resolution and negotiation techniques; team-building skills (Johari Window perspective); cross-cultural communication; creativity and design thinking; structured problem-solving and decision-making**.**	7 Hrs
Unit 4	**Strategizing Career Planning:** SMART goal setting; mapping skills to career paths; understanding industry expectations; emerging futuristic soft and hard skills (domain-wise); personalized career roadmap; certification planning (technical and non-technical); networking skills and participation in professional communities	7 Hrs
Unit 5	**Profile Building, Portfolio & Personal Branding:** ATS-friendly résumé preparation and common mistakes; video résumé creation and self-marketing pitch; LinkedIn profile optimization and networking strategies; developing online portfolios using platforms such as GitHub, Behance, Google Sites, and Toastmasters	8 Hrs
Unit 6	**Employment Readiness & Industry Integration:** Workplace simulation activities (mock emails, meetings, discussions); mock personal interviews; understanding sector-specific industry dynamics; unconventional career opportunities after engineering; job-hunting strategies and popular job platforms	8 Hrs

Text Books:

1. Alex K., Soft Skills, S. Chand Publishing
2. Meenakshi Raman & Prakash Singh, Business Communication, Oxford University Press

Reference Books:

1. Stephen R. Covey,The 7 Habits of Highly Effective People,Free Press Publication
2. Daniel Goleman, Emotional Intelligence,published by Bantam Books.
3. Shiv Khera, You Can Win,published by Bloomsbury Publishing
4. Richard N. Bolles, What Color Is Your Parachute? Published by Ten Speed Press, Crown Publishing Group

E Resources:

1. NPTEL: Soft Skills and Personality Development
2. LinkedIn Learning – Communication & Career Development Courses
3. Harvard Business Review – Communication & Leadership Articles
4. Coursera /edX – Career Development & Employability Skills Modules

Mapping of COs with POs & PSO

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3SH205OE1.1	2	3	2	–	–	–	–	2	3	–	–			
3SH205OE1.2	–	2	–	–	–	2	3	3	3	–	–			
3SH205OE1.3	–	3	2	–	–	2	2	3	–	–	–			
3SH205OE1.4	–	3	3	–	–	2	–	–	–	2	3			
3SH205OE1.5	–	2	3	–	3	–	–	–	2	–	2			
3SH205OE1.6	–	2	2	–	2	2	–	2	3	–	2			
3SH205OE1CO	1	3	2	-	1	2	1	2	2	1	1			

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level:	**5**	Course Code:	**3SH205OE2**	Course Category:	**OE**
Course Name	**Team Building & Management**				
Credits	**03**	Total L:T:P Hours	3:0:0 **45 Hrs**	Total SL Hours	**45 Hrs**
Total Credit Hours	**90 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:
Subject Code 3SH205OE2Team Building & Management is a compulsory Open Elective Course for Second Year B. Tech All Branch Students.

Course Objectives:
The Objective of the course is to develop teamwork capabilities, leadership and managerial skills, collaborative problem-solving abilities, conflict management techniques, and effective decision-making skills required in professional and organizational settings.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3SH205OE2.1	Explain the principles and importance of effective team building in organizations to foster collaborative work culture.	C-2
3SH205OE2.2	Apply team dynamics and collaboration strategies to achieve common goals.	C-3 A-3
3SH205OE2.3	Analyze leadership styles and managerial roles for effective team performance.	C-4
3SH205OE2.4	Demonstrate conflict resolution, negotiation, and interpersonal management skills for effective team performance.	C-3 A-3
3SH205OE2.5	Apply motivation and performance management techniques in team-based environments for achieving organizational goals.	C-3
3SH205OE2.6	Perform effectively as a team member or leader in simulated managerial scenarios to develop leadership competencies	C-3 P-3 A-3

Course Contents:

Unit 1	**Fundamentals of Team Building:** Concept of teams; types of teams; stages of team development; characteristics of effective teams; roles and responsibilities of team members; barriers to effective teamwork; team norms and values.	7 Hrs
Unit 2	**Team Dynamics & Interpersonal Relationships:** Group behavior and dynamics; interpersonal communication in teams; trust and collaboration; listening as a team skill; diversity and inclusion in teams; cross-cultural team management	8 Hrs

Unit 3	**Leadership in Teams:** Leadership concepts; leadership styles; emotional intelligence and leadership; situational leadership; influence and power in teams; leadership ethics and responsibilities.	7 Hrs
Unit 4	**Conflict Management & Negotiation:** Sources and types of conflict; conflict resolution techniques; negotiation strategies; managing difficult team members; stress management; maintaining team harmony	7 Hrs
Unit 5	**Motivation, Performance & Team Effectiveness:** Motivation theories; team motivation techniques; goal setting and performance measurement; feedback and appraisal systems; decision-making in teams; problem-solving techniques.	8 Hrs
Unit 6	**Managerial Skills & Team-Based Applications:** Managerial roles and functions; planning, organizing, and controlling teams; delegation and coordination; workplace simulations (team meetings, role plays); case studies on team management; team performance evaluation.	8 Hrs

Text Books:

1.Stephen P. Robbins, Organizational Behavior, Pearson Education

2. L.M. Prasad, Management Principles and Practices, published by Sultan Chand & Sons

Reference Books:

1. Patrick Lencioni, The Five Dysfunctions of a Team, published by Jossey-Bass
2. Peter G. Northouse, Leadership, published by SAGE Publications
3. Daniel Goleman, Emotional Intelligence,published by Bantam Books

E Resources:

1. NPTEL – Organizational Behavior& Management Courses
2. LinkedIn Learning – Team Leadership & Management Modules
3. Harvard Business Review – Teamwork & Leadership Articles
4. Coursera / edX – Team Management and Leadership Courses

Mapping of COs with POs & PSO

CO	**PO**											**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
3SH205OE2.1	2	–	–	–	–	–	–	–	–	–	–			
3SH205OE2.2	–	2	2	–	–	–	–	3	2	–	–			
3SH205OE2.3	–	3	3	–	–	–	–	2	–	–	–			
3SH205OE2.4	–	2	2	–	–	2	3	3	–	–	–			
3SH205OE2.5	–	2	2	–	–	–	–	2	–	2	–			
3SH205OE2.6	–	2	2	–	–	2	–	3	2	–	2			
3SH205OE2 CO	1	2	2	-	-	1	1	2	1	1	1			

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **4.5**	Course Code: **3CH206PC1**		Course Category: **PCC**		
Course Name	**Chemical Engineering Thermodynamics Lab**				
Credits	**01**	Total L:T:P etc. Hours	0:0:2 **30 Hrs**	Total SL Hours	**--**
Total Credit Hours	**30 Hrs**				
SEE Marks	**--**	SEE Time	**--**	CIA Marks	**--**
EE Marks	**25**	PA Marks	**25**	Total Marks	**50**

Course Description:
Subject Code 3CH206PC1Chemical Engineering Thermodynamics Lab is a compulsory Program Core Course for Second Year B. Tech Chemical Engineering Program.

Course Objectives:
The objective of this course is to experimentally evaluate thermodynamic properties, phase behaviour, flow processes, and equilibrium parameters to reinforce core principles of Chemical Engineering Thermodynamics.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH206PC1.1	Perform experiments accurately to determine colligative properties and appreciate the effect of impurities on phase behaviour.	C-4, P-4, A-3
3CH206PC1.2	Operate laboratory systems safely to verify thermodynamic laws in closed and open systems using energy balance equations.	C-3, P-4, A-2
3CH206PC1.3	Conduct heat-of-solution experiments to analyze thermo chemical properties while valuing precise measurement and data recording.	C-4, P-4, A-3

List of Practicals:

Minimum eight practicals from the list mentioned below.

1. Determination of boiling point elevation in presence of impurity.
2. Determination of freezing point depression in presence of impurity.
3. Critical solution temperature of phenol water system.
4. Critical Solution temperature of phenol water system in presence of impurity like NaCl.
5. Study of Flow Through a Nozzle and Verification of Steady Flow Energy Equation
6. Determination of Equilibrium Constant of Esterification Reaction
7. Determination of Heat of Solution of a Salt (Enthalpy of Solution)
8. Verification of First Law of Thermodynamics Using a Closed System
9. Study of Liquid–Liquid Equilibrium (LLE) for Partially Miscible Systems (UCST or LCST)
10. Study of Effect of Temperature on Chemical Equilibrium (Le Charlier's Principle Demonstration)

List of Virtual Labs:

1. https://thermodynamics-iitb.vlabs.ac.in/exp/boiling-points-ebulliometer/procedure
2. https://thermodynamics-iitb.vlabs.ac.in/exp/solubility-solid-solvent

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CH206PC1.1	3	2	-	3	2	-	-	-	-	-	2	2	3	-
3CH206PC1.2	3	3	-	3	3	-	-	-	-	-	2	2	3	-
3CH206PC1.3	3	3	-	3	2	-	-	-	-	-	2	2	2	-
3CH206PC1CO	3	3	-	3	2	-	-	-	-	-	2	2	3	-

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **3CH207PC1**		Course Category: **PCC**		
Course Name	**Chemical Engineering Analysis Lab**				
Credits	**01**	Total L:T:P etc. Hours	0:0:2 **30 Hrs**	Total SL Hours	**--**
Total Credit Hours	**30 Hrs**				
SEE Marks	**--**	SEE Time	**--**	CIA Marks	**--**
EE Marks	**25**	PA Marks	**25**	Total Marks	**50**

Course Description:
Subject Code 3CH207PC1Chemical Engineering Analysis Lab is a compulsory Program Core Course for Second Year B.Tech. Chemical Engineering.

Course Objectives:
The objective of this course is to perform practicals based on physicochemical analysis, titrimetric and instrumental methods, and to study reaction kinetics in chemical engineering systems.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH207PC1.1	Demonstrate physicochemical and titrimetric techniques to determine acid strength and critical solution temperatures for analytical evaluation.	C-3, P-5
3CH207PC1.2	Perform conductometric, potentiometric and pH-metric techniques to analyze unknown solutions for accurate chemical characterization.	C-4,P-5 & A-2
3CH207PC1.3	Apply kinetic study methods to determine rate constants, activation energies and reaction effects for understanding chemical reaction behaviour.	C-3,P-4 & A-1

List of Practicals:
Minimum eight practicals from the list mentioned below.

1. Determination of the Critical Solution Temperature (CST) for phenol water system.
2. Determination of the strength of a strong acid (HCl) by titrating with a strong base (NaOH) Conductometrically.
3. Acid Base titration by using Phenolphthalein indicator.
4. Determination of strength of an unknown HCl solution using a pH-metric titration against a standard NaOH solution.
5. Determination of Specific rate constant of hydrolysis of ethyl acetate.
6. Determination of Energy of Activation.
7. Determination of relative strength of two acids by kinetic study of reaction.

8. Effect of Concentration on the rate of reaction of Sodium Thiosulphate with hydrochloric acid.
9. Effect of Temperature on the rate of reaction of Sodium Thiosulphate with hydrochloric acid.
10. Determination of strength of an unknown HCl solution potentiometrically

List of Virtual Labs:

1. https://ccnsb06-iiith.vlabs.ac.in/exp/infra-red-spectroscopy/procedure.html
2. https://www.labxchange.org/library/items/lb:LabXchange:7bf9423d:lx_simulation:1?t=e0ea2815-0e90-4d7c-bc33-fe616d907c16
3. https://www.labxchange.org/library/items/lb:LabXchange:a1943218:lx_simulation:1?t=e0ea2815-0e90-4d7c-bc33-fe616d907c16
4. https://ccnsb06-iiith.vlabs.ac.in/exp/spectroscopic-techniques/

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CH207PC1.1	3	2	-	3	2	-	-	-	-	-	2	3	2	-
3CH207PC1.2	3	3	-	3	3	-	-	-	-	-	2	3	2	-
3CH207PC1.3	3	3	-	3	2	-	-	-	-	-	2	3	2	-
3CH207PC1CO	3	3	-	3	2	-	-	-	-	-	2	3	2	-

Correlation levels-1: Slight (Low),2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **3CH208PC1**		Course Category:	**PCC**	
Course Name	**Process Instrumentation Lab**				
Credits	**01**	Total L:T:P etc. Hours	0:0:2 **30 Hrs**	Total SL Hours	**--**
Total Credit Hours	**30 Hrs**				
SEE Marks	**--**	SEE Time	**--**	CIA Marks	**--**
EE Marks	**25**	PA Marks	**25**	Total Marks	**50**

Course Description:
Subject Code 3CH208PC1Process Instrumentation Labis a compulsory Programme core Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:
The objective of this course is to perform practical's on the concepts of Process Instrumentation Lab measurement device.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH208PC1.1	Apply principles of industrial instrumentation to evaluate measurement accuracy, instrument response, and process behavior.	C-3 & P-4
3CH208PC1.2	Determine flow coefficients of flow meters and analyze control valve characteristics to assess flow control performance.	C-2 & P-1
3CH208PC1.3	Calibrate pressure, temperature, level, and flow measuring instruments such as thermocouples, level detectors, Venturimeter, and Orifice meter to ensure accurate and reliable measurements.	C-4 & P-7

List of Practical's:
Minimum eight practical's from the list mentioned below.
1. Calibration of pressure gauge using Dead WeightTester.
2. Measurement of level using air purge leveldetector.
3. Calibration of Bimetallicthermometer
4. Calibration of Orifice meter/ Venturimeter / Rota meter
5. Find flow coefficient of Venturi meter /Orifice meter.
6. To Understand control valve flow coefficient.
7. To Understand inherent characteristic control valve.
8. To Understand Installed characteristic control valve.
9. To Understand hysteresis of control valve.
10. To Understand range ability control valve.

List of Virtual Labs: 1. 1.
http://www.digimat.in/nptel/courses/video/103105064/103105064.html

Mapping of COs with POs and PSOs:

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
3CH208PC1.1	3	2	2	3	2	-	-	-	-	2	2	3	2	2
3CH208PC1.2	3	3	3	3	2	-	-	-	-	2	2	3	3	2
3CH208PC1.3	3	3	2	3	2	2	-	-	2	3	2	3	3	3
3CH208PC1CO	3	2	2	3	2	-	-	-	-	2	2	3	2	2

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **3CH209EM1**		Course Category: **EEM**		
Course Name	**Engineering Economics**				
Credits	**02**	Total L:T:P etc. Hours	2:0:0 **30 Hrs**	Total SL Hours	**30 Hrs**
Total Credit Hours	**60 Hrs**				
SEE Marks	--	SEE Time	--	CIA Marks	--
EE Marks	--	PA Marks	**50**	Total Marks	**50**

Course Description:
Subject Code 3CH209EM1 Engineering Economics is a Entrepreneurship Economics Management Education Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:
The objective of this course is to learn the basics of economics like demand and supply, costing factors, market structures. Learning how to use problem-solving methods to make decisions in the face of Privatization and Globalization.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH209EM1.1	Identify economic analysis to evaluate the impact of financial factors on projects.	C-1
3CH209EM1.2	Explain competition in the market and the effects of inflation in the economic structure to understand their impact on economic performance.	C-2
3CH209EM1.3	Predict decisions to evaluate the scope of business in global scenario.	C-3

Course Contents:

Unit 1	**Nature and scope of economics to Engineers :** Nature and scope of economics, Demand and Supply, Demand: concepts, specification, types of demand. Demand Analysis: significance of demand analysis, law of diminishing utility, consumer surplus. Demand Forecasting: concept of forecasting, techniques of demand forecasting.	10 Hrs
Unit 2	**Market and Its Types and Characteristics:** Meaning, types of market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition. Inflation: Causes, measurement, effects, controlling of inflation.	10 Hrs
Unit 3	**Nature and characteristics of Indian economy:** Privatization – meaning, merits and demerits. Globalisation of Indian economy – merits and demerits. Concepts of VAT, WTO. Banking, Foreign exchange.	10 Hrs

Text Books:

1. K.K. Seo , Bernard J. Winger, Managerial Economics, Richard D. Irwin; 5th edition (1 December 1979)
2. J. L. Riggs, Engineering Economics, McGraw Hill Education; 4th edition (6 January 2004)

Reference Books:

1. Adhikary M., Managerial Economics, New Delhi Khosla Publishing House 1994,3rd ed.
2. *Dan Strenhoff and JF Burgess*, "Small Business Management Fundamentals", McGraw. Hill Book Company (1986).

E-Resources:

1. https://nptel.ac.in/courses/112107209
2. https://archive.nptel.ac.in/content/syllabus_pdf/112107209.pdf
3. https://www.eolss.net/sample-chapters/c13/E6-29-30.pdf
4. NPTEL Course, Business Analysis for Engineers by Dr. S. Vaidhyasubramaniam, Department of Management, IIT Madras.

Mapping of COs with Pos:

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CH209EM1.1	2	2	-	-	-	3	-	-	-	3	2	-	1	-
3CH209EM1.2	-	2	-	-	-	3	1	-	2	-	2	1	-	1
3CH209EM1.3	-	2	-	-	-	3	-	-	3	3	-	1	1	2
3CH209EM1 CO	1	2	-	-	-	3	-	-	2	2	2	1	1	1

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code:	**3SH210VE1**	Course Category:	**VEC**
Course Name	**Constitutional Values and Fundamental Duties**			
Credits	**02**	Total L:T:P Hours	2:0:0 **30 Hrs**	Total SL Hours **30 Hrs**
Total Credit Hours	**60 Hrs**			
SEE Marks	--	SEE Time	--	CIA Marks --
EE Marks	**25**	PA Marks	**25**	Total Marks **50**

Course Description:
Subject Code 3SH210VE1 Constitutional Values and Fundamental Duties is a compulsory Valus enhancement Course for Second Year B. Tech.

Course Objectives:
The objective of the course is to introduce the Indian Constitution, its historical background, fundamental values, rights, and duties.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3SH210VE1.1	Explain the historical background, making, and significance of the Indian Constitution to Understand the Constitution, Preamble, and core values.	C2
3SH210VE1.2	Interpret Fundamental Rights and Duties (Articles 12–35, 51A) to evaluate their implications through case studies in professional and civic life.	C3
3SH210VE1.3	Apply constitutional principles to engineering ethics, sustainability concerns (Articles 48A, 51A(g)), and demonstrate social commitment, innovation, and inclusive growth as nation builders.	C3

Course Contents:

Unit 1	**Introduction to the Constitution and Fundamental Values**: Overview of the Indian Constitution – Historical background and making of the Constitution; Meaning of Constitution; Preamble – Meaning and significance. Core Constitutional Values – Justice (Social, Economic, Political); Liberty (thought, expression, belief, faith, worship); Equality (status and opportunity); Fraternity (dignity and unity of the nation). Relevance of constitutional values for professionals and citizens.	10 Hrs
Unit 2	**Fundamental Rights and Duties**: Fundamental Rights (Articles 12–35) – Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right	10 Hrs

	to Constitutional Remedies. Fundamental Duties (Article 51-A) – Importance and implications; Role of youth and professionals in upholding duties. Case studies highlighting real-life significance of rights and duties.	
Unit 3	**Application of Constitutional Values in Engineering and Public Life**: Ethical Responsibilities and Constitutional Alignment – Engineering ethics and public interest; Environment and sustainability as constitutional concern (Articles 48A, 51A(g)); Engineers as nation builders – Social commitment, innovation, and inclusive growth.	10 Hrs

Text Books:

1. Basu D. D., Introduction to the Constitution of India, LexisNexis Publication, New Delhi (Twenty-Third Edition).
2. Jain M. P., Constitution of India, LexisNexis Publication, New Delhi (Eighth Edition).
3. Laxmikanth M., Indian Polity, McGraw Hill Education, New Delhi (Sixth Edition).
4. Austin Granville, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, New Delhi.
5. Shukla V. N., Constitution of India, Eastern Book Company, Lucknow (Twelfth Edition).
6. Government of India, Constitution of India (Bare Act), Government of India Publication, New Delhi.

Reference Books:

1. Subhash Kashyap, Our Constitution, National Book Trust, New Delhi.
2. Durga Das Basu, Shorter Constitution of India, LexisNexis Publication.
3. P. M. Bakshi, The Constitution of India, Universal Law Publishing.
4. J. N. Pandey, Constitutional Law of India, Central Law Agency.
5. Seervai H. M., Constitutional Law of India, N. M. Tripathi Pvt. Ltd. (Vols. I–III).
6. B. Shiva Rao, The Framing of India's Constitution: A Study, Indian Institute of Public Administration.
7. D. C. Wadhwa, Political Science and Constitutional Law, Eastern Book Company.
8. Madhav Khosla, The Indian Constitution: Oxford India Short Introductions, Oxford University Press.

E Resources:

1. NPTEL course on Constitutional Studies, Prof. Sudhir Krishnaswamy, National Law School of India University
2. Constitutional Values and Fundamental Duties (University of Delhi – aligned with NEP 2020, available via NPTEL/DU open learning) https://kmc.du.ac.in/kmcouter/collnews/download/40727448169063791359.pdf/LinkedContents/pdf/All/All

Mapping of COs with POs & PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3SH210VE1.1	3	2	-	1	-	-	-	-	-	-	-	2	2	
3SH210VE1.2	-	3	2	2	-	2	3	3	-	-	-	3	2	-
3SH210VE1.3	-	-	3	3	-	2	3	2	-	2	-	3	3	2
3SH210VE1CO	1	2	2	2	-	2	2	2	-	1	-	3	2	1

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **3CH400FP1**		Course Category: **FP**		
Course Name	**Field Project**				
Credits	**02**	Total L:T:P etc. Hours	0:0:4 **60 Hrs**	Total SL Hours	**--**
Total Credit Hours	**60 Hrs**				
SEE Marks	**--**	SEE Time	**--**	CIA Marks	**--**
EE Marks	**25**	PA Marks	**25**	Total Marks	**50**

Course Description:

Subject Code 3CH400FP1 Community Engagement Project is a Compulsory Experimental Learning Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:

The objective of this course is to identify basic chemical related community issues. Suggest simple, practical solutions based on chemical knowledge. Present finding and recommendations effectively.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH400FP1.1	Analyze field observations, record essential data, and acknowledge community concerns to identify and define real-world chemical engineering problems and local issues.	C-4,P-3& A-1
3CH400FP1.2	Interpret literature sources, prepare data-collection tools, and appreciate community inputs to develop a structured and feasible plan for identified project issues.	C-2, P-2 & A-3
3CH400FP1.3	Apply engineering principles, construct and adjust simple prototypes, and demonstrate responsible practice to propose practical low-cost solutions for community or process-related needs.	C-3, P-4 & A-2

Course Contents:

Module	Description	Hours
Module 1	Orientation & Sensitization	4Hrs
Module 2	Field Visit & Problem Identification	24Hrs
Module 3	Problem–Solution Design & Implementation	20Hrs
Module 4	Documentation, Presentation & Reflection	12Hrs

Note:

1. Students must perform collaboratively within their assigned practical batch groups only.

2. Projects (Must select from the guidelines provided)

1. Field Visit to Swachh Bharat Project Sites and Assessment of Solid Waste Management Practices
2. Soil Health Testing, Drinking Water Quality Analysis and Environmental Sample Assessment
3. Climate Change Awareness, Environmental Pollution and Community Impact Assessment

3. Suggested Chemical Project Themes

1. Water, Wastewater and Environmental Pollution Management
2. Solid Waste Management, Recycling and Waste-to-Resource Technologies
3. Sustainable Rural and Community-Based Process Engineering
4. Water Quality, Sanitation and Public Health Assessment
5. Iindustrial Pollution Prevention and Cleaner Production
6. Energy Conservation and Renewable Energy Applications
7. Climate Change, Carbon Footprint and Sustainable Resource Management
8. Community-Based Waste Valorization and Circular Economy
9. Environmental Monitoring and Basic Chemical Analysis
10. Sustainable Process Design for Rural and Urban Communities
11. Waste Utilization, Resource Recovery & Sanitation
12. Clean Energy, Renewable Fuels & Rural Energy Systems
13. Chemical Safety, Public Awareness & Community Health
14. Water Quality, Treatment & Public Health
15. Food Processing, Preservation & Rural Entrepreneurship
16. Environmental Monitoring & Green Chemistry

4. Documentation /Project Report Format:

The Documentation /Project Report shall contain the following sections:

1. Title Page
2. Certificate & Declaration
3. Abstract
4. Introduction (Community + E&TC relevance)
5. Objectives
6. Literature Survey
7. Methodology (Survey + Technical)
8. Problem Identification
9. Proposed E&TC Solution
10. Implementation / Simulation
11. Results & Analysis
12. Community Feedback & Social Impact
13. Conclusion & Future Scope
14. References
15. Appendices (Photos, questionnaires certification letter issued by the Gram Panchayat office)

Course Plan

Lecture No.	Module Title	Topic	Hours
1	**Module1: Orientation & Sensitization**	Community Engagement & Role of Engineers, Ethics, Social Responsibility & SDGs for Chemical Engineers, Overview of Swachh Bharat Mission, Soil Health, Drinking Water Quality, Climate Change and Environmental Sustainability, Identification of Community Institutions (GP, School, Self Help Group (SHG), Health Centre), Field Safety, Team Formation, Area & Theme Allocation, Orientation and Sensitization	4
2	**Module 2: Field Visits & Problem Identification**	Pre-visit study, permissions and planning for field activities. Site identification and documentation of sanitation, waste and water facilities.	24
3		Field data collection and observation of waste, soil, water and environmental conditions.	
4		Soil and water sample collection, testing and data recording	
5		Analysis of soil and water quality and comparison with standards	
6		Problem identification and preliminary Chemical Engineering solutions.	
7	**Module 3: Engineering Problem–Solution Design & Implementation-**	Analysis of field data and identification of environmental problems.	20
8		Preparation of simple process flow diagrams and improvement plans.	
9		Identification of deficiencies in waste, water, sanitation and	

		pollution control systems.	
10		Development of solutions for waste management, water treatment and pollution control.	
11		Preparation of material requirements and preliminary cost estimates.	
12		Evaluation of technical feasibility, sustainability and community benefits.	
13	**Module 4:** **Documentation, Presentation & Reflection**	Data analysis, graphical representation, results, discussion and conclusion.	12
14		Project report preparation, finalization and presentation.	
15		Evaluation and Viva	

Mapping of COs with Pos & PSOs:

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
3CH400FP1.1	2	3	-	3	-	3	-	-	2	-	2	2	3	-
3CH400FP1.2	2	3	3	3	-	2	-	2	3	-	2	2	3	-
3CH400FP1.3	3	2	3	3	3	3	-	2	2	-	2	3	3	2
3CH400FP1 CO	2	3	2	3	1	3	-	1	2	-	2	2	3	1

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **3AL001NC1**		Course Category: **NC**		
Course Name	**Disaster Management and Preparedness**				
Credits	--	Total L:T:P Hours	2:0:0 **30 Hrs**	Total SL Hours	--
Total Credit Hours	--				
SEE Marks	--	SEE Time	--	CIA Marks	--
EE Marks	--	PA Marks	--	Total Marks	--

Course Description:
Subject Code 3CE001NC1 Disaster Management and Preparedness is a Compulsory Non-Credit course for Second Year B. Tech all disciplines.

Course Objectives:
The objective of this course is to provide students with a comprehensive understanding of disasters, their types, impacts, the complete disaster management cycle, and the roles of various agencies in Disaster Risk Reduction.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CE001NC1.1	Identify the concepts of disaster, hazard, vulnerability and risk, and classify disasters to understand the basic nature, causes and profiles of disasters in India.	C-2
3CE001NC1.2	Analyze the disaster management cycle for risk assessment, mitigation, preparedness, response, recovery, and international disaster management frameworks.	C-4
3CE001NC1.3	Apply disaster management practices, including stakeholder roles, national policies, engineers' responsibilities, and preparedness measures for effective disaster risk reduction.	C-3

Course Contents:

Unit 1	**Introduction to Disaster Management:** Concepts and definitions – disaster, hazard, vulnerability, risk, severity, frequency, exposure, capacity, and impact; classification of disasters- Natural disasters: earthquakes, tsunami, landslides, mining, Hydro-Meteorological Disasters: floods, draught, cyclones, coastal erosion. Biological Disaster: epidemics, pest attacks, forest fire, Manmade disasters: Industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, vulnerability profile of India, ecological fragility; principles of disaster prevention and mitigation	10 hrs
Unit 2	**Disaster Management Cycle and Framework:** Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity	12 hrs

	Development. Awareness During Disaster – Evacuation, Disaster Communication, Search and Rescue, Emergency Operation Centre, Incident Command System, Relief and Rehabilitation. Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure, Early Recovery, Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action Phases of disaster management; vulnerability and capacity assessment, post-disaster environmental response	
Unit 3	**Disaster Management practices:** Roles and responsibilities of government, community, local bodies, NGOs, and other stakeholders, National Policy on Disaster Management Act 2005 Mega Disasters of India and Lessons Learnt, Disaster Management practices at working and residential places. Key responsibility of engineers in disaster reduction techniques, medical preparedness aspect of disaster.	8 hrs

Textbooks:

1. Sharma, S. C. (2022). Disaster Management, Khanna Publication.
2. Subramanian, R. (2024). Disaster Management. Vikas Publication.

Reference Books:

1. Gaur, R. C. (2018). Environmental Engineering and Disaster Management. New Age International.
2. Pradeep Sahni, 2024, Disaster Risk Reduction in South Asia, Prentice Hall.
3. Mondal, D. (2022). Disaster Management. New Delhi: CBS Publishers & Distributors
4. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
5. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
6. Natural Disaster Management Policy , 2009,GOI
7. H.N. Shrivastava& G.D. Gupta, Management of Natural Disasters in developing Countries, Daya Publishers , Delhi
8. S.L. Goyal, Encyclopedia of disaster Management, Vol I,II & III Disaster Managemnt Policy and administration, Deep & Deep, New Delhi,2006
9. Coppola D P, Introduction to International Disaster Management, Elsevier Science (B/H), London, 2007
10. Disaster Mitigation in Asia & Pacific, Asian Development Bank

Course Assignments

Internal Assessment at Institute level will be based on following assignments:

1) Study of Recent Disasters (at local, state and national level)
2) Preparation of Disaster Risk Management Plan of an Area or Sector
3) A Case study on Disaster Management

E Recourses:

1. https://onlinecourses.swayam2.ac.in/ntr25_ed61/preview

Mapping of COs with POs & PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CE001NC1.1	3	2	-	-	-	3	2	-	-	-	3	-	-	-
3CE001NC1.2	3	3	-	-	-	3	3	-	-	-	3	2	2	-
3CE001NC1.3	3	3	-	-	-	3	3	-	-	3	3	1	2	2
3CE001NC1.CO	3	3	-	-	-	3	3	-	-	1	3	1	2	1

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **3CH211DH1**		Course Category: **DH**		
Course Name	**Biofuels- Types and Applications**				
Credits	**03**	Total L:T:P etc. Hours	3:0:0 **45 Hrs**	Total SL Hours	**45 Hrs**
Total Credit Hours	**90 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:
Subject Code 3CH211DH1 Biofuels- Types and Applications is a Double Minor / Honours in Chemical Engineering for Second Year B. Tech.

Course Objectives:
The objective of this course is to provide the knowledge about properties, composition, features of bio fuels and uses of biomass and their environmental impacts.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH211DH1.1	Explain energy sources and biomass types to understand the basics of renewable fuels.	C-3
3CH211DH1.2	Analyze biomass composition and pretreatment to enable effective conversion processes.	C-4
3CH211DH1.3	Compare bioethanol and biobutanol production and practice ethanol recovery to learn alcohol-based biofuel generation.	C-4
3CH211DH1.4	Examine lipid sources and perform transesterification to produce biodiesel.	C-3
3CH211DH1.5	Illustrate biohydrogen production and conduct pyrolysis with upgrading to explore advanced biofuel pathways.	C-4
3CH211DH1.6	Describe and assemble enzymatic and microbial fuel cells to develop basic bioelectrochemical systems.	C-4

Course Contents:

Unit 1	**Introduction:** Sources of energy, introduction of Biofuels, availability of bio-mass, composition of biomass, terrestrial biomass, aquatic biomass. Physical and chemical properties of biomass. Useful and undesirable features of Biofuels	7 Hrs
Unit 2	**Types of Biomass:** Types of biomass, Composition of lignocelluloses, energy crops, chemical pretreatment, enzymatic pretreatment, degradation of cellulose, trichodermacellulases, bacterial cellulases, and comparison with degradation of high starch crops.	8 Hrs

Unit 3	**Bioethanol:** Bioethanol vs. Petrol, production of bio ethanol, ethanol recovery, Bio-butanol: Properties and standards of bioethanol, Lignocellulosic biomass composition and characterizations.	7Hrs
Unit 4	**Biodiesel:** Sources and processing of biodiesel (fatty acid methyl ester); nature of lipids, especially fatty acids and triglycerides. Sources and characteristics of lipids for use as biodiesel feedstock; and conversion of feedstock into biodiesel (transesterification). Use of vegetable oil (SVO) and waste vegetable oil (WVO).	8Hrs
Unit 5	**Bio-hydrogen:** Production of bio hydrogen from anaerobic bacteria, photosynthetic algae, photosynthetic - hydrogenase system. Pyrolysis, bio-oil upgradation.	8 Hrs
Unit 6	**Fuel cells:** Enzymatic fuel cells, microbial fuel cells. Fuel Cell Principle of working, construction and applications.	7 Hrs

Text Books:

1. R.C. Brown, Biorenewable Resources Engineering, New Products from Agriculture, Wiley - Blackwell Publishing, 2003.
2. S. Lee, Y. Shah and K. Park, Biofuels and Bioenergy: Processes and Technologies, Taylor & Francis, 2011.

Reference Books:

1. S.K. Khanal, Anaerobic Biotechnology for Bioenergy Production: Principles and Applications, Wiley - Blackwell Publishing 2008.
2. M. Kaltschmitt and H. Hofbauer, Biomass Conversion and Biorefinery, Springer Publishing, 2008.

E-Resource:

1. NPTEL Online Courses – Renewable Energy Engineering, Bioenergy. https://nptel.ac.in
2. MNRE (India) – National Policy on Biofuels, reports, and updates. https://mnre.gov.in

Mapping of COs with POs & PSOs:

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CH211DH1.1	3	2	3	2	3	-	-	-	-	-	-	2	2	-
3CH211DH1.2	3	-	3	-	3	-	-	-	-	-	-	3	3	-
3CH211DH1.3	-	-	2	-	3	-	-	-	-	-	-	3	3	2
3CH211DH1.4	3	2	3	2	3	-	-	-	-	-	-	3	3	2
3CH211DH1.5	3	-	3	-	3	-	-	-	-	-	-	3	3	2
3CH211DH1.6	-	-	2	-	3	-	-	-	-	-	-	3	3	2
3CH211DH1 CO	2	1	3	1	3	-	-	-	-	-	-	3	3	1

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **3CH211DH2**		Course Category: **DH**		
Course Name	**Industrial Hygiene and Occupational Health**				
Credits	**03**	Total L:T:P etc. Hours	3:0:0 **45 Hrs**	Total SL Hours	**45 Hrs**
Total Credit Hours	**90 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**-**	PA Marks	**-**	Total Marks	**100**

Course Description:
Subject Code 3CH211DH2 Industrial Hygiene and Occupational Health is a Double Minor / Honours in Chemical Engineering for Second Year B. Tech.

Course Objectives:
The objective of the course is to introduce occupational health hazards in process industries, covering toxicology, exposure assessment, control strategies, physical/ergonomic/biological risks, and basics of health management with legal and regulatory standards.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3CH211DH2.1	Analysis and classification of industrial hygiene hazards with reference to real incidents.	C-4
3CH211DH2.2	Interpret toxicology data to calculate permissible exposure durations.	C-3
3CH211DH2.3	Perform selection and application of exposure assessment methods to prepare hazard communication charts.	C-4
3CH211DH2.4	Evaluate physical hazards using data such as noise dose and heat stress to propose appropriate control measures.	C-5
3CH211DH2.5	Perform assessment of ergonomic and biological risks to recommend practical redesign measures.	C-5
3CH211DH2.6	Analysis and summarization of occupational health requirements to prepare compliance and audit checklists	C-4

Course Contents:

Unit 1	**Introduction & Scope of Industrial Hygiene:** Scope and principles; hazard categories (chemical, physical, biological, ergonomic); roles of an industrial hygienist; link between industrial hygiene and process safety. Case study: Bhopal gas tragedy — lessons in IH failure.	7 Hrs
Unit 2	**Basics of Toxicology & Exposure:** Dose–response, acute vs chronic toxicity; LD_{50}, LC_{50}; TLV, PEL, OEL, IDLH, STEL, ceiling limits; toxic interactions. Analytical: Estimate safe exposure durations from TLV values	8 Hrs
Unit 3	**Chemical Exposure Assessment & Controls:** Routes of exposure (inhalation, dermal, ingestion); monitoring strategies (air sampling, direct-reading instruments, biological	7 Hrs

	monitoring); hierarchy of controls. Skill: Interpret MSDS and prepare a hazard communication chart (GHS labels).	
Unit 4	**Physical Hazards:** Noise (measurement, effects, controls); vibration; heat stress; radiation (ionizing & non-ionizing). Analytical: Calculate noise dose and evaluate against OSHA standards. Case study: Heat stress incidents in petrochemical plants.	8 Hrs
Unit 5	**Ergonomic & Biological Hazards:** Principles of ergonomics; musculoskeletal disorders; workstation design; biological agents in chemical and pharma plants. Skill: Identify ergonomic risk factors in a plant layout	7 Hrs
Unit 6	**Occupational Health Management & Legislation:** Common occupational diseases (silicosis, asbestosis, lead poisoning, byssinosis); health surveillance & medical examinations; Indian legislations (Factories Act, ESI, Workmen's Compensation); ILO/ OSHA/WHO conventions. Skill: Prepare a compliance checklist/ report for a chemical plant.	8 Hrs

Text Books:

1. Plog, B.A., Niland, J., & Quinlan, P. Fundamentals of Industrial Hygiene, 6th Edition, National Safety Council, 2012.
2. Goetsch, D.L. Occupational Safety and Health for Technologists, Engineers, and Managers, 9th Edition, Pearson, 2019.
3. Bridger, R.S. Introduction to Ergonomics, 3rd Edition, CRC Press (Taylor & Francis), 2008.

Reference Books:

3. Patty's Industrial Hygiene and Toxicology (Volumes I–IV) Edited by Harris, R.L., 6th Edition, Wiley-Interscience, 2011.
4. Robert Friis, Occupational Health and Safety for the 21st Century, Jones and Bartlett Learning, 2015.

E-Resources:

https://onlinecourses.nptel.ac.in/noc20_mg43/preview

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CH211DH2.1	3	3	2	2	2	3	-	-	2	-	2	3	3	-
3CH211DH2.2	3	3	2	3	3	2	-	-	2	-	2	3	3	-
3CH211DH2.3	3	2	3	3	3	2	-	2	3	2	2	3	3	2
3CH211DH2.4	2	2	3	3	3	3	-	2	2	2	2	3	3	2
3CH211DH2.5	2	2	3	2	3	3	-	2	2	2	2	3	3	2
3CH211DH2.6	2	2	2	2	2	3	-	2	2	2	2	3	3	2
3CH211DH2 CO	3	2	3	3	3	3	-	2	2	2	2	3	3	2

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **4CH212PC1**		Course Category: **PCC**		
Course Name	**Fluid Flow Operation**				
Credits	**03**	Total L:T:P etc. Hours	3:0:0 **45 Hrs**	Total SL Hours	**45 Hrs**
Total Credit Hours	**90 Hrs**				
SEE Marks	**60**	SEE Time	**03 Hr**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:

Subject Code4CH214PC1 Fluid Flow Operation is a Programme Core Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:

The objective of this course is to provide fundamental knowledge of fluid properties, classification, and behavior under static and dynamic conditions and apply the principles of fluid kinematics, continuity, and motion equations in engineering applications.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH214PC1.1	Explain fluid properties and static pressure relations to build conceptual understanding for analyzing fluid at rest.	C-2
4CH214PC1.2	Apply laminar–turbulent flow concepts and dimensional analysis to determine velocity profiles for engineering flow applications.	C-3
4CH214PC1.3	Apply Bernoulli and Navier–Stokes laws to determine flow behavior for solving dynamic fluid problems.	C-3
4CH214PC1.4	Demonstrate flow measuring devices to measure discharge and velocity for industrial fluid flow monitoring.	C-3
4CH214PC1.5	Analyze performance of pumps, compressors and flow machinery to select suitable equipment for process industries.	C-4
4CH214PC1.6	Evaluate drag, settling and packed bed flow to design systems for solid–fluid separation efficiency.	C-5

Course Contents:

Unit 1	**Fluid Properties and Fluid Statics:** Definition, basic concepts of fluid, Properties of fluids and their classification. Fluid statics: Forces on fluids, pressure depth relationship for compressible and incompressible fluids. Forces on submerged bodies. Rigid body motion, pressure measurements, Euler's equation.	5Hrs

Unit 2	**Kinematics of Flow:** Fluid flow: Laminar and turbulent flows, Equations of Continuity and Motion in laminar flows and its applications for the calculation of velocity profiles, Dimensional analysis; Buckingham's Pi Theorem; Dimensionless numbers and their physical significance.	5 Hrs
Unit 3	**Fluid Dynamics:** Bernoulli's Equation and engineering applications, Conservation of mass, momentum and energy balance, Navier-Stokes equations, Basics of Turbulent flows, motion for turbulent flows: Prandtl mixing length theory,. Turbulent pipe flow, Boundary layer theory.	5 Hrs
Unit 4	**Flow Measurement:** Flow measuring devices for chemical plants: Orifice meter, Venturimeters, Rotameter, Pitot tube and rectangular & V-Notches.	5 Hrs
Unit 5	**Fluid Moving Machinery:** Pressure drop in Pipe fitting and valves, Friction Construction, working and characteristic features of various types of pumps, compressors, blowers and fans.	5 Hrs
Unit 6	**Flow Past Bodies:** Flow past immersed bodies: Drag, Drag coefficients, Flow through beds of solids, Particle motion, Terminal velocity, Hindered settling, flow through packed bed and fluidized Bed.	5 Hrs

Text Books:

1. K. A. Gavhane, Fundamentals of Chemical Engineering and Materials, 1st Edition (2024).
2. W. L. McCabe, J. C. Smith, P. Harriott P., Unit Operations of Chemical Engineering, 7 th Ed., McGraw-Hill, New York, 2017.
3. R. B. Bird, W. E. Stewart, E. N. Lightfoot, Transport Phenomena, 2nd ed., John Wiley & Sons.
4. Coulson J. M. and Richardson J. F. Chemical Engineering, Vol. 1sixth edition Elsevier publication.
5. Dr. R.K.Bansal , Fluid Mechanics and Hydraulic Machines, 9th edition, Laxmi publications.

Reference Books:

1. F. M. White, Fluid Mechanics, 9 th Ed., McGraw Hill, 2022.
2. G. K. Batchelor, An Introduction to Fluid Dynamics, 2nd Ed., Cambridge Univ Press, (2000)

E-Resources:

1. https://nptel.ac.in/courses/105101082
2. https://nptel.ac.in/courses/103104044NPTEL
3. https://onlinecourses.nptel.ac.in/noc23_ch32/previewNPTEL
4. https://nptel.ac.in/courses/103105353NPTEL

Mapping of COs with Pos and PSO's:

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
4CH214PC1.1	3	2	-	-	-	-	-	-	-	-	-	3	-	-
4CH214PC1.2	3	3	-	-	2	-	-	-	-	-	-	3	3	-
4CH214PC1.3	3	3	3	2	2	-	-	-	-	-	-	3	-	-
4CH214PC1.4	3	2	3	2	3	-	-	-	-	-	-	3	3	-
4CH214PC1.5	3	3	3	2	3	-	-	-	-	-	-	3	3	-
4CH214PC1.6	3	3	3	3	2	3	-	-	-	-	-	3	3	-
4CH214PC1 CO	3	3	2	2	2	1	-	-	-	-	-	3	2	-

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **4CH213PC1**		Course Category: **PCC**		
Course Name	**Chemical Engineering Mechanical Operation**				
Credits	**02**	Total L:T:P etc. Hours	2:0:0 **30 Hrs**	Total SL Hours	**30 Hrs**
Total Credit Hours	**60 Hrs**				
SEE Marks	**60**	SEE Time	**03 Hr**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:
Subject Code4CH210PCChemical Engineering Operation-I is a Programme Core Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:
To analyze the physical characteristics of particles like size, shape, and density, and how these properties affect mechanical operations and its separation by different means.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH210PC1.1	Perform size reduction and screening operations to analyze industrial solid processing.	C-1
4CH210PC1.2	Understand the principles and operation of classifiers and thickeners to achieve effective solid separation.	C-2
4CH210PC1.3	Select appropriate solid transportation systems to ensure efficient material handling.	C-3
4CH210PC1.4	Understand filtration equipment to separate solids from liquids effectively.	C-2
4CH210PC1.5	Understand the principles of centrifuges and cyclones to enhance solid–fluid separation.	C-2
4CH210PC1.6	Understand adsorption mechanisms to apply adsorption in industrial separation processes.	C-2

Course Contents:

Unit 1	Size reduction, stages of reduction, Equipments operating variables, laws of energies, energy requirements. Screening: Screen analysis, Particle size distribution, Unit operation design, basis concepts.	7Hrs
Unit 2	Classification: Equal falling particles, equipments, jigging, tabling. Gravity settling, drag force, terminal settling velocity. . Sedimentation: Continuous thickeners.	8Hrs
Unit 3	Storage and handling of solids, transportation by means of positive and negative pressure Mixing principle, mixers, agitation, types of agitators,	7Hrs

Unit 4	Filtration: Theory, operation, types, flotation agents, flotation cells. Filter Calculations, filtration equation for compressible and non-compressible cakes, Specific cake resistance. Filtration: Constant pressure and constant rate and their equipment's.	08Hr
Unit 5	Centrifuges: Theory, Equipment's, types and calculations. . Cyclones: Hydro cyclones, liquid scrubbers and electrostatic precipitators.	7Hrs
Unit 6	Adsorption, theory, type and application, nature of adsorbents, industrial adsorbents. Adsorption in fixed bed, fluidized beds, adsorption equilibria calculations for vapor, gas and liquid adsorption. Adsorption, operation such as single stage, multi stage, cross current and multistage counter current operation and equipment's. Recent developments in mechanical operation equipment's.	8 Hrs

Text Books:

1. Gupta, S. K. (2006). Momentum Transfer Operations (2nd ed.). Tata McGraw-Hill.
2. McCabe, W. L., Smith, J. C., and Harriott, P. (2005). Unit Operations of Chemical Engineering (7th ed.). Tata McGraw-Hill.
3. Coulson, J. M., and Richardson, J. F. (1999). Chemical Engineering, Volume I (6th ed.). Pergamon Press.
4. Foust, A. S., Wenzel, L. A., Clump, C. W., Maus, L., and Andersen, L. B. (1980). Principles of Unit Operations (2nd ed.). John Wiley & Sons.

Reference Books:

1. Brown, C. G. (1950). Unit Operations. John Wiley & Sons.
2. Badger, W. L., and Banchero, J. T. (1955). Introduction to Chemical Engineering. McGraw-Hill.
3. Treybal, R. E. (1980). Mass Transfer Operations (3rd ed.). McGraw-Hill.
4. Hiremath, R. S., and Kulkarni, A. P. (2009). Mechanical Operations, Volume I. Nirali Prakashan.

E-resources:

1. http://digimat.in/nptel/courses/video/103107123/L03.html

Mapping of COs with Pos and PSO's:

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
4CH210PC1.1	3	3	2	2	-	-	-	-	-	-	-	3	2	2
4CH210PC1.2	3	3	2	2	-	-	-	-	-	-	-	3	2	2
4CH210PC1.3	3	2	3	2	2	-	-	-	2	-	-	3	3	2
4CH210PC1.4	2	3	3	3	2	-	-	-	-	-	-	3	3	2
4CH210PC1.5	2	2	3	2	2	-	-	-	-	-	-	3	3	3
4CH210PC1.6	3	2	3	3	2	-	-	-	-	-	-	3	3	3

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **4CH214PC1**		Course Category: **PCC**		
Course Name	**Process Calculations**				
Credits	**02**	Total L:T:P Hours	3:0:0 **30 Hrs**	Total SL Hours	**30 Hrs**
Total Credit Hours	**60 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:
Subject Code 3CH212PC1 Process Calculation is a compulsory Program Core Course for Second Year B.Tech. Chemical Engineering.

Course Objectives:
The objective of this course is to develop students ability to apply fundamental chemical engineering principles such as unit operations, stoichiometry, material and energy balances, and combustion calculations to analysed, design, and evaluate chemical process systems.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH212PC1.1	Analyze engineering problems using systematic process calculations and dimensional analysis to ensure accurate unit conversions and reliable quantitative results.	C-4
4CH212PC1.2	Apply the concepts of mole fraction and mass fraction to determine and represent the composition of solid, liquid, and gaseous mixtures in process systems.	C-3
4CH212PC1.3	Integrate mass conservation principles and material balance classifications to evaluate and solve unit operation problems related to phase behavior and product distribution.	C-6
4CH212PC1.4	Apply stoichiometric relationships to formulate material balance equations for analyzing reacting systems in chemical processes.	C-3
4CH212PC1.5	Interpret thermo chemical data to assess energy efficiency and optimize heat utilization for improved performance of chemical processes.	C-2
4CH212PC1.6	Evaluate fuel performance using calorific value and combustion efficiency to assess overall combustion quality and energy effectiveness.	C-5

Course Contents:

Unit 1	**Basic Chemical Calculations:** Introduction to process calculation, Dimensions and systems of units, Fundamental quantities of units, Derived quantities, Definition and units of force, volume, pressure, work, energy, power, heat, Unit conversions in SI systems, Numerical.	08 Hrs
Unit 2	**Molecular Concepts and Gas Laws:** Gram mole and molecular weight, mole and mass fraction, Composition of solids, liquids and gases, Concept of Normality, Molarity and Molality, PPM (Parts Per Million), Ideal Gas Law, STP and NTP conditions, Dalton's Law, Partial Pressure, Amagat's Law, Average Molecular Weight, Density of Gas Mixture, Raoult's Law, Henry's Law.	07 Hrs
Unit 3	**Material Balance without Chemical Reaction:** Law of conservation of mass, classification of Material balance problems, Distillation, Evaporation, Absorption, Extraction, Drying, Filtration, Mixing, Crystallization, Bypass Operations, Numerical.	08 Hrs
Unit 4	**Material Balance with Chemical Reaction:** Terms involved in Stoichiometry, Stoichiometric equation, stoichiometric coefficient, Limiting Reactant, Excess Reactant, Percent excess, and percentage Conversion, percentage Yield, and selectivity, Numerical.	07 Hrs
Unit 5	**Energy Balance:** Energy balance for open and closed systems, Sensible heat and heat capacities, Heat of reaction, energy balance during Phase Change Operations, Hess's law of constant Heat Summation, Numerical.	08 Hrs
Unit 6	**Fuel and Combustion:** Classification of fuel, Calorific value of fuel, GCV, NCV, Air requirement, Theoretical Air and Oxygen, Excess Air, heat and material balance of combustion processes. Numerical	07 Hrs

Text Books:

1. O.A. Hougen, K.M. Watson, R.A. Ragatz, Chemical Process Principles, (CBS publications New Delhi 1995 edition)- part-I
2. Narayanan K.V. and Lakshmikutty B, Stoichiometry and Process Calculations, PHI; 2nd edition, Year2016ISBN: 8120352890
3. R. M. Felder, Ronald W. Rousseau, Lisa G. Bullard, Elementary Principles of Chemical Processes, 4th Ed., John Wiley & Sons, Asia, 2017.
4. Felder, R. M. and Rousseau, R. W., Elementary Principles of Chemical Processes, 5th Edn., John Wiley & Sons, New York, 2005.
5. Himmelblau D.H., James B. Riggs, Basic Principles and Calculations in Chemical Engineering, Prentice Hall, 2012, 8th Edition.

Reference Books:

1. Bhatt, B. I., Vora, S. M., Stoichiometry, Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2004.
2. Narayanan K V and Lakshmikutty B, Stoichiometry and Process Calculations, Prentice Hall of India Pvt Ltd, New Delhi 2006.
3. Sikdar, D. C., Chemical Process Calculations, Prentice Hall of India.
4. Hougen. O. A, Watson K.M. and Ragatz R.A., Chemical Process Principles, Part -I, Material and Energy Balance".
5. N. Chopey, Handbook of Chemical Engineering Calculations, 4th Ed., Mc-Graw Hill, 2012.
6. Olaf, K.M. Watson and R. A. R. Hougen, Chemical Process Principles, Part 1: Material and Energy Balances, 2nd Ed., John Wiley & Sons, 2004.
7. Nayef Ghasem, Redhouane Henda, Principles of Chemical Engineering Processes: Material and Energy Balances, CRC Press, 2015, 2nd Edition.

E- Resources:

1. https://bietdvg.edu/media/department/BT/data/learning-materials/stoichometry1.pdf
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCHA1304.pdf
3. https://thechemgate.wordpress.com/wp-content/uploads/2019/01/process-calculation-by-watson.pdf
4. https://nptel.ac.in/courses/103103165
5. https://nptel.ac.in/courses/103105209
6. https://www.unitoperation.com/

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3CH201PC1.1	3	3	-	2	2	-	-	-	-	-	2	3	2	-
3CH201PC1.2	3	2	-	2	2	-	-	-	-	-	2	3	2	-
3CH201PC1.3	3	3	-	2	2	-	-	-	-	-	3	3	3	-
3CH201PC1.4	3	3	-	2	3	-	-	-	-	-	3	3	3	-
3CH201PC1.5	3	2	-	2	2	2	-	-	-	-	3	3	3	2
3CH201PC1.6	3	2	-	2	2	2	-	-	-	-	3	3	3	2
3CH201PC1CO	3	3	-	2	2	1	-	-	-	-	3	3	3	1

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **4CH215MD1**		Course Category:		**MDM-II**
Course Name	**Air Pollution and Control**				
Credits	**02**	Total L:T:P etc. Hours	2:0:0 **30 Hrs**	Total SL Hours	**30 Hrs**
Total Credit Hours	**60 Hrs**				
SEE Marks	**30**	SEE Time	**2 Hrs**	CIA Marks	**20**
EE Marks	**-**	PA Marks	**-**	Total Marks	**50**

Course Description:
Subject Code 4CH215MD1 Air Pollution and Control is a Multidisciplinary Minor Chemical Engineering Course for Second Year B. Tech.

Course Objectives:
The objective of this course is to provide an understanding of air pollution sources, characteristics, impacts, and control methods, enabling students to analyze sources and apply suitable control mechanisms.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH215MD1.1	Perform identification and classification of major air pollutants to evaluate their sources and impacts on humans, materials, and vegetation.	C-5
4CH215MD1.2	Understanding of basic atmospheric elements and meteorological factors to explain fundamental principles of air sampling.	C-2
4CH215MD1.3	Perform analysis of simple air pollution control methods for particulate and gaseous pollutants to outline basic air quality standards.	C-4

Course Contents:

Unit 1	**Air Pollutants, Sources & Effects:** Classification of air pollutants, Particulate pollutants, Gaseous pollutants, Major sources of air pollution: Industrial, Vehicular, Domestic, Effects of air pollution on Human beings, Materials, Vegetation; Brief introduction to: Global warming, Ozone layer depletion	10 Hrs
Unit 2	**Basic Sampling, Analysis & Atmospheric Concepts :** Basic principles of air sampling, Source sampling (concept), Ambient sampling (concept); Basic analysis of common pollutants (principles only, Elements of atmosphere (simple) Meteorological factors influencing air pollution: Wind direction, Wind rose, Lapse rate (concept only)	10 Hrs
Unit 3	**Air Pollution Control & Basic Management:** Concept and basic principles of air pollution control, Simple particulate control methods: Settling chamber, Cyclone, Bag filter, Simple gaseous pollutant control: Absorption, Adsorption, Air quality standards (overview only), General preventive measures, Basic idea of zoning in urban air quality management	10 Hrs

Text Books:

1. Anjaneyulu, D., “Air Pollution and Control Technologies”, Allied Publishers, Mumbai, 2002 Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi,1996

Reference Books:

1. " Rao M.N., and Rao H. V. N., Air Pollution Control, Tata-McGraw-Hill, New Delhi, 1996.
2. “W.L.Heumann, Industrial Air Pollution Control Systems, McGraw- Hill, New Yark, 1997.
3. “Mahajan S.P., Pollution Control in Process Industries, Tata McGraw-Hill Publishing Company, New Delhi, 1991.
4. Peavy S.W., Rowe D.R. and Tchobanoglous G. Environmental Engineering, McGraw Hill, New Delhi, 1985
5. Garg, S.K., “Environmental Engineering Vol. II”, Khanna Publishers, New Delhi

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ce14/preview

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
4CH215MD1.1	3	2	2	2	2	3	-	-	2	-	2	3	3	-
4CH215MD1.2	3	3	2	3	3	2	-	-	2	-	2	3	3	-
4CH215MD1.3	2	2	3	2	3	3	-	2	2	2	2	3	3	2
4CH215MD1 CO	3	2	2	2	3	3	-	-	2	-	2	3	3	-

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level:	**5**	Course Code:	**4SH216OE1**	Course Category:	**OE**
Course Name	**Quantitative and Logical Reasoning**				
Credits	**03**	Total L:T:P Hours	3:0:0 **45 Hrs**	Total SL Hours	**45 Hrs**
Total Credit Hours	**90 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:

Subject Code 4SH216OE1Quantitative and Logical Reasoning is a compulsory Open Elective Course for Second Year B. Tech All Branch Students.

Course Objectives:

The Objective of the Course is to develop quantitative aptitude, logical reasoning, problem-solving efficiency, and decision-making skills for placements, competitive exams, and real-life applications

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
4SH216OE1.1	Apply arithmetic and numerical techniques to solve quantitative problems accurately.	C-3
4SH216OE1.2	Solve algebraic and equation-based problems using simplification and approximation methods to improve problem-solving efficiency.	C-3
4SH216OE1.3	Analyze logical reasoning problems using structured and critical thinking approaches to improve decision-making skills.	C-4
4SH216OE1.4	Interpret and analyze data using graphical and tabular methods for decision making for strategic planning.	C-4
4SH216OE1.5	Solve complex logical puzzles and advanced reasoning problems efficiently for competitive examination success.	C-3
4SH216OE1.6	Demonstrate effective aptitude test strategies integrating quantitative and logical reasoning skills for career advancement opportunities.	C-3

Course Contents:

Unit 1	**Number System & Arithmetic Foundations:** Number system fundamentals; LCM and HCF applications; divisibility rules; percentage calculations; ratio and proportion; averages; profit and loss; simple and compound interest; speed mathematics and shortcut techniques.	7Hrs
Unit 2	**Algebra, Equations & Simplification Techniques:** Linear and quadratic equations; algebraic expressions; simplification and approximation; indices and surds; inequalities; time and work; pipes and cisterns; time, speed and distance; mixtures and alligation.	7 Hrs

Unit 3	**Logical Reasoning: Analytical & Critical Thinking:** Coding–decoding; blood relations; direction sense; series and pattern recognition; analogies; ranking and ordering; syllogisms; statement and assumption; statement and conclusion; cause–effect reasoning.	7 Hrs
Unit 4	**Data Interpretation & Analytical Aptitude:** Tables; pie charts; line graphs; bar graphs; caselets; data sufficiency; DI shortcut techniques; approximation in data interpretation; comparative and predictive data analysis.	8Hrs
Unit 5	**Advanced Logical Reasoning & Puzzle Solving:** Seating arrangements (linear, circular, and complex); floor-based puzzles; scheduling puzzles; selection-based puzzles; Venn diagrams; logical grouping; critical reasoning frameworks	8 Hrs
Unit 6	**Placement Aptitude Mastery & Test Strategies:** Integrated quantitative and logical reasoning practice; decision-making and elimination strategies; speed improvement techniques; mock placement aptitude patterns (TCS, Infosys, Wipro, Accenture, Capgemini); common error analysis; test-taking strategies; aptitude and reasoning simulations.	8 Hrs

Text Books:

1. R. S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publishing
2. Arun Sharma, Logical Reasoning and Data Interpretation, McGraw Hill

Reference Books:

1Arun Sharma, How to Prepare for Quantitative Aptitude,published by McGraw Hill Education.
2. R.S. Aggarwal, A Modern Approach to Logical Reasoning, published by S. Chand Publishing
3. M.K. Pandey, Analytical Reasoning, published by BSC Publishing Co. Pvt. Ltd.
4. Rajesh Verma, Fast Track Objective Arithmetic, published by Arihant Publications

E Resources:

1. NPTEL – Quantitative Aptitude & Logical Reasoning Courses
2. IndiaBIX – Quantitative and Logical Reasoning Practice
3. CareerRide – Aptitude Preparation Modules
4. PrepInsta / HackerEarth – Placement Aptitude Practice Platforms

Mapping of COs with POs & PSO

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
4SH216OE1.1	3	3	2	–	–	–	–	–	–	–	–			
4SH216OE1.2	3	3	2	–	–	–	–	–	–	–	–			
4SH216OE1.3	–	3	3	–	–	–	–	–	–	–	–			
4SH216OE1.4	–	3	2	–	–	–	–	–	–	–	–			
4SH216OE1.5	–	3	3	–	–	–	–	–	–	–	–			
4SH216OE1.6	–	3	2	–	–	–	–	–	–	2	3			
4SH216OE1 CO	1	3	3	–	–	–	–	–	–	1	1			

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level:	**5**	Course Code:	**4SH216OE2**	Course Category:	**OE**
Course Name		**Critical Thinking & Decision Making**			
Credits	**03**	Total L:T:P Hours	3:0:0 **45 Hrs**	Total SL Hours	**45 Hrs**
Total credit Hours	**90 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:
Subject Code 4SH216OE2 Critical Thinking & Decision Making is a compulsory Open Elective Course for Second Year B. Tech All Branch Students.

Course Objectives:
The objective of this course is to develop critical thinking and decision-making competencies by strengthening analytical reasoning and structured problem-solving skills applicable to professional and real-world situations.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
4SH216OE2.1	Apply critical thinking frameworks to analyze problems systematically.	C-3
4SH216OE2.2	Evaluate information, assumptions, and arguments for logical consistency and validity.	C-5
4SH216OE2.3	Analyze complex situations and identify feasible alternatives for decision making.	C-4
4SH216OE2.4	Design rational and ethical decision-making strategies under uncertainty to ensure sustainable organizational outcomes.	C-6 A-3
4SH216OE2.5	Apply quantitative and qualitative tools to support decision-making processes.	C-3
4SH216OE2.6	Demonstrate effective decision making in simulated professional and team-based scenarios to resolve workplace challenges effectively	C-3 P-3 A-3

Course Contents:

Unit 1	**Foundations of Critical Thinking:** Concept of critical thinking; elements of reasoning; logical vs illogical thinking; assumptions and inferences; inductive and deductive reasoning; common cognitive biases; barriers to critical thinking.	7Hrs
Unit 2	**Analytical Reasoning & Problem Framing:** Problem identification and structuring; root cause analysis; issue trees; questioning techniques; systems thinking; analytical reasoning models.	7 Hrs

Unit 3	**Decision Making Models & Techniques:** Rational decision-making model; intuitive decision making; bounded rationality; decision trees; cost–benefit analysis; risk and uncertainty; heuristics.	7 Hrs
Unit 4	**Data-Driven & Ethical Decision Making:** Use of data in decision making; qualitative vs. quantitative data; basic decision matrices; ethical frameworks; professional ethics; social and environmental considerations in decisions.	8Hrs
Unit 5	**Creativity, Innovation & Strategic Thinking:** Creative thinking techniques; lateral thinking; design thinking approach; scenario planning; strategic decision making; innovation in problem solving.	8 Hrs
Unit 6	**Applied Decision Making & Case Analysis:** Case studies from industry and management; individual and group decision simulations; conflict resolution through decision frameworks; decision-making under pressure; reflection and feedback	8 Hrs

Text Books:

1. Alec Fisher, Critical Thinking, published by Cambridge University Press.
2. John Adair, Decision Making and Problem Solving, published by Kogan Page.

Reference Books:

1. Daniel Kahneman, Thinking, Fast and Slow published by Farrar, Straus and Giroux.
2. Rolf Dobelli, The Art of Thinking Clearly, published by Sceptre.
3. John S. Hammond, Ralph L. Keeney, Howard Raiffa, Smart Choices, published by Harvard Business School Press.
4. Ken Watanabe, Problem Solving 101, published by Portfolio.

E Resources:

1. NPTEL – Critical Thinking &Decision Making Courses
2. Coursera – Critical Thinking and Decision-Making Modules
3. Harvard Business Review – Decision Making Articles
4. MIT OpenCourseWare – Decision Analysis

Mapping of COs with POs & PSO

CO	**PO**											**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
4SH216OE2.1	2	3	2	–	–	–	–	–	–	–	–			
4SH216OE2.2	–	3	3	–	–	–	–	–	–	–	–			
4SH216OE2.3	–	3	2	–	–	–	–	–	–	–	–			
4SH216OE2.4	–	3	3	–	–	2	3	–	–	–	–			
4SH216OE2.5	–	2	2	–	2	–	–	–	–	–	–			
4SH216OE2.6	–	2	2	–	–	2	–	2	2	–	2			
4SH216OE2. CO	1	3	3	-	1	1	1	1	1	-	1			

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **4CH217PC1**		Course Category: **PCC**		
Course Name	**Fluid Flow Operation Lab**				
Credits	**01**	Total L:T:P etc. Hours	0:0:2 **30 Hrs**	Total SL Hours	**--**
Total Credit Hours	**30 Hrs**				
SEE Marks	**--**	SEE Time	**--**	CIA Marks	**--**
EE Marks	**25**	PA Marks	**25**	Total Marks	**50**

Course Description:

Subject Code4CH218PC1 Fluid Flow Operation Lab is a compulsory Programme core Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:

The objective of this course is to perform practical's on the concepts of Fluid Flow Operation and working of Flow measurement device.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH218PC1.1	Operate Bernoulli-based flow instruments (orifice meter, Venturimeter, Pitot tube to determine discharge and pressure characteristics for fluid flow assessment.	C-3 & P-4
4CH218PC1.2	Differentiate and value laminar–turbulent flow behavior using Reynolds experiment to enhance conceptual understanding for engineering decision-making..	C-4 & A-3
4CH218PC1.3	Manipulate and test notches, valves, and flow meters to evaluate measurement accuracy and performance for process fluid operations.	C-5 & P-4

List of Practicals:

Minimum eight practicals from the list mentioned below.

1. Verification of Bernoulli's theorem.
2. Determination of Turbulent flow and Laminar flow by Reynolds apparatus.
3. To determine the coefficient of the discharge of Orifice meter.
4. To determine the coefficient of discharge of Venturimeter.
5. To determine the coefficient of velocity for Pitot tube.
6. To determine the coefficient of discharge of Rotameter.
7. To determine the coefficient of discharge for Rectangular notch.
8. To determine the coefficient of discharge for Triangular notch.
9. Experiment on characteristics of the Centrifugal pump.

10. To study the different types of Valves in chemical process industry.

List of Virtual Labs:

1. https://me.iitp.ac.in/Virtual-Fluid-
2. vlab.co.in/participating-institute-iiit-hyderabad
3. https://fm-nitk.vlabs.ac.in/List%20of%20experiments.html
4. vlab.co.in/participating-institute-nitk-surathkal

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
4CH218PC1.1	3	2	-	3	3	1	-	-	-	-	-	3	2	-
4CH218PC1.2	3	3	-	2	-	-	-	1	-	-	-	2	3	-
4CH218PC1.3	3	2	3	3	3	-	-	-	1	-	2	3	3	-
4CH218PC1CO	3	2	1	3	2	-	-	-	-	-	1	3	3	-

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **4CH218PC1**		Course Category: **PCC**		
Course Name	**Chemical Engineering Mechanical Operation Lab**				
Credits	**01**	Total L:T:P etc. Hours	0:0:2 **30 Hrs**	Total SL Hours	**--**
Total Credit Hours	**30 Hrs**				
SEE Marks	**--**	SEE Time	**--**	CIA Marks	**--**
EE Marks	**25**	PA Marks	**25**	Total Marks	**50**

Course Description:

Subject Code 4CH213PC1Chemical Engineering Operation-I Lab is a compulsory Programme core Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:

The objective of this course is to perform practical's on the concepts of Chemical Engineering Operation-I.on size reduction of particles and its separation by different means of equipments.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH213PC1.1	Perform crushing, grinding, screening, jigging, and sedimentation experiments to determine operational performance and equipment efficiency.	C-1& P-4
4CH213PC1.2	Analyze particle size distribution, cyclone separator efficiency, and transport equipment performance to assess separation and material handling effectiveness.	C-4& P-1
4CH213PC1.3	Apply experimental data to design basic unit operation equipment such as thickeners and to evaluate conveying and separation systems.	C-3 & P-5

List of Practicals:

Minimum eight practicals from the list mentioned below.

1. To Understand the Law of Crushing & Grinding using Jaw Crusher.
2. To Understand the Law of Crushing & Grinding using the Ball Mill.
3. To Demonstrate to Design the Thickener using the Sedimentation Test.
4. To Understand to Determine the Efficiency of Cyclone Separator.
5. To Understand to Study the sieve analysis.
6. To Understand to study the operation of Trammel.
7. To Understand to Study the operation of Jigging.
8. To Understand to Study the Screw Conveyor.

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
4CH213PC1.1	3	2	2	2	-	-	-	-	-	2	-	3	2	2
4CH213PC1.2	3	3	2	3	-	-	-	-	-	2	-	3	3	2
4CH213PC1.3	3	2	3	2	2	-	-	-	2	3	2	3	3	3
4CH213PC1CO	3	2	2	2	-	-	-	-	-	2	-	3	2	2

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **4CH219VS1**		Course Category: **VSC**		
Course Name	**Computer Application in Chemical Engineering**				
Credits	**02**	Total L:T:P etc. Hours	0:0:4 **30 Hrs**	Total SL Hours	**30 Hrs**
Total Credit Hours	**60 Hrs**				
SEE Marks	**--**	SEE Time	**--**	CIA Marks	**--**
EE Marks	**--**	PA Marks	**50**	Total Marks	**50**

Course Description:
Subject Code 4CH2119VS1 Computer Application in Chemical Engineering is a Vocational and Skill Enhancement Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:

The objective of this course is to develop fundamental knowledge of computer applications and programming tools used in chemical engineering for data analysis, process calculations, simulation, and problem-solving.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH2119VS1.1	Apply basic computer programming concepts and software tools for solving chemical engineering problems.	C-2 & P-2
4CH2119VS1.2	Analyze and interpret engineering data using computational and simulation techniques.	C-3 & P-5
4CH2119VS1.3	Develop computer-based solutions for process control, modelling, and optimization in chemical engineering applications.	C-4 & P-6

List of Practicals:
Minimum eight free hand drawing sheets from the list mentioned below.
1. Study of basic operations and functions in Microsoft Excel.
2. Curve fitting and graphical analysis using Microsoft Excel.
3. Statistical design and analysis of experiments using Microsoft Excel for engineering applications.
4. Study of MATLAB environment and basic programming commands.
5. Curve fitting and data analysis using MATLAB.
6. Modelling and simulation of process control systems using Simulink in MATLAB.
7. Study of Aspen Plus interface and simulation environment.
8. Estimation of thermodynamic properties of user-defined components such as vanillin and ibuprofen using the UNIFAC property method in Aspen Plus.
9. Determination of boiling point of n-butane at 1 bar and 10 bar using Gibbs free energy relations of vapour and liquid phases with the PR-BM property method in Aspen Plus.

10. Simulation and separation analysis of Benzene–Toluene–Xylene (BTX) mixture through distillation using Aspen Plus software.

Text Books:

1. Rao V. Dukkipati, MATLAB for Engineers, New Age International Publishers, 2010.
2. Richard Turton, Richard C. Bailie, Wallace B. Whiting and Joseph A. Shaeiwitz, Analysis, Synthesis and Design of Chemical Processes, Prentice Hall, 2018.
3. H. S. Kalsi, Computer Concepts and Applications, Wiley India, 2017.

Reference Books:

1. William L. Luyben, Process Modeling, Simulation and Control for Chemical Engineers, McGraw Hill, 1990.
2. Stanley I. Sandler, Chemical and Engineering Thermodynamics, Wiley, 2017.
3. Aspen Technology Inc., Aspen Plus User Guide and Documentation, AspenTech, 2023.
4. DWSIM Team, DWSIM Simulation Software Documentation, 2024.

E-Resources:

1. Smith, R., "Process Simulation and Design Using Aspen Plus," Chemical Engineering Research and Design, 2016.
2. Edgar, T. F., Himmelblau, D. M., and Lasdon, L. S., "Optimization of Chemical Processes Using MATLAB," Computers & Chemical Engineering, 2001.
3. Cutlip, M. B. and Shacham, M., "Problem Solving in Chemical and Biochemical Engineering with POLYMATH, Excel, and MATLAB," Prentice Hall, 2008.
4. Calçada, L. A. and de Medeiros, J. L., "Application of DWSIM in Chemical Process Simulation and Education," Computer Applications in Engineering Education, 2020.
5. Langtangen, H. P., "Python and MATLAB for Engineering Computations," Springer Journal of Scientific Computing, 2012.

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
4CH2119VS1.1	3	2	2	2	-	-	-	-	-	-	-	1	1	-
4CH2119VS1.2	2	2	3	-	2	3	-	-	-	-	-	1	1	-
4CH2119VS1.3	2	3	2	3	2	-	-	2	-	-	3	2	-	1
4CH219VS1CO	2	2	2	2	1	1	-	1	-	-	1	1	1	-

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code:	**4SH220AE1**	Course Category:	**AEC**
Course Name	**Technical Writing**			
Credits	**02**	Total L:T:P Hours	1:0:2 **45 Hrs**	Total SL Hours	**15 Hrs**
Total Credit Hours	**60 Hrs**			
SEE Marks	**--**	SEE Time	**--**	CIA Marks	**--**
EE Marks	**--**	PA Marks	**50**	Total Marks	**50**

Course Description:
Subject Code 4SH220AE1 Technical Writing is common Ability Enhancement Course for Second Year B. Tech.

Course Objectives:
The objective of the course is to enhance students' ability to write effective technical documents, professional correspondence, and research-oriented content with clarity, accuracy, and ethical standards.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
4SH220AE1.1	Apply principles of technical writing in engineering documents.	C-3 P-2 A-2
4SH220AE1.2	Apply technical writing skills to prepare professional documents.	C-4 P-2 A-2
4SH220AE1.3	Create ethical, well-structured technical and research documents using IEEE referencing for professional and academic communication.	C-3 P-3 A-3

Course Contents:

Unit 1	**Fundamentals of Technical Writing:** Nature and importance of technical communication, characteristics of technical writing, audience analysis, technical vocabulary, grammar and style, clarity and conciseness, paragraph structure, coherence, technical descriptions, instructions and manuals.	7 Hrs
Unit 2	**Professional and Research Writing:** Technical reports and documentation, structure of reports, abstracts and summaries, research papers, project proposals, resumes and cover letters, business emails, documentation ethics, plagiarism, referencing styles (IEEE), editing and proofreading.	8 Hrs

List of Practicals:

Minimum eight practicals from the list mentioned below.
1. Analysis of Technical Communication to Identify the nature, purpose of given technical documents and evaluate their effectiveness.
2. Editing technical text for clarity and brevity
3. Technical description of an engineering device/system

4. Writing step-by-step technical instructions
5. Preparation of structured technical reports
6. Resume and cover letter drafting
7. Technical report writing based on laboratory work, case study, or project work
8. Abstract and executive summary writing for technical documents
9. Referencing and citation using IEEE format
10. Editing, proofreading, and plagiarism check of technical documents

Text Books:

1. Rizvi A. M. & Patnaik P., Effective Technical Communication, McGraw Hill Education (India), New Delhi (Second Edition).
2. Verma S., Technical Communication for Engineers, Vikas Publishing House Pvt. Ltd., New Delhi (First Edition).
3. Misra P. & Tyagi K., Advanced Technical Communication, PHI Learning Pvt. Ltd., New Delhi (Second Edition).

Reference Books:

1. Chauhan G. S., Kashiramka S. & Thimmesha L., Technical Communication, Cengage Learning India Pvt. Ltd., New Delhi (First Edition).
2. Alred G. J., Brusaw C. T. & Oliu B., Handbook of Technical Communication, Oxford University Press, New Delhi (Second Edition).
3. IEEE Editorial Style Manual, IEEE Standards Association, IEEE, USA (Latest Edition).
4. Joseph G. & Joseph B., Grammar and Usage for Technical Communication, Cambridge University Press India, Delhi (First Edition).

E Resources :

1. NPTEL–SWAYAM, IIT Roorkee, Technical Communication for Engineers.
2. https://owl.purdue.edu
3. https://ieeeauthorcenter.ieee.org

Mapping of COs with POs & PSOs:

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
4SH220AE1.1	-	-	-	-	-	-	-	-		3	-			
4SH220AE1.2	-	-	-	-	-	-	-	-	3	3	-			
4SH220AE1.3	-	-	-	-	-	-	-	3		3	3			
4SH220AE1 CO	-	-	-	-	-	-	-	1	1	3	1			

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code:	**3SH210VE1**	Course Category:	**VEC**
Course Name	**Constitutional Values and Fundamental Duties**			
Credits	**02**	Total L:T:P Hours	2:0:0 **30 Hrs**	Total SL Hours **30 Hrs**
Total Credit Hours	**60 Hrs**			
SEE Marks	**--**	SEE Time	**--**	CIA Marks **--**
EE Marks	**25**	PA Marks	**25**	Total Marks **50**

Course Description:
Subject Code 3SH210VE1 Constitutional Values and Fundamental Duties is a compulsory Valus enhancement Course for Second Year B. Tech.

Course Objectives:
The objective of the course is to introduce the Indian Constitution, its historical background, fundamental values, rights, and duties.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
3SH210VE1.1	Explain the historical background, making, and significance of the Indian Constitution to Understand the Constitution, Preamble, and core values.	C2
3SH210VE1.2	Interpret Fundamental Rights and Duties (Articles 12–35, 51A) to evaluate their implications through case studies in professional and civic life.	C3
3SH210VE1.3	Apply constitutional principles to engineering ethics, sustainability concerns (Articles 48A, 51A(g)), and demonstrate social commitment, innovation, and inclusive growth as nation builders.	C3

Course Contents:

Unit 1	**Introduction to the Constitution and Fundamental Values**: Overview of the Indian Constitution – Historical background and making of the Constitution; Meaning of Constitution; Preamble – Meaning and significance. Core Constitutional Values – Justice (Social, Economic, Political); Liberty (thought, expression, belief, faith, worship); Equality (status and opportunity); Fraternity (dignity and unity of the nation). Relevance of constitutional values for professionals and citizens.	10 Hrs
Unit 2	**Fundamental Rights and Duties**: Fundamental Rights (Articles 12–35) – Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies. Fundamental Duties (Article	10 Hrs

	51-A) – Importance and implications; Role of youth and professionals in upholding duties. Case studies highlighting real-life significance of rights and duties.	
Unit 3	**Application of Constitutional Values in Engineering and Public Life**: Ethical Responsibilities and Constitutional Alignment – Engineering ethics and public interest; Environment and sustainability as constitutional concern (Articles 48A, 51A(g)); Engineers as nation builders – Social commitment, innovation, and inclusive growth.	10 Hrs

Text Books:

1. Basu D. D., Introduction to the Constitution of India, LexisNexis Publication, New Delhi (Twenty-Third Edition).
2. Jain M. P., Constitution of India, LexisNexis Publication, New Delhi (Eighth Edition).
3. Laxmikanth M., Indian Polity, McGraw Hill Education, New Delhi (Sixth Edition).
4. Austin Granville, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, New Delhi.
5. Shukla V. N., Constitution of India, Eastern Book Company, Lucknow (Twelfth Edition).
6. Government of India, Constitution of India (Bare Act), Government of India Publication, New Delhi.

Reference Books:

1. Subhash Kashyap, Our Constitution, National Book Trust, New Delhi.
2. Durga Das Basu, Shorter Constitution of India, LexisNexis Publication.
3. P. M. Bakshi, The Constitution of India, Universal Law Publishing.
4. J. N. Pandey, Constitutional Law of India, Central Law Agency.
5. Seervai H. M., Constitutional Law of India, N. M. Tripathi Pvt. Ltd. (Vols. I–III).
6. B. Shiva Rao, The Framing of India's Constitution: A Study, Indian Institute of Public Administration.
7. D. C. Wadhwa, Political Science and Constitutional Law, Eastern Book Company.
8. Madhav Khosla, The Indian Constitution: Oxford India Short Introductions, Oxford University Press.

E Resources :

1. NPTEL course on Constitutional Studies, Prof. Sudhir Krishnaswamy, National Law School of India University
2. Constitutional Values and Fundamental Duties (University of Delhi – aligned with NEP 2020, available via NPTEL/DU open learning) https://kmc.du.ac.in/kmcouter/collnews/download/40727448169063791359.pdf/LinkedContents/pdf/All/All

Mapping of COs with POs & PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
3SH210VE1.1	3	2	-	1	-	-	-	-	-	-	-	2	2	
3SH210VE1.2	-	3	2	2	-	2	3	3	-	-	-	3	2	-
3SH210VE1.3	-	-	3	3	-	2	3	2	-	2	-	3	3	2
3SH210VE1CO	1	2	2	2	-	2	2	2	-	1	-	3	2	1

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **4CE222VE1**		Course Category: **VEC**		
Course Name	**Environmental Science**				
Credits	**02**	Total L:T:P etc. Hours	2:0:0 **30 Hrs**	Total SL Hours	**30 Hrs**
Total Credit Hours	**60 Hrs**				
SEE Marks	**30**	SEE Time	**02 Hr**	CIA Marks	**20**
EE Marks	**--**	PA Marks	**--**	Total Marks	**50**

Course Description:

Subject Code 4CE222VE1 Environmental Science is a Value Educational Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:

The objective of this course is to develop awareness of the environment, natural resources, and sustainability, including environmental issues, laws, and individual roles in promoting sustainable living.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH214PC1.1	Explain environmental concepts, renewable and non-renewable resources, associated problems, and the role of individuals in conservation to promote responsible resource management for sustainable living.	C-2
4CH214PC1.2	Analyze major types of pollution, their causes, effects, and control measures along with disaster management strategies to develop awareness and proactive prevention skills.	C-4
4CH214PC1.3	Evaluate sustainable development practices, environmental protection acts, and the roles of NGOs and engineers to enhance legal understanding and responsible environmental decision-making.	C-5

Course Contents:

Unit 1	**Environmental Concept and Resource Management:** Environmental Science Definition, scope and importance. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable life styles.	10 Hrs

Unit 2	**Environmental Pollution:** Pollution: Definition, Causes, Effects and control measure of (a) Air Pollution, (b) Water Pollution, (c) Soil Pollution (d) Noise Pollution (e) Nuclear hazards. Solid waste Management: 3R's Principles (Reduce, Reuse, Recycle), Method and significance. Disaster Management: Floods, earth quake, cyclone and landslides.	10 Hrs
Unit 3	**Sustainable Development and the Environment:** Sustainable Development- Definition, need and importance, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people. Environment Protection Act. Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Role of Institutions, NGO's, Engineers in implementation.	10 Hrs

Text Books:

1. Erach Bharucha, Textbook for Environmental studies, Universities Press (India),1st Edition, 2005.
2. Dr. Shanta Satyanarayan, Dr. Suresh Zade, Dr. Sitre & Dr. Meshram, A Textbook of Environmental studies, Allied Publishers Pvt. Ltd., New Delhi First edition, 2009.

Reference Books:

1. Dr. S. V. S. Rana, Essentials of Ecology and Environmental Science, PHI Learning Pvt. Ltd, Delhi .
2. Anil Kumar De, Environmental Chemistry, Wiley Eastern Limited.
3. T.G. Miller, Environmental Science, Wadsworth Publishing Co, 13th edition.
4. P. D. Sharma, Ecology and Environment, P. D. Sharma, Rastogi publications .
5. Dr. D.D. Mishra, Fundamental concepts in Environmental studies, . S. Chand publications.
6. A. Kaushik and C. P. Kaushik, Perspectives in environmental Studies, New Age International (P) Limited.

E-Resources:

1. https://nptel.ac.in/courses/127105018 NPTEL
2. https://nptel.ac.in/courses/103107215 NPTEL
3. https://onlinecourses.nptel.ac.in/noc19_ge23/preview NPTEL
4. https://onlinecourses.nptel.ac.in/noc23_hs155/preview NPTEL

Mapping of COs with Pos:

CO	PO											PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
4CH214PC1.1	3	2	-	-	-	3	-	-	-	-	-	3	2	-
4CH214PC1.2	3	3	-	2	-	3	-	-	-	-	-	3	3	-
4CH214PC1.3	3	2	3	-	-	3	-	-	1	-	-	3	3	-
4CH214PC1 CO	3	2	1	1	-	3	-	-	-	-	-	3	3	-

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **4CH223DH1**		Course Category: **DH**		
Course Name	**Biogas- Production Process Engineering**				
Credits	**04**	Total L:T:P etc. Hours	4:0:0 **60 Hrs**	Total SL Hours	**60 Hrs**
Total Credit Hours	**120 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**--**	PA Marks	**--**	Total Marks	**100**

Course Description:

Subject Code 4CH223DH1 Biogas- Production Process Engineering is a Double Minor / Honours in Chemical Engineering for Second Year B. Tech.

Course Objectives:

The objective of this course is to provide the knowledge about properties, composition, features of bio-fuels and uses of biomass and their environmental impacts.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH223DH1.1	Explain the biological foundations and chemical reactions of anaerobic digestion and characterize common feedstocks for biogas production.	C-3
4CH223DH1.2	Analyze and model biogas production using mass and energy balances along with basic bio-kinetic models such as Monod-type to evaluate process performance and efficiency.	C-4
4CH223DH1.3	Select and size appropriate anaerobic reactor configurations (e.g., CSTR, UASB, plug-flow, covered lagoons) for a given feedstock and loading.	C-4
4CH223DH1.4	Propose pre-treatment, co-digestion and process-control strategies to maximize methane yield and operational stability.	C-3
4CH223DH1.5	Evaluate biogas cleaning, upgrading, and utilization to assess their performance and energy efficiencies.	C-4
4CH223DH1.6	Assess environmental, economic, safety, and regulatory aspects of biogas plants and conduct a basic techno-economic and environmental evaluation for sustainable project appraisal.	C-4

Course Contents:

Unit 1	**Introduction, Feedstocks & Biogas Fundamentals:** Global context: role of biogas in waste management and renewable energy Feedstock types: animal manure, sewage sludge, MSW (organic fraction), food waste, energy crops, agro-industrial residues	10 Hrs
Unit 2	**Characterization of feedstocks :** TS, VS, C:N ratio, biodegradability, inhibitors Biogas composition and properties, calorific value, energy content	10 Hrs
Unit 3	**Microbiology & Biochemical Pathways :** Stages of anaerobic digestion: hydrolysis, acidogenesis, acetogenesis, methanogenesis, Microbial groups and syntrophy Inhibitors and toxicity Batch and continuous biochemical kinetics	10 Hrs
Unit 4	**Reactor configurations and their applications:** CSTR, continuous stirred tank, plug-flow, UASB, fixed-film, anaerobic lagoons, dry digesters Key design parameters: HRT, OLR, SRT, mixing, gas hold-up, temperature regimes	10 Hrs
Unit 5	**Feedstock Handling, Pre-treatment & Co-digestion:** Collection, transport, storage and homogenization of substrates Mechanical, thermal, chemical and biological pre-treatments (e.g., grinding, steam explosion, alkaline treatment, enzymatic addition) Co-digestion principles and benefits; substrate compatibility and blend design Solids handling and digestate management	10 Hrs
Unit 6	**Biogas Cleaning, Upgrading & Utilization:** Gas cleaning: H_2S removal, moisture removal, siloxane removal, particulate filtration Upgrading for biomethane: water wash, pressure swing adsorption, membrane separation, chemical scrubbing Utilization: CHP systems, gas engines, boilers, fueling vehicles, pipeline injection basics Storage and compression; safety issues for handling gas	10 Hrs

Text Books:

1. D. Deublein & A. Steinhauser, Biogas from Waste and Renewable Resources: An Introduction, 2nd ed., Wiley, (latest edition).
2. A. Wellinger, J. D. Murphy & D. Baxter (eds.), The Biogas Handbook: Science, Production and Applications, Woodhead/Elsevier, 2013.
3. B. E. Rittmann & P. L. McCarty, Environmental Biotechnology: Principles and Applications, 2nd ed., McGraw-Hill, 2020.

Reference Books:

1. M. H. Gerardi, The Microbiology of Anaerobic Digesters, Wiley, 2003.
2. P. N. Hobson & A. Wheatley, Anaerobic Digestion: Modern Theory and Practice, Elsevier, 1993.
3. L. Appels, Review Articles on Principles and Potential of Anaerobic Digestion, Progress in Energy and Combustion Science, 2008.

E-Resources:

1. Bioenergy Resources – Manuals and global bioenergy databases. http://www.fao.org
2. TERI (The Energy and Resources Institute) – Case studies and publications on Indian biofuels. https://www.teriin.org

Mapping of COs with POs & PSOs:

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
4CH223DH1.1	3	2	3	2	3	3	-	-	-	-	-	2	2	-
4CH223DH1.2	3	-	2	-	3	2	-	-	-	-	-	3	3	-
4CH223DH1.3	-	-	2	-	3	2	-	-	-	-	-	3	3	2
4CH223DH1.4	3	2	3	2	3	3	-	-	-	-	-	3	3	2
4CH223DH1.5	3	-	2	-	3	2	-	-	-	-	-	3	3	2
4CH223DH1.6	-	-	2	-	3	2	-	-	-	-	-	3	3	2
3CH211DH1 CO	2	1	2	1	3	2	-	-	-	-	-	3	3	1

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **4CH223DH2**		Course Category: **DH**		
Course Name	**Fire Safety & Explosion Control**				
Credits	**04**	Total L:T:P etc. Hours	4:0:0 **60 Hrs**	Total SL Hours	**60 Hrs**
Total Credit Hours	**120 Hrs**				
SEE Marks	**60**	SEE Time	**3 Hrs**	CIA Marks	**40**
EE Marks	**-**	PA Marks	**-**	Total Marks	**100**

Course Description:
Subject Code 4CH223DH2 Fire Safety & Explosion Control is a Double Minor / Honours in Chemical Engineering for Second Year B. Tech.

Course Objectives:
The objective of the course is to introduce the physical and chemical basis of fires and explosions, hazard assessment and control, and train students in fire protection, regulatory compliance, and emergency response for industry-ready safety and design skills.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH223DH2.1	Perform explanation of fire fundamentals and key combustion properties to understand fire behavior.	C-2
4CH223DH2.2	Describe fire dynamics and heat transfer in industrial fires to understand industrial fire behavior	C-1
4CH223DH2.3	Differentiate of explosion types to outline their industrial consequences.	C-4
4CH223DH2.4	Identify fire detection and suppression systems to select appropriate agents.	C-3
4CH223DH2.5	Suggest explosion prevention and mitigation measures to minimize industrial hazards.	C-5
4CH223DH2.6	Interpretate lessons from major accidents to apply qualitative fire risk assessment.	C-3

Course Contents:

Unit 1	**Fire science & fundamentals:** Fire triangle & tetrahedron, stages of fire development; Fuel–oxidizer chemistry, heat of combustion, flammability, flash point & autoignition; Flammability limits (LEL/UEL), vapor pressure, ignition energy; Flame types (premixed, diffusion), flame temperature basics.	10 Hrs
Unit 2	**Combustion behavior, fire dynamics & heat transfer:** Heat transfer mechanisms in fires (conduction, convection, radiation) and their role in fire spread; Pool fires, jet fires and flash fires: physical characteristics, burning rates, flame height correlations; Thermal radiation: view factors, simple radiation flux estimation for pool fires; Fire growth in enclosures and venting	10 Hrs

	basics.	
Unit 3	**Explosion phenomena and effects :** Deflagration vs detonation; blast wave basics and overpressure effects on structures/people; BLEVE (Boiling Liquid Expanding Vapor Explosion) mechanism and consequences; Vapor cloud explosions (VCE) congested vs open areas; Dust explosions: ignition sources, K_{st} concept and dust layering hazards.	10 Hrs
Unit 4	**Fire detection, suppression & protection systems :** Detection technologies: smoke, heat, flame detectors; fire & gas detection networks; Extinguishing media: water (sprinklers), foam (types and selection), dry chemical, CO_2, clean agents — strengths & limitations; Fixed systems: deluge, pre-action, foam suppression for hydrocarbon fires; mobile extinguishers selection; Fire water demand (qualitative), hydrant & hose-reel basics.	10 Hrs
Unit 5	**Explosion prevention & mitigation :** Inerting and purging for flammables; atmosphere control; LFL avoidance; Explosion venting (conceptual), suppression, flame arrestors, isolation valves; Relief systems for overpressure: conceptual sizing considerations (API/ASME approach overview — qualitative), safe disposal (flares, recovery); Plant layout & spacing: separation, bunding, domino effect limitation.	10 Hrs
Unit 6	**Occupational Health Management & Legislation:** Overview of relevant standards & codes (NFPA, API/ASME guidance, IEC/ISO pointers basics); Industrial case studies (Flixborough, Piper Alpha, selected refinery fires); engineering failures and preventive measures; Fire & emergency planning basics: evacuation, mutual aid, drills and response roles; Introduction to fire risk assessment: qualitative screening credible.	10 Hrs

Text Books:

1. J. A. Purkiss, Long-Yuan Li, Fire Safety Engineering Design of Structures, Third Edition, Taylor & Francis, 2013.
2. Christopher J. Wieczorek, Daniel T. Gottuk, SFPE Handbook of Fire Protection Engineering, Springer, 2015.
3. A.K. Das, Principles of Fire Safety Engineering Understanding Fire and Fire Protection, PHI Learning Pvt. Ltd, 2020.

Reference Books:

1. Rolf K. Eckhoff, Dust Explosions in the Process Industries Identification, Assessment and Control of Dust Hazards, Gulf Professional Publishing, 2003.
2. Dennis P. Nolan, Handbook of Fire and Explosion Protection Engineering Principles for Oil, Gas, Chemical, and Related Facilities, Gulf Professional Publishing, 2018.
3. NFPA 921, Guide for Fire and Explosion Investigations, NFPA, 2008.

E-Resources:

https://onlinecourses.nptel.ac.in/noc24_me31/preview

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
4CH223DH2.1	3	2	2	2	3	2	-	-	2	-	-	3	2	-
4CH223DH2.2	3	3	2	3	3	2	-	-	2	-	-	3	2	-
4CH223DH2.3	3	3	3	2	2	3	-	-	2	-	-	3	3	2
4CH223DH2.4	2	2	3	2	3	2	-	2	3	2	-	3	3	2
4CH223DH2.5	2	2	3	2	3	3	-	2	2	2	-	3	3	2
4CH223DH2.6	2	3	3	3	2	3	-	2	3	-	-	3	3	2
4CH223DH2 CO	3	3	3	2	3	3	-	-	2	-	-	3	3	-

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **5CH224EC1**		Course Category: **EC**		
Course Name	**Fluidization Engineering**				
Credits	**04**	Total L:T:P etc. Hours	2:0:4 **90 Hrs**	Total SL Hours	**30 Hrs**
Total Credit Hours	**120 Hrs**				
SEE Marks	**30**	SEE Time	**2 Hrs**	CIA Marks	**20**
EE Marks	**25**	PA Marks	**25**	Total Marks	**100**

Course Description:
Subject Code 5CH224EC1 Fluidization Engineering is an Exit course in Chemical Engineering for Second Year B. Tech.

Course Objectives:
The objective of this course is to introduce the fundamentals of fluidization and fluidized bed hydrodynamics. It also covers heat and mass transfer characteristics and basic industrial applications of fluidized bed systems.

Course Outcomes:
After completing the course students will be able to:

CO	Course Outcome	Domain Level
5CH224EC1.1	Explain the basic concepts of fluidization to identify fluidization regimes and describe industrial applications of fluidized beds.	C-2
5CH224EC1.2	Interpret of bed hydrodynamics and the role of distributors to explain simple entrainment and elutriation behavior.	C-3
5CH224EC1.3	Describe mass transfer in fluidized beds to explain the working principles of major industrial fluidized bed systems.	C-2

Course Contents:

Unit 1	**Fundamentals of Fluidization:** Introduction to multiphase systems- Concept of fluidization & fluidized bed behavior- Fixed → Expanded → Fluidized bed transition- Types of fluidizations (particulate, aggregative – simple diagrams)- Minimum fluidization velocity (UMF): concept, significance, simple numerical- Fluidization regimes: bubbling, slugging, turbulent (qualitative only)- Industrial applications: fluidized bed dryer, FBC, FCC, gasifier	10 Hrs
Unit 2	**Hydrodynamics & Contacting in Fluidized Beds:** Pressure drop in fluidized beds- Bed expansion characteristics- Bubble formation in fluidized beds (simple explanation)- Particle mixing and segregation- Entrainment & elutriation: simple concept, cyclone role- Gas–solid contacting efficiency- Distributors: purpose, types, easy design considerations	10 Hrs

Unit 3	**Heat/Mass Transfer & Industrial Systems:** Better heat and mass transfer in fluidized beds: brief reasons- Gas–solid contact area and mixing: simple effects- Working principle of a fluidized bed dryer- Fluidized bed combustor (FBC): basic working- FCC reactor: simple catalyst circulation- Scale-up basics: avoiding slugging, selecting particle size- Short case examples: Dryer, FCC, Gasification	10 Hrs

List of Practicals:

Minimum Eight practical's from the list mentioned below.

1. Introduction to fluidization equipment and safety.
2. Visual study of fluidization behavior (fixed → bubbling → slugging).
3. Determination of minimum fluidization velocity (UMF).
4. Pressure drop in fixed bed.
5. Pressure drop in fluidized bed.
6. Bed expansion study with varying superficial velocities.
7. Effect of particle size on fluidization characteristics.
8. Effect of particle density on fluidization.
9. Study of bubble formation and regimes
10. Study of distributor plates (perforated vs nozzle types).

Textbooks:

1. D. Kunii, Octave Levenspiel., "Fluidization Engineering", Elsevier, 2013

Reference Books:

1. Wen-Ching Yang, "Handbook of Fluidization and Fluid-Particle Systems" Marcel Dekker, INC, 2003.
2. John R. Grace, "Essentials of Fluidization Technology" Wiley-VCH, 2020.
3. John G. Yates , Paola Lettieri, "Fluidized-Bed Reactors: Processes and Operating Conditions" Springer, 2016.
4. Howard, J.R. "Fluidized Bed Technology: Principles and Applications" Taylor & Francis, 1989

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ch41/preview
2. http://kcl.digimat.in/nptel/courses/video/103103132/lec1.pdf
3. https://uorepc-nitk.vlabs.ac.in/exp/flow-through-fluidized-bed/
4. https://learncheme.com/virtual-laboratories/
5. https://www.vlab.co.in/broad-area-chemical-engineering

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
5CH224EC1.1	3	2	2	1	2	2	-	-	1	-	-	3	3	2
5CH224EC1.2	3	3	2	3	3	2	-	-	1	-	-	3	3	1
5CH224EC1.3	3	2	3	2	3	2	-	-	2	-	-	3	3	2
5CH224EC1 CO	3	2	2	2	3	2	-	-	1	-	-	3	3	2

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Level: **5**	Course Code: **5CH225EC1**		Course Category: **EC**		
Course Name	**Chemical Process Utilities**				
Credits	**02**	Total L:T:P Hours	2:0:0 **45 Hrs**	Total SL Hours	**45 Hrs**
Total Credit Hours	**90 Hrs**				
SEE Marks	**30**	SEE Time	**3 Hrs**	CIA Marks	**20**
EE Marks	**--**	PA Marks	**--**	Total Marks	**50**

Course Description:

Subject Code 5CH225EC1 Chemical Process Utilities is a compulsory Exit Course for Second Year B.Tech. Chemical Engineering.

Course Objectives:

The objective of this course is to impart fundamental knowledge of industrial utilities and to familiarize students with maintenance, equipment handling, and safety practices essential for efficient operation of chemical process plants.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
5CH225EC1.1	Interpret the role of process utilities and the major treatment methods used for industrial water.	C-2
5CH225EC1.2	Analyze refrigeration systems, refrigerants, cooling towers, and psychrometric processes used in chemical industries.	C-4
5CH225EC1.3	Apply standard maintenance methods to ensure reliable and safe operation of chemical process plant equipment.	C-3

Course Contents:

Unit 1	**Introduction to Chemical Process Utilities and Water Utility:** Significance of Process Utilities, Classification, Selection criteria for utilities, Role of utilities in process design and operation. Water as a utility in process industries, types, Sources, Properties, and uses of water of industrial water, Methods of water softening processes, Lime soda process (cold and hot), Zeolite process, Ion exchange process and Reverse Osmosis.	10 Hrs
Unit 2	**Refrigeration, Air Conditioning & Cooling Systems:** Refrigeration principles, properties, selection, environmental impact of Refrigerants, Carnot and Reverse Carnot Cycle, Bell Coleman air refrigeration Cycle, Vapor compression, absorption refrigeration, Induced and forced draft Cooling Tower, Psychrometry, classification of Humidity, Sling Psychrometer, Psychrometric Chart, Psychrometric Process, Humidification and dehumidification.	10 Hrs

Unit 3	**Plant Maintenance & Safety Utilities:** Introduction to plant maintenance, Classification, Duties and responsibility of plant maintenance department, Electrical & instrumentation maintenance, Maintenance Planning and Scheduling, Maintenance of Mechanical Equipment, Compressors, Cooling towers and Boiler Online maintenance of pump and rotameter, Safety in Maintenance.	10 Hrs

Text Books

1. Lyle, O., Efficient Use of Steam, HMSO, 1963.
2. Stoccker, W.F., Refrigeration and Air Conditioning, Mc-Graw Hill, 1950. 5.
3. Kurl, W.F. J.H.M., Reuse of Water in Industry, Butterworth, London.
4. James K. Carson, Refrigeration, Theory and Applications Mc. Graw Hill, New York, 2009, ISBN: 078-87- 403-0363-6
5. Powel S. T., Industrial Water Mc. Graw Hill, New York, 2009, ISBN 9781118843727

Reference Books

1. Nordell,Eskel."Water Treatment for industrial and other uses" Reinhold Publishing Corporation, New York (1961).
2. Plant Utilities by Dr. Mujawar, Nirali Prakashan Publication.
3. Plant Utilities by D.B. Dhone, Nirali Prakashan Publication.
4. P.L.Balleney, Thermal Engineering, Khanna Publisher, New Delhi
5. Sathiyamoorthy Manickkam, Chemical Plant Utilities by Lambert Academic Publishing
6. R. K. Jain, Plant maintenance engineering and management by Khanna Publication
7. Efficient Use of Steam, Oilver Lyle Prentice Hall 1963

E- Resources

1. https://www.intarcon.com/en/refrigeration-system/
2. https://onlinecourses.nptel.ac.in/noc23_me31/preview
3. https://home.iitk.ac.in/~gtm/thermodynamics/ui/Course_home-3
4. https://onlinecourses.nptel.ac.in/noc23_me31/preview

Mapping of COs with POs and PSOs

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
5CH225EC1.1	3	2	-	-	-	3	-	-	-	-	2	3	2	-
5CH225EC1.2	3	3	2	2	2	2	-	-	-	-	2	3	3	-
5CH225EC1.3	2	2	3	-	2	3	2	-	-	-	2	3	3	2
5CH225EC1.CO	3	2	2	2	2	3	2	-	-	-	2	3	3	2

Correlation levels- 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)