

Jawaharlal Darda Institute of Engineering & Technology, Yavatmal (Autonomous College)
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-I	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	3CH209EM	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	3CE001NC1	2	0	0	0	2	-										
Total				19	0	10	17	46	22			450				300		750	
Notional Learning Hours : [Workload (teaching/guidance/practicum) 27x15 = 405 Hrs] + [Learner-engaged time 17x15 = 255 Hrs]																			
Optional Course for Double Minor / Honours Degree																			
12	Double Minor / Honours Course - I	DH	3_211DH	3	0	0	3	6	3	60	40	100	40					100	3 Hrs.

Semester - IV (Second Year)

[illegible]

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	Total SL Hours	45 Hrs
Total Credit Hours	90 Hrs		45 Hrs		
SEE Marks	60	SEE Time	3 Hrs	CIA Marks	40
EE Marks	--	PA Marks	--	Total Marks	100

(13,14,35,50-PO1,PO2&PO3)(Cognitive)-[PO4,PO5,PO6&PO11][Psychomotor&Affective]

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	C-5

	energy balance calculations for practical engineering equipment.	
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	8 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.	7 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.	8 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.	7 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
6. P.K. Nag, Engineering Thermodynamics.

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.bookekey.app/files/pdf/book/en/thermodynamics-by-enrico-fermi.pdf>

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

(4,13,16,35- PO1,PO2 & PO3 Cognitive & PO4,PO5 Psychomotor PO6 Affective)

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	C-4

	characterize molecular structure and determine chemical properties.	
3CH202PC1.6	Examine electrochemical concepts, cell types and conductometric-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

1. <http://www.rnlkwc.ac.in/pdf/studymaterial/chemistry/Spectroscopy.pdf>
2. https://web.iitd.ac.in/~sdeep/Spectroscopy_lecture_1_2.pdf
3. <https://www.bcebhagalpur.ac.in/wpcontent/uploads/2020/03/Spectroscopic-Techniques-and-Applications.pdf>
4. <http://digimat.in/nptel/courses/video/104106122/L54.html>

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

(29,31,41-PO1 to PO5) Cognitive

Course Description:

Subject Code 3CH201PC Process 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: Humanerror, instrumenterror. Elements of Instruments: Primary and secondary .Transducers: definition, classification primary and secondary .Static characteristics of instruments and Dynamic characteristic. Transmitter :definition different types.	8 Hrs
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 :Ionizationgauge. 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 ultrasonicFlowmeter. , Pitot tube. Variable area flow meter,: Magnetic Flow meter, Head flow meters:Hg manometer and its type	8 Hrs
Unit 5	Level Measurements Introduction: Industrial application of Level measurement. Direct level measurement: Sight glass method, Hook auge mehod.,Differntial pressure method :Air purge mehod,. 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
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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>

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	Total SL Hours	30 Hrs
Total Credit Hours	60 Hrs		30 Hrs		
SEE Marks	30	SEE Time	2 Hrs	CIA Marks	20
EE Marks	--	PA Marks	--	Total Marks	50

(14,15,55- PO1,PO2 & PO3 Cognitive & PO6,PO7 Affective)

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:

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

1. Dr. Anand S. Bal, An introduction to Environmental Management
2. Pandey G.N. and Camey G.C.; Environmental Engineering, Tata McGraw Hill Book Co., New Delhi (1989).
3. Mahajan S.P. Pollution Control in Process Industries, Tata McGraw Hill Book Co.
4. 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

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

E- Resources

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

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

Course Description:

Subject Code 3SH205OE1 Soft Skills & Profile Building is a compulsory Open Elective Course for Second 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.	7 Hrs
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.	8 Hrs
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

Level:	5	Course Code:	3SH205OE2	Course Category:	OE
Course Name	Team Building & Management				
Credits	03	Total L:T:P Hours	3:0:0	Total SL Hours	45 Hrs
Total Credit Hours	90 Hrs		45 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

Level: 5	Course Code: 3CH206PC1			Course Category: PCC	
Course Name		Chemical Engineering Thermodynamics Lab			
Credits	01	Total L:T:P etc. Hours	0:0:2	Total SL Hours	--
Total Credit Hours	30 Hrs		30 Hrs		
SEE Marks	--	SEE Time	--	CIA Marks	--
EE Marks	25	PA Marks	25	Total Marks	50

(31,40,50&58-PO1&PO2)(Cognitive)-[PO4,PO5&PO11]/[Psychomotor&Affective]

Course Description:

Subject Code 3CH206PC1 Chemical 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>

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	Total SL Hours	--
Total Credit Hours	30 Hrs		30 Hrs		
SEE Marks	--	SEE Time	--	CIA Marks	--
EE Marks	25	PA Marks	25	Total Marks	50

(5, 10, 23, 47- PO1,PO2 Cognitive & PO4,PO5 Psychomotor PO11 Affective)

Course Description:

Subject Code 3CH207PC1 Chemical 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 relative strength of two acids by kinetic study of reaction.
7. Effect of Concentration on the rate of reaction of Sodium Thiosulphate with hydrochloric acid.
8. Effect of Temperature on the rate of reaction of Sodium Thiosulphate with hydrochloric acid.
9. Determination of strength of an unknown HCl solution potentiometrically
10. Determination of the concentration of water by using UV Spectrophotometer.

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/>

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

(29,31,41-PO1 to PO5) Cognitive, Psycomotor

Course Description:

Subject Code 3CH208PC1 Process Instrumentation 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 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 behaviour.	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 Weight Tester.
2. Measurement of level using air purge level detector.
3. Calibration of Bimetallic thermometer
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 rangeability control valve.

List of Virtual Labs:

- 1.<http://www.digimat.in/nptel/courses/video/103105064/103105064.htm>

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

(23,14,21-PO2, PO6,PO9,PO10,PO11- Cognitive)

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	<i>Explain competition in the market and the effects of inflation in the economic structure to understand their impact on economic performance.</i>	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
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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.

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
Total Credit Hours	60 Hrs		30 Hrs
SEE Marks	--	SEE Time	--
EE Marks	--	PA Marks	50
		Total Marks	50

(2,11-PO1,PO2,PO4,PO5,PO6,PO11) (Cognitive)

Course Description:

Subject Code 3SH210VE1 Constitutional Values and Fundamental Duties is a compulsory Value 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	10 Hrs
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	(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.	
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 51-A) – Importance and implications; Role of youth and professionals in upholding duties. Case studies highlighting real-life significance of rights and duties.	10 Hrs
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. Drga 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>

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

(2,18,36,25,21,20-PO1,PO2,PO3-Cognitive,PO4,P06,PO8&PO9,PO11-Psychomotor&Affective)

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	<i>Analyze</i> 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	<i>Interpret</i> 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	<i>Apply</i> 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

(Note: Students are required to select any one of the project types/domains listed below, working in groups with a minimum of 5 and a maximum of 10 members.)

Suggested Activities for Field Project / Industry Projects

(Students may select any topic relevant to their local context or interest area)

A. Waste Utilization, Resource Recovery & Sanitation

1. Organic Waste to Bio-Resources

- Field study of village/market/hostel organic waste generation.
- Designing small biodigester units or compost accelerators.
- Production of Bio-slurry fertilizers, Biogas for cooking, Compost inoculum

2. Solid Waste Segregation & Material Recovery

- Community-level waste audit.
- Building simple separation units for plastics, metals, and organics.
- Training communities on safe handling and chemical hazard identification.

3. Chemical Waste/STP/ETP Awareness

- Visits to small-scale industries for effluent assessment.
- Developing simplified flow diagrams for waste treatment.
- Advising MSMEs on safe disposal practices.

B. Clean Energy, Renewable Fuels & Rural Energy Systems

1. Biomass to Energy

- Study of agricultural residues and calorific value.
- Demonstration of: Briquetting, Torrefaction, Biogas generation, Bioethanol from starch waste

2. Solar & Thermal Applications

- Design of solar drying units for: Turmeric, onions, fruits, Herbs and medicinal plants and Chemical pre-processing materials

3. Low-Cost Fuel Alternatives

- Developing improved cook stoves with reduced indoor pollution.
- Awareness on LPG safety, fuel storage, and emission reduction.

C. Chemical Safety, Public Awareness & Community Health

1. Household and Agricultural Chemical Safety

- Training on safe handling of: Fertilizers, Pesticides, Cleaning agents and Fuels and solvents
- Demonstrating first-aid steps for chemical exposure.

2. Safe Storage & Labeling Practices

- Designing pictorial labels for low-literacy populations.
- Creating community demonstration units for safe chemical storage.

3. Engaging Schools & SHGs

- Field modules on “Chemistry in Everyday Life”: soaps, disinfectants, food additives.
- Workshops on menstrual hygiene and sanitary product disposal.

D. Water Quality, Treatment & Public Health

1. Rural/Urban Water Quality Assessment

- Field sampling of drinking water, river/pond water, borewell water.
- On-site testing: pH, hardness, turbidity, alkalinity, chlorine, TDS.
- Identification of contamination patterns (agro-chemicals, industrial effluents, iron, fluoride, nitrates).

2. Design of Low-Cost Water Purification Solutions

- Fabrication of household water filters using: Activated carbon from agro-waste, Ceramic membranes and Natural adsorbents (rice husk ash, biochar)
- Community-level chlorination and disinfection systems.

3. Awareness and Public Health Outreach

- Workshops on safe water storage, microbial contamination, and sanitation.
- Demonstrations on point-of-use purification.

E. Food Processing, Preservation & Rural Entrepreneurship

1. Low-Cost Food Processing Units

- Small units for: Oil extraction, Fruit pulp concentration, Grain cleaning and grading and Herbal extract preparation

2. Chemical Engineering behind Food Quality

- Study of: Moisture content, Acidity, Preservatives, Pasteurization and Dehydration

3. Product Development for Self-Help Groups (SHGs)

- Soap making, herbal cosmetics, disinfectants, pickles, dehydrated foods.
- Simple packaging and shelf-life improvement techniques.

F. Environmental Monitoring & Green Chemistry

1. Air Pollution Studies

- Ambient air quality measurement (dust, smoke, VOC indicators).
- Setting up low-cost particulate sensors.

2. Green Chemistry Interventions

- Promoting biodegradable materials.
- Demonstrations on replacing hazardous household chemicals with safer alternatives.

3. Climate Literacy

- Workshops on carbon footprint, waste minimization, green living.

Tentative Report Template For Field Project

Title page

- **Project Title:**
- **Student Name & Roll Number:**
- **Faculty Guide Name:**
- **Date of Submission:**

1. Introduction

- Brief Overview of the selected activity
- Why this issue was chosen

2. Objectives

- Clear statement of objectives (What problem is being addressed?)

3. Methodology

- Approach taken (Survey, Workshops, Development of Solutions, etc.)
- Tools and technology used.

4. Execution & Implementation

- Step-by-step description of how the activity was conducted.
- Challenges faced and how they were overcome.

5. Observations & Impact Assessment

- Community response and engagement levels.
- Quantitative & qualitative impact.

6. Learnings & Outcome

- Key takeaways for students.
- Skills developed and knowledge gained.

7. Suggestions & Future Scope

- Recommendations for scaling up the project.
- How Technology can further enhance the solution.

8. References & Acknowledgements

- Research materials, website, or experts consulted.
- Acknowledgment of community members or organizations who contributed.

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

Course Description:

Subject Code 3AL001NC1 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 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	12 hrs
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 and Area or Sector
- 3) A Case study on Disaster Management

E Recourses:

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

5	Course Code: 3CH211DH1		Course Category: DH		
Level:					
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

(55, 57, 58 - PO1, PO3 & PO5)(Cognitive)

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 pre-treatment to enable effective conversion processes.	C-4
3CH211DH1.3	Compare bio ethanol and bio butanol 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.	

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>

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	Total SL Hours	45 Hrs
Total Credit Hours	90 Hrs		45 Hrs		
SEE Marks	60	SEE Time	3 Hrs	CIA Marks	40
EE Marks	-	PA Marks	-	Total Marks	100

(6,15,19,25,-PO1,PO3,PO6,PO8,9,PO11) Cognitive, Affective

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	8 Hrs

	exposure durations from TLV values	
Unit 3	Chemical Exposure Assessment & Controls: Routes of exposure (inhalation, dermal, ingestion); monitoring strategies (air sampling, direct-reading instruments, biological monitoring); hierarchy of controls. Skill: Interpret MSDS and prepare a hazard communication chart (GHS labels).	7 Hrs
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:

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

E-Resources:

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

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

(1,2,5,9- PO1,PO2,PO3,PO4&PO5-Cognitive & Psychomotor)

Course Description:

Subject Code 4CH214PC1 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 behaviour 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,	8 Hrs
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	Euler's equation.	
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.	8 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. Von- Karman integral equation.	8 Hrs
Unit 4	Flow Measurement: Flow measuring devices for chemical plants: Orifice meter, Venturimeters, Rotameter, Pitot tube and rectangular & V-Notches.	7 Hrs
Unit 5	Fluid Moving Machinery: Pressure drop in Pipe fitting and valves, Friction Construction, working and characteristic features of various types of pumps like reciporating pump, rotary pump, Centrifugal pump, compressors, blowers and fans.	7 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.	7 Hrs

Text Books:

1. K. A. Gavhane, Fundamentals of Chemical Engineering and Materials, 1st Edition (2024).
2. W. L. McCabe, J. C. Smith, P. HarriottP., 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>

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

(1,2,3-PO1,PO2,PO3,PO4,PO5) (Cognitive)

Course Description:

Subject Code 4CH210PC Chemical Engineering Operations 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.	7 Hrs
Unit 2	Classification: Equal falling particles, equipments, jigging, tabling. Gravity settling, drag force, terminal settling velocity. Sedimentation: Continuous thickeners.	8 Hrs
Unit 3	Storage and handling of solids, transportation by means of positive and negative pressure Mixing principle, mixers, agitation, types of agitators	7 Hrs

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.	8 Hrs
Unit 5	Centrifuges: Theory, Equipment's, types and calculations. Cyclones: Hydro cyclones, liquid scrubbers and electrostatic precipitators.	7 Hrs
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>

Level: 5	Course Code: 4CH214PC1			Course Category: PCC	
Course Name	Process Calculations				
Credits	02	Total L:T:P Hours	2:0:0	Total SL Hours	30 Hrs
Total Credit Hours	60 Hrs		30 Hrs		
SEE Marks	60	SEE Time	3 Hrs	CIA Marks	40
EE Marks	--	PA Marks	--	Total Marks	100

(1,34,50,58-PO1&PO2)(Cognitive)-[PO4 to PO7&PO11][Psychomotor&Affective]

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
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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.	05 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.	05 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.	05 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.	05 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.	05 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	05 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, Year 2016 ISBN: 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. Chohey, 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://nptel.ac.in/courses/103105110>
7. <https://www.unitoperation.com/>
8. <https://nptel.ac.in/courses/103/103/103103165/>

Level: 5	Course Code: 4CH215MD1		Course Category: MDM		
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

(51,52,53,57-PO1 to PO6) Cognitive

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
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Text Books:

1. Anjaneyulu, D., “Air Pollution and Control Technologies”, Allied Publishers, Mumbai, 2002
2. 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 York, 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
6. Mahajan, S.P., “Pollution Control in Process Industries”, Tata McGraw-Hill, New Delhi, 1991

E-Resources:

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

Level: 5	Course Code: 4SH216OE1		Course Category: OE		
Course Name	Quantitative and Logical Reasoning				
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 4SH216OE1 Quantitative 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.	7 Hrs
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.	8 Hrs
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:

1. Arun 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

Level: 5	Course Code: 4SH216OE2			Course Category: OE	
Course Name	Critical Thinking & Decision Making				
Credits	03	Total L:T:P etc. Hours	3:0:0	Total SL Hours	45 Hrs
Total Credit Hours	90 Hrs		45 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.	7 Hrs
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.	8 Hrs
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

Level: 5	Course Code: 4CH217PC1		Course Category: PCC		
Course Name	Chemical Engineering Mechanical Operations 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

(1,2,3-PO1,PO2,PO3,PO4,PO5) (Cogninitive,Psychomotor)

Course Description:

Subject Code4CH213PC1Chemical Engineering Operations 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 the Thickener using the Sedimentation Test.
4. To Understand the Efficiency of Cyclone Separator.
5. To understand the sieve analysis.
6. To understand the operation of Trammel.
7. To Understand To Study the operation of Jigging.
8. To Understand the Screw Conveyor.

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

(8,16,17-PO1,PO2,PO4&PO5-Cognitive & Psychomotor)

Course Description:

Subject Code 4CH218PC1 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. vlab.co.in/participating-institute-iiit-hyderabad
2. <https://fm-nitk.vlabs.ac.in/List%20of%20experiments.html>
3. vlab.co.in/participating-institute-nitk-surathkal

Level: 5	Course Code: 4CH219VS1			Course Category: VSC	
Course Name		Machine Design & Drawing			
Credits	02	Total L:T:P etc. Hours	0:0:4	Total SL Hours	30 Hrs
Total Credit Hours	60 Hrs		30 Hrs		
SEE Marks	--	SEE Time	--	CIA Marks	--
EE Marks	--	PA Marks	50	Total Marks	50

(9,13,27-PO1,PO2,PO3,PO4,PO5,PO6,PO8,PO11-Cognitive,Psychomotor & Affective)

Course Description:

Subject Code 4CH2119VS1 Machine Design & Drawing is a Vocational and Skill Enhancement Course for Second Year B. Tech. Chemical Engineering.

Course Objectives:

The objective of this course is to understand background in mechanics of materials-based failure criteria underpinning the safety-critical design of machine components. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CH2119VS1.1	Prepare the design data, design analysis, and design synthesis.	C-2 & P-2
4CH2119VS1.2	Apply design standards for the proposed design safety	C-3 & P-5
4CH2119VS1.3	Analyse and perform the design assignment, their aims and objectives, scope, special emphasis and limitation.	C-4 & P-6

List of Practicals:

Minimum eight free hand drawing sheets from the list mentioned below.

1. Traditional design methods, Design process.
2. Design analysis and Design synthesis.
3. Limits, Fits and tolerances.
4. Stress concentration and notch sensitivity in materials.
5. Stress-Strain diagram, Soderberg diagrams.
6. Design & Drawing of Riveted joints.
7. Design & Drawing of Welded joints.
8. Design & Drawing of Thin Pressure Vessel.
9. Design & Drawing of Thick Pressure Vessel.
10. Design & Drawing of Spherical Shells

Text Books:

1. Bhatt, N. D., *Machine Drawing*, Charotar Publication, 2003.
2. Khurmi, R. S., *Machine Design*, S. Chand Publication, 2005

Reference Books:

1. Dr. P. C. Sharma & Dr. D. K. Agrawal, Machine Design Katsons Book publication.
2. C. S. Sharma, Kamlesh Purohit, Design of Machine elements PHI publication.
3. V. B. Bhandari, Design of Machine elements, Tata McGraw Hill Publication.
4. Jindal, Machine Design, Pearson publications.

E-Resources:

1. <https://eg-dei.vlabs.ac.in/>
2. <https://www.vlab.co.in/broad-area-chemical-engineering>
3. <https://www.udemy.com/course/mechanical-engineering-Drawing>

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

(117,118- PO9,PO11) (Cognitive)

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. & Thimmesh 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://ieeauthorcenter.ieee.org>

Level: 5	Course Code: 4SH221EM1	Course Category: EEM
Course Name	Fundamentals of Book Keeping and Accounting	
Credits	02	Total L:T:P Hours
Total Credit Hours	60 Hrs	1:0:2 45 Hrs
SEE Marks	--	SEE Time
EE Marks	--	PA Marks
		Total SL Hours
		15 Hrs
		CIA Marks
		--
		Total Marks
		50

Course Description:

Subject Code 4SH221EM1 Fundamentals of Book Keeping and Accounting is an Ability Enhancement Course for Second Year B. Tech students that introduce basic accounting principles, bookkeeping processes, and financial statements for business applications.

Course Objectives:

The objective of the course is to develop students' skills in recording and analyzing financial transactions and to enable effective use of accounting information for decision-making.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
4SH221EM1.1	Apply basic principles of bookkeeping and accounting for recording and maintaining financial transactions accurately.	C-3 P-2 A-2
4SH221EM1.2	Analyze financial statements such as income statement, balance sheet, and cash flow statement for supporting financial understanding and business decision-making.	C-4 P-2 A-2
4SH221EM1.3	Apply accounting tools and techniques for evaluating financial performance and improving business efficiency.	C-3 P-3 A-3

Course Contents:

Unit 1	Foundation of Book keeping and Accounting Definition, objectives, and importance of accounting, Difference between accounting and bookkeeping, accounting equation, double entry system, Debit vs credit, accrual vs cash accounting, Terminology- depreciation, amortisation, CapEx vs OpEx. Source of Document (invoice, receipt, Purchase Order), Work Flow (Journal, posting to the ledger), Preparing trial balance, Software Integration- A brief overview of ERP (SAP/ oracle and tools like a tally/ quick book).	8 Hrs
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Unit 2	Financial Statements & Decision Making Income Statement, Balance Sheet, Cash flow Statement. Ratio Analysis (Current Ratio, Debt to equity, ROI), Cost Accounting (Fixed vs Variable, Break-even), Taxation Basics (Corporate IT)	7 Hrs
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List of Practicals:

Minimum eight practicals from the list mentioned below.

1. Categories a list of items (Laptop, Office Rent Deposit, Cash, Bank Loan, Software Licenses) into Assets, Liabilities, or Equity.
2. Use the Double-Entry System to record buying raw materials, paying technician wages, and receiving a client advance.
3. Identify discrepancies like uncashed cheques, bank charges, or direct deposits from clients.
4. Compare the Straight-Line Method vs. the Written Down Value (WDV) method (as per Indian Income Tax rules).
5. Distinguish between Direct Costs (raw materials, factory power) and Indirect Costs (office salary, marketing).
6. Analyze the Annual Report of an Indian tech giant (e.g., L&T or Tata Motors).
7. Calculate the Current Ratio (liquidity), Debt-to-Equity (solvency), and Return on Investment (ROI).
8. Input Fixed Costs (Rent, Machinery) and Variable Costs (Material per unit) into a spreadsheet to find the Break-Even Point.
9. Value the remaining stock after several purchases and sales using the First-In, First-Out (FIFO) method.
10. Enter 5 basic transactions into a trial version of Tally Prime or a cloud-based tool like Zoho Books

Text Books:

1. S.N. Maheshwari S.K. Maheshwari & S.K. Maheshwari., Financial Accounting, Vikas Publishing House (Eleventh Edition)
2. N. Ramachandran, Ramkumar Kakani., Financial Accounting for Management, McGraw Hill Education (Sixth Edition)

Reference Books:

1. R. L. Gupta & U. K. Gupta., Financial Accounting, Sultan Chand & Sons, (Ninth revised Edition)
2. Dr. Santanu Chakrabarty & Dr. Nilanjan Singha Roy., Accounting & Finance for engineering, Lawpoint Publications (Second Edition)
3. Bhushan Kumar Goyal., Accounting for Everyone, Taxmann Publications Pvt. Ltd (First Edition)

E Resources:

1. SWAYAM, Financial Accounting / Business Accounting
2. National Digital Library of India, <https://ndl.iitkgp.ac.in>
3. Tally Education, <https://tallyeducation>.

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

Course Description:

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

Course Objectives:

The objective of this course is to develop understanding of environmental systems, natural resource management, ecological balance, and sustainable development practices to promote awareness and responsibility toward environmental protection and societal well-being.

Course Outcomes:

After completing the course students will be able to:

CO	Course Outcome	Domain Level
4CE222VE1.1	Analyze renewable and non-renewable natural resources and associated problems to promote sustainable utilization for future generations.	C-4
4CE222VE1.2	Analyze food chains, webs, and ecological pyramids to evaluate ecological interactions and succession processes.	C-4
4CE222VE1.3	Examine shift from unsustainable to sustainable development to promote responsible resource planning for society.	C-3

Course Contents:

Unit 1	Renewable and non-renewable resources: Environmental Science, Definition, scope and importance, Need for public awareness, 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
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Unit 2	Ecosystem: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem.	10 hrs
Unit 3	Social Issues & Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions, Environment Protection Act. Air (Prevention and Control of Pollution) Act., Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, public awareness.	10 hrs

Text Books:

1. Suresh K. Dhameja, Environmental Studies, Katson Books
2. Benny Joseph, Environmental Studies, McGraw Hill Education

Reference Books:

1. Gilbert M. Masters & Wendell Ela, Introduction to Environmental Engineering and Science, Pearson Education
2. William Cunningham & Mary Cunningham, Environmental Science, McGraw Hill

E Resources:

1. <https://www.vlab.co.in/broad-area-civil-engineering>

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

(39, 55, 57, 58 – PO1, PO3, PO5, & PO6)(Cognitive)

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 ₂ S 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>

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

(3,12,30,33,58-PO1 to PO5, PO9) Cognitive, Psychomotor

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:	10 Hrs

	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 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 (worst credible scenario).	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. Wiecek, 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:

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

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

(8,13,29,60-PO1 to PO3, PO6) Cognitive

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 &	10 Hrs

	elutriation: simple concept, cyclone role- Gas-solid contacting efficiency-Distributors: purpose, types, easy design considerations	
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>

Level: 5	Course Code: 5CH225EC1			Course Category: EC	
Course Name	Chemical Process Utilities				
Credits	04	Total L:T:P Hours	2:0:4	Total SL Hours	30 Hrs
Total Credit Hours	120 Hrs		90 Hrs		
SEE Marks	30	SEE Time	2 Hrs	CIA Marks	20
EE Marks	25	PA Marks	25	Total Marks	100

(14,29,35,42,50-PO1,PO2&PO3)(Cognitive)-[PO4 to PO7&PO11][Psychomotor&Affective]

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
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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, Oliver 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