Academic Program: UG

Academic Year 2024-25

Syllabus

VII & VIII Semester B.E.

Chemical Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002
(An Autonomous Institute approved by AICTE & Affiliated to VTU, Belagavi)

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for VII & VIII semester of UG program in Chemical Engineering is recommended by Board of Studies of Chemical Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2024-25 till further revision.

Principal Chairman BoS & HoD

College Vision and Mission

SDMCET –Vision

To develop competent professionals with human values.

SDMCET – Mission

- To have contextually relevant curricula.
- To promote effective teaching learning practices supported by modern educational tools and techniques.
- To enhance research culture.
- To involve industrial expertise for connecting classroom content to real life situations.
- To inculcate ethics and impart soft skills leading to overall personality development

SDMCET- Quality Policy

- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

Vision and mission of Department

Vision

To develop proficient Chemical Engineers to meet industrial and societal needs.

Mission

1. To design the curricula in tune with industry.
2. To inculcate research culture with ethics to disseminate knowledge.
3. To collaborate with industry and academia for sustainable growth.

Program Educational Objectives (PEOs)

The Chemical Engineering UG Programme at SDMCET is framed and designed such that within first few years after graduation, the graduates will be able to:

- **I.** Analyze, design and professionally practice in the area of Chemical Engineering and allied disciplines by acquiring good knowledge of basic sciences and Chemical Engineering.
- **II.** Create applications to solve real-life problems of Chemical Engineering in a broad range of career path to fulfill ethical, economical, environmental and social responsibilities.
- **III.** Pursue higher studies and carry out research in Chemical Engineering and allied Engineering and Management.
- **IV.** Work in multidisciplinary teams with good communication skills and leadership qualities to solve engineering problems and develop entrepreneural skills.

Program Outcomes (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific outcomes (PSOs)

13. **Plant operations and Control:** Conceptualize the knowledge and information gained in mass and energy balance, thermodynamics, transport phenomena, kinetics, unit operations, process control, equipment design that can be used in design, control and optimizing the Chemical processes.
14. **Quality, Feasibility and impact studies:** Develop an integrated process and modify it attributing to economy, environmental friendly, ethics coupled with safety by applying principles of chemical engineering.
15. **Development of engineering solutions through experiments:** Apply knowledge of chemical engineering in solving both industry and academic problems using experimental methods including design of experiments and simulation to analyze, interpret and present the data.

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD
Department of Chemical Engineering
VII Semester
Scheme of Teaching and Examinations 2024-25

Course Code	Course category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Course Credit	CIE	Theory (SEE)		Practical (SEE)	
					Max Marks	Max Marks	Duration in Hrs	Max Marks	Duration in Hrs
21UCHC700	PC	Process Dynamics and Control	3 - 0 - 0	3	50	100	3	-	-
21UCHE7XX	PE	Program Elective-3	3 - 0 - 0	3	50	100	3	-	-
21UCHE7XX	PE	Program Elective-4	3 - 0 - 0	3	50	100	3	-	-
21UCHE7XX	PE	Program elective -5	3 - 0 - 0	3	50	100	3	-	-
21UCHO7XX	OE	Open Elective-3	3 - 0 - 0	3	50	100	3	--	--
21UHUC700	HU	Research Methodology	2 - 0 - 0	2	50	50	2	--	--
21UCHL701	PC	Process Control Laboratory	0 - 0 - 2	1	50	--	--	50	3
21UCHL702	PC	Major Project Phase-1	0 - 0 - 4	2	50	--	--	50	3
Total			**17- 0 -6**	**20**	**400**	**550**	**17**	**100**	**9**
Electives									
21UCHE704	PE	Plant Utilities and Industrial safety	3-0-0	3	50	100	3	-	-
21UCHE705	PE	Transport Phenomena	3-0-0	3	50	100	3	-	-
21UCHE706	PE	Process Engineering Economics and Management	3-0-0	3	50	100	3	-	-
21UCHE707	PE	Sugar Technology	3-0-0	3	50	100	3	-	-
21UCHE708	PE	Process Modelling in Chemical Engineering	3-0-0	3	50	100	3	-	-
21UCHE709	PE	Bioprocess Engineering	3-0-0	3	50	100	3	-	-
21UCHO710	OE	Solid waste Management	3-0-0	3	50	100	3	-	-
21UCHO711	OE	Advanced waste water treatment	3-0-0	3	50	100	3	-	-
21UCHO712	OE	Nanotechnology	3-0-0	3	50	100	3	-	-

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD
Department of Chemical Engineering
VIII Semester
Scheme of Teaching and Examinations 2024-25

Course Code	Course category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Course Credit	CIE	Theory (SEE)		Practical (SEE)	
					Max Marks	Max Marks	Duration in Hrs	Max Marks	Duration in Hrs
21UCHL800	PC	Technical Seminar/Independent Study	0-0-2	1	50	--	--	--	--
21UCHL801	PC	Major Project Phase-2 (In Industry/college/ through internship)	0-0-18	9	50	--	--	50	3
21UCHL802	PC	Internship-2	4-6 Weeks	3	50	--	--	50	3
Total			**0– 0 – 20**	**13**	**150**		**--**	**100**	**3**

Total credits offered for the third year: 33

VII Semester

21UCHC700	Process Dynamics and Control	(3-0-0) 3

Contact Hours: 39

Course Learning Objective (CLO):

1. The purpose of this course is to introduce the key concepts in automation of process plants.

Course Outcomes (COs):

Description of the course outcome: At the end of the course student will be able to		Mapping to POs (1-12)/ PSOs (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Outline the basic principles and importance of process control in industrial process plants.	13	1	-
CO-2	Formulate and study dynamic models of first order system.	-	2,3	13
CO-3	Formulate and study dynamic models for second order system and lag.	-	2,10	13
CO-4	Predict closed loop behavior using block diagram and analyze control valves.	-	2	13
CO-5	Analyze controllers and determine the stability of a closed-loop feed-back control system.	-	2,3	13

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	2.0	2.0	2.0	-	-	-	-	-	-	2.0	-	-	1.4	-	-

Course Content:

Unit-I

Introduction: Process control, objectives, benefits, PID diagrams, classification of variables, control configuration, classification of control systems. Mathematical modeling, Laplace transform, types of inputs- step, impulse, linear and sinusoidal. **08 Hrs.**

Unit-II

Process Dynamics: First order systems, transfer functions - mercury in glass thermometer, level, mixing tanks, stirred tank reactors, first order system in series: interacting and non-interacting systems, linearization of non-linear first order systems. **08 Hrs.**

Unit-III

Second Order Systems: U-tube manometer, damped oscillator, response equations, terms for underdamped system, transportation lag**.** **07 Hrs.**

Unit-IV

Block Diagram: Importance, reduction rules, servo and regulatory system, closed loop transfer function.

Final Control Element: control valves, types, actuators, positioners, valve characteristics. **08 Hrs.**

Unit-V

Controllers: Transfer functions for two position, proportional, Proportional +Reset (P+I), Proportional + Rate (P+D), Proportional + Reset + Rate controller (P+I+D).

Stability: Stability criterion, Routh Hurwitz test, Root Locus method. **08Hrs.**

Reference Books:

1) Donald Coughanour and Steven Leblanc, “Process System Analysis and Control”, 3/e, McGraw Hill, New Delhi, McGraw Hill 1991.
2) Luyben, “Process Modeling, Simulation and Control for Chemical Engineers”, 2/e, McGraw Hill, 1990. ISBN -13: 978-0070391604
3) Coulson and Richardson, “Chemical Engineering” Vol, III, 3/e, Pengeman Press,2006.
4) George Stephanopoules, “Chemical Process Control” An Introduction to Theory and Practical, Pearson, New Delhi, 2014. ISBN - 9780131286290

21UHUC700	**Research Methodology**	**(2-0-0)2**

Contact Hours: 26

Course Learning Objectives (CLOs):

The students are expected to learn about the need and types of research, problem formulation, literature review, measurement, scaling, data collection, testing of hypothesis, result interpretation and report writing.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Formulate the research problem, carryout literature survey and decide the methodology.	-	2	-
CO-2	Importance of Literature survey and need to identify gaps	5	2	
CO-3	Describe measurement and scaling and data collection &report writing		3	2
CO-4	Test the hypothesis, interpret &analyze the results and write the report.		4	

CO-5	Explain the need for interpretation and report writing	-	5	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level		1.66	2	2	2.5							

Pre-requisites:

Design and Analysis of Engineering subjects related issues

Contents:

Unit-I

Research Methodology: Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology.

Defining the Research Problem: Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration. **06Hrs.**

Unit-II

Reviewing the literature: Importance of the literature review in research, how to review the literature, searching the existing literature, reviewing the selected literature and writing about the literature reviewed.

Research Design: Meaning of research design, need for research design, features of a good design, important concepts relating to research design.**05Hrs.**

Unit-III

Measurement and Scaling: Measurement in research, measurement scales, sources of error in measurement, scaling, meaning of scaling and important scaling techniques.

Data Collection: Collection of primary data, observation method, interview method, collection of data through questionnaires. **05Hrs.**

Unit-IV

Testing of Hypotheses: What is a Hypothesis? Basic concepts concerning testing of hypotheses, procedure for hypothesis testing, flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses. **05Hrs.**

Unit-V

Interpretation and Report Writing: Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral

presentation and mechanics of writing a research report, precautions for writing research reports, plagiarism and its significance. **05Hrs.**

Reference Books:

1) C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 4th Edition, 2018.
2) Ranjit Kumar, Research Methodology a step-by-step guide for beginners, SAGE Publications, 3rd Edition, 2011.
3) Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.

21UCHL701 Process Control Laboratory (0-0-2)1

Contact Hours: 26

Course Learning Objective (CLO):

1. The purpose of this laboratory is to introduce the key concepts in automatic control and instrumentation of process plants.

Course Outcomes (COs):

Description of the course outcome: At the end of the course student will be able to		**Mapping to POs (1-12)/PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Apply fundamentals of industrial processes, process measurement and process control theory.	4, 15	9,10	-
CO-2	Analyze transient behavior of simple systems.	4, 15	9,10	-
CO-3	Analyze data from experiments and prepare well organized laboratory report.	4, 15	9,10	-

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	-	-	-	3.0	-	-	-	-	2.0	2.0	-	-	-	-	3.0

List of Experiments:

1. Step response of first order systems (Thermometer).
2. Step response for Single capacity System - first order System.
3. Step & Impulse response for two first order systems arranged in Non - Interacting mode.
4. Step & Impulse response for first order systems arranged in Interacting mode.
5. Step response of first order system (stirred tank heater).
6. Control Valve Characteristics.
7. Temperature sensors characteristics – RTD, Thermocouple, Thermistor.
8. Characteristics of Temperature Transmitter.
9. Characteristics of I/P and P/I converters.

10. Analysis of Flapper-Nozzle system.
11. Temperature Control Trainer– ON/OFF, P, PI, PD, PID action.

Note: Minimum 10 experiments to be conducted.

Reference Books:

1) Donald Coughanour and Steven Leblanc, "Process System Analysis and Control", 3/e, McGraw Hill, New Delhi, McGraw Hill 1991.
2) Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", 2/e, McGraw Hill, 1990. ISBN -13: 978-0070391604

21UCHL702	Major Project Phase – 1	(0-0-4) 2

Contact Hours: 52

Course Learning Objectives (CLOs):

1. To identify the problems in thrust areas of chemical engineering.
2. To plan experimental or theoretical work using multidisciplinary knowledge.
3. To apply the science, mathematical computational engineering and economics knowledge for solution of the problem selected.
4. To use various advanced instruments for the analysis with techniques.
5. To interact with industries, research centers and other colleges.
6. To understand the principle to work in teams and the concept of leadership.
7. To learn flow sheeting, designing and report writing skills.

Course Outcomes (COs):

Description of the course outcome: At the end of the course student will be able to		**Mapping to POs (1-12) PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify the topic of chemical engineering or integrated problems (allied fields).	2,10	8, 12	6, 7, 14
CO-2	Compare the literature review and select suitable materials and methodologies for selected topic.	3,4,5,15	8,11,12	7, 10, 14
CO-3	Interpret the experimental results with discussion and economic analysis.	11,15	8,10,12	9
CO-4	Prepare a precise report on the work done with proper guidelines and references.	10	8,15	9

CO-5	Organize and present the work carried out to justify the results obtained with conclusion	9, 10, 12	8, 11	2, 4

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	-	2.0	3.0	2.0	3.0	1.0	1.0	2.0	1.66	2.4	2.33	2.0	-	1.0	2.66

Course Content:

Major project phase-1 in which the students are expected to locate the state of the art technology in his domain of interest by an extensive literature survey and Select a topic from an emerging area relevant to their branch/interdisciplinary and define the problem for the project work. The material collection, survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The project shall consist of a team of students not more than 4. Each batch shall be assigned with a guide. A committee consisting of minimum 3 faculty members of which guide is a member shall evaluate at the end for CIE. The weightage of marks shall be 50% for the committee and 50% for the guide. There is a SEE (viva voce) examination which shall be examined by two internal examiners appointed by COE based on the suggestions by the respective HoD.

Reference Books/Material:

Offline/online chemical engineering and its related field Journals.
Books in the area of chemical engineering and its related field

21UCHE704 Plant Utilities and Industrial Safety (3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs):

1. To understand the utilities in a chemical process plant, types, role and their selection.
2. To understand the principles of safety with insight of safety analysis techniques and application of safety devices.

Course Outcomes (COs):

Description of the course outcome: At the end of the course student will be able to		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Comprehend the selection and role of utilities and appraise the generation, handling and role of water and steam.	-	3	14

CO-2	Appraise the generation, handling and role of air with the use of devices.	3	14	-
CO-3	Assess refrigerants, evaluate the performance and apply refrigeration.	3	7,14	-
CO-4	Prioritize safety aspects, plan and use safety devices in defiant situations in a chemical plant.	3	6,8	14
CO-5	Interpret safety analysis tools and techniques and translate to hazardous conditions.	3	7	14

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	-	-	2.8	-	-	2.0	2.0	2.0	-	-	-	-	-	1.4	-

Course content:

Unit-I

Introduction: Utilities and their role, selection criteria etc. **Water and Steam:** Resources, Cooling water-requirements and treatments, Water softening methods- Ion exchange, water pretreatment, recycle and reuse. Steam quality, consumption, distribution, condensate removal and recovery. **08 Hrs.**

Unit-II

Air: Compressed air for process and instruments, Blowers and Fans- Multistage Compression-features, Vacuum pumps, Air Drying-Pressure swing Adsorption with applications, Skarstrom cycle. **08 Hrs.**

Unit-III

Refrigeration: Carnot Cycle and Reverse Carnot Cycles, Primary and Secondary refrigerants, Vapor Compression Refrigeration; various refrigerants, Vapor Absorption Refrigeration, Comparison. **08 Hrs.**

Unit-IV

Process Safety and Devices: Safety aspect, safe design, Intrinsic and Extrinsic safety, Hazards, Risk, Toxicity, Flammability, Fire, Explosion, TLV, Sources of ignition, Hazardous materials, Reactive chemicals, Combustion and Flammability, Gas explosion, Dust Explosion, UCVCE, Static Electricity, Vacuum Hazards, Inert Gas Hazards, Gas Dispersion, Safety Devices; Pressure Relief Systems, Emergency relief devices. **08 Hrs.**

Unit-V

Safety Analysis and Case Studies: Hazard Analysis (HAZAN), Hazard and Operability studies (HAZOP), Comparison, Risk Analysis and Estimation, Safety

check list. Case Studies: Bhopal, Jaipur, Flixborough, Mexico [LPG Fire]

07 Hrs.

Reference Books:

1) Perry's "Handbook of Chemical Engineers" 7/e, Mc-Graw Hill Publications.
2) Frank P. Lees, "Loss Prevention", Vol 1 and Vol 2.
3) Jack Broughton, "Process Utilities", I Chem publications.

21UCHE705 Transport Phenomena (3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs):

1. To provide basic understanding of laws governing transport processes and effect of various parameters.
2. To provide an understanding of steady state shell balances for velocity, temperature and concentration distribution under laminar flow.
3. To deal with equations of change and analogies amongst transport processes along with their applications

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	State laws of momentum, energy and mass transport. Discuss effect of temperature and pressure on transport properties of fluid.	1	-	-
CO-2	Formulate velocity distribution equations under laminar flow conditions to solve transport problems.	-	2, 3, 13	1
CO-3	Formulate temperature distribution equations under laminar flow conditions to solve transport problems.	-	2, 3, 13	1
CO-4	Formulate concentration distribution equations under laminar flow conditions to solve transport problems.	-	2, 3, 13	1
CO-5	Apply equations of change for isothermal systems and write analogies between momentum, heat and mass transport problems.	-	2, 3, 13	1

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	1.4	2.0	2.0	-	-	-	-	-	-	-	-	-	2.0	-	-

Prerequisites: Fluid Mechanics, Heat and Mass Transfer

Course content:

Unit-I

Introduction: Importance of transport phenomena in chemical engineering, Momentum, Energy and Mass transport, Newton's law of viscosity, Newtonian and Non-Newtonian fluids. Fourier's law of heat conduction, Ficks law of diffusion, effect of temperature and pressure on transport properties of fluids. Numerical problems using all law. **07 Hrs.**

Unit-II

Velocity Distribution in Laminar Flow: Steady state shell momentum balance, boundary conditions applicable to momentum transport problems, flow over a flat plate, flow through circular tube, flow through annulus, flow between parallel plates and slit. Numerical problems using the equation derived above. **09 Hrs.**

Unit-III

Temperature Distribution in Laminar Flow: Steady state shell balance, boundary conditions applicable to energy transport problems, heat conduction through compound walls, heat conduction with internal generation by electrical source, nuclear and viscous energy sources. Heat conduction in a cooling fin, Forced and free convection heat transfer. Numerical problems using equation derived above. **08 Hrs.**

Unit-IV

Concentration Distribution in Laminar Flow: Steady state shell balance, Boundary conditions applicable to mass transport problems, Diffusion through stagnant gas and liquid films, Equimolar counter diffusion, Diffusion into falling film, Forced convection mass transfer, Diffusion with homogeneous and heterogeneous reaction. Numerical problems using the equation derived above. **08 Hrs.**

Unit-V

Equation of Change of Isothermal Systems: Non isothermal systems and Multicomponent systems. Application of these equations in solving steady state problem.

Analogies and Navier Stokes equation: Simple numerical problems on it. Analogies between Momentum, Heat and mass transport and their numerical problems. **07 Hrs.**

Reference Books:

1) Bird, Stewart and Lightfoot, "Transport Phenomena", John Wiley, 2/e. 1994.
2) Robert Brodkey and Henry C. Hershey, "Transport Phenomena Unified Approach", International Edition- 1988. ISBN-10: 0070079633
3) Bennet and J. E., "Momentum Heat and Mass Transfer", Myer- McGraw Hill. 3/e. 1982.
4) Suryavanshi and Dongre, "Transport Phenomena", Nirali Prakashan. 7/e. 2012. ISBN: 978-81962-56-5.

21UCHE706 Process Engineering Economics and Management (3–0–0)3

Contact Hours: 39

Course Learning Objective (CLO):

1. Prepare the students to analyse cost/revenue data and carry out economic analysis in the decision-making process to justify alternatives/projects on an economic basis and prepare to function in the business and management side of professional engineering practice.

Course Outcomes (COs):

Description of the course outcome: At the end of the course student will be able to		**Mapping to POs (1,12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Comprehend the concepts of plant location, layout and feasibility survey and perform cost estimation.	-	9,10	12
CO-2	Apply economic concepts viz. depreciation, cash flow, profitability, replacement, breakeven analysis etc. in solving chemical engineering problems.	10,11	9,14	12
CO-3	Interpret production management with its virtues inclusive of automation, work study and method study applied to a chemical industry.	10,11	9,14	12
CO-4	Interpret material management with its virtues inclusive of value engineering applied to a chemical industry.	10,11	9	12
CO-5	Interpret marketing management with its virtues inclusive of product life cycle applied to a chemical industry.	10, 11	9	12

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14	PSO-15
Mapping Level	-	-	-	-	-	-	-	-	2.0	2.8	3.0	1.0	-	2.0	-

Course content:

Unit-I

Introduction Importance of economics and management, plant location and plant layout, feasibility survey.

Cost Estimation Methods employed for the total cost estimation. Cost Index

08 Hrs.

Unit-II

Depreciation: Different methods of Depreciation. Time value of money and its equivalence, Cash flow diagrams, Taxes and Insurance.

Profitability and Methods of Evaluation: Replacement and alternative investments, Break even analysis, Financial statements. **08 Hrs.**

Unit-III

Production Management: Types of production, production, planning, schedule, work study, method study, incentives and bonus, automation, organization of production, planning and control departments. **08 Hrs.**

Unit-IV

Material Management: Functions of purchasing. Quantity standards and Inspection. Sources of supply, Inventory management, ABC analysis, EOQ model. Value analysis and engineering. **08 Hrs.**

Unit-V

Marketing Management: Functions of marketing, marketing and sales, marketing engineer, and Market research. Product life cycle, Promotion of sales. Pricing methods, advertisements etc. **07 Hrs.**

Reference Books:

1) Peters and Timmerhaus, “Plant design and Economics for Chemical Engineers”, McGraw Hill, 1991.
2) Banga and Sharma, latest edition “Industrial Organization and Engineering Economics”, Khanna Publications, 2008.
3) Tripathi and Reddy, “Principles of Management”, 5/e, Tata McGraw-Hill Education, 2004.

21UCHE707	**Sugar Technology**	**(3-0-0) 3**

Contact Hours: 39

Course Learning Objective (CLO):

1. To understand different cultivation and analytical methods, various unit operations and unit processes with practical difficulties encountered during the production of sugar.

Course Outcomes (COs):

Description of the course outcomes: At the end of the course student will be able to		**Mapping to POs (1-12) /PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Comprehend overall scenario, sugar cane cultivation, analysis	5	-	-

	and milling process.			
CO-2	Classify various purification methods and advantages.	1	-	-
CO-3	Outline various unit operations, equipments and advantages.	-	14	-
CO-4	Compare various production methods and distillation types.	3	-	5
CO-5	Compare different co-generation systems and efficiency along with pollution control measures.	7	3	-

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	3.0	-	2.5	-	2.0	-	3.0	-	-	-	-	-	-	2.0	-

Course content:

Unit- I

Over view of Sugar Industry: Overall scenario of sugar industry both globally and in India. Factory site, layout of the factory. Sugar cane, sugar plantation, plant protection of sugar cane crop. Sugar cane cultivation, harvesting and milling process. Composition of cane and juice, properties of sucrose and reducing sugars. Various analytical methods used in sugar industry. **08 Hrs.**

Unit- II

Purification: clarifying and bleaching agents, defecation process. Classification of sulphitation and carbonation methods. Advantages of carbonation over sulphitation. Methods for the clarification of the syrup. Filtration of scums.

08 Hrs.

Unit- III

Unit operations: Evaporation, multiple effect evaporation, various features of evaporators design, causes of entrainment, incrustation formation and removal, crystallization, boiling syrup massecuites, requirements of good pan boiling, rate of crystallization, factors affecting the crystal growth, various types of crystallizers, boiling schemes, condensers, centrifugal operation, dryers, grading of sugar. **08 Hrs.**

Unit- IV

Distillery: Molasses, storage, utilization, various distillation types, advantages. Production of ethanol by fermentation process, factors influencing the production of alcohol, design considerations for distillation column, distillery wastes, treatment, disposal. **08 Hrs.**

Unit- V

Co-generation: Types of co-generation systems, quality of bagasse and boilers used, efficiency, production of steam, quality of steam, pollution control measures for water, air, solid wastes and noise in sugar industries. **07 Hrs.**

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Reference Books:

1) Honing P (Ed), "Principles of Sugar Technology", Vol I to III, Elsevier publishing company, 2010.
2) Jenkinos. G.H., "Introduction to cane sugar Technology", Elsevier, 1966.
3) Mathur.R.B.L, "Handbook of cane Sugar Technology", 2/e, Oxford and I.B.H. Publishing Co., 1997.
4) R.K. Rajputh, "A text book on Power Plant Engineering", 2/e, Laxmi publications (p) Ltd., New Delhi, 2001.

21UCHE708 Process Modeling and Simulation in Chemical Engineering (3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs):

1. To study basic concepts of modeling and formulation of mass and energy balance relationships and thereby it helps for the development of complex models.
2. To understand the advanced technologies in simulation field and the applicability in industries.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1,12)/ PSO (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Compare and apply the different fundamentals to develop the models for chemical engineering system.	1,3	2	5
CO-2	Interpret and develop different mathematical methods for chemical engineering system.	3,13	1, 2	5
CO-3	Apply and assess different relevant software and models for solving chemical engineering problems.	5, 13	2,3	-
CO-4	Identify the different simulation tools and Ability to solve chemical engineering problems using	5, 13	2,3	-

	numerical techniques			
CO-5	Demonstrate and analyse the different model solving ability for various chemical engineering process.	5, 13	2, 3	-

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14	PSO-15
Mapping Level	2.5	2.0	2.4	-	2.2	-	-	-	-	-	-	-	3.0	-	-

Course content:

Unit-I

Modeling in Chemical Engineering: Introduction, Principles of Formulation, Fundamental laws; Continuity Equation, Energy Equation, Equation of motion, Transport Equations, Equation of States, Equilibrium, Chemical Kinetics, Classification of Mathematical models. **08 Hrs.**

Unit-II

Numerical Techniques: Iterative convergence methods like bisection and secant method, Newton raphson method, Numerical integration of ordinary differential equations like Euler and Runge Kutta method. Numerical solution of partial differential equations of first order approximation with examples. **08 Hrs.**

Unit-III

Models in Chemical Engineering: Introduction, Series of Isothermal, Constant-Holdup CSTRs, CSTRs with Variable Holdups, Two Heated Tanks, Gas-Phase, Pressurized CSTR, Non-isothermal CSTR, Single-Component Vaporizer, Multicomponent Flash Drum, Batch Reactor, Reactor With Mass Transfer, Ideal Binary Distillation Column, Multicomponent Non-ideal Distillation Column Batch Distillation With Holdup. **08 Hrs.**

Unit-IV

Computer Simulation: Introduction to Simulation, Role of Computers and Numerical Methods in simulation, Iterative convergence methods, Explicit Convergence methods, Explicit Numerical Integration algorithm, Implicit Methods, Numerical examples. **08 Hrs.**

Unit-V

Specific Simulation/ Model Development: Batch reactor, CSTR, Bioreactor, activity coefficient models, Distillation and equilibrium Flash vaporization. **07 Hrs.**

Reference Books:

1) William L. Luyben, “Process modeling, simulation and control for Chem. Engg.”, Mc.Graw Hill, 1990.
2) Edger TF and Himmelblau D M, “Optimization of chem. Process” Mcgraw Hill, 1989.
3) Asghar Hussain, “Chemical process simulation”, Wiley Eastern Ltd, 1986.

4) Roger G.E Franks, “Modeling and Simulation in Chemical Engineering” Wiley Inter science. New York, USA, 1972.

21UCHE709 Bioprocess Engineering (3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs):

1. To provide the students with the basics of bioreactor engineering.
2. To develop bioengineering skills for the production of biochemical product using integrated biochemical processes.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1,12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Select appropriate bioreactor configurations and operation modes based upon the nature of bioproducts and cell lines and other process criteria.	-	3, 7	2
CO-2	Design and analyse the scale up criteria for the different bioreactors.	5	2, 3, 7	-
CO-3	Understand the enzyme kinetics and design the immobilized enzyme bioreactors.	13	3, 7	-
CO-4	Apply modeling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.	5	3, 7	-
CO-5	Identify the different cell cultivation system to apply in the different bioreactors.	13	3, 7	-

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	-	1.5	2.0	-	3.0	-	2.0	-	-	-	-	-	3.0	-	

Course content:

Unit-I

Operational Modes of Bioreactors: Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, two stage cultivation. Packed bed reactor, airlift reactor, fluidized bed reactor and bubble column reactor. **08 Hrs**.

Unit-II

Bioreactor Scale-Up: Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed. **08 Hrs.**

Unit-III

Bioreactor Consideration in Enzyme Systems: Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors. **08 Hrs.**

Unit-IV

Modeling and Simulation of Bioprocesses: Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetic and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism. **08 Hrs.**

Unit-V

Recombinant Cell Cultivation: Different host vector system for recombinant cell cultivation strategies and advantages. E.coli, yeast Pichia pastoris/ Saccharomyces cereviseae, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system. **07 Hrs.**

Reference Books:

1) Jens Nielson, John Villadsen and Gunnar Liden, “Bioreaction engineering principles”, 2/e, Kulwer Academic, 2002
2) Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, 2/e, CRC press, London. 1995.
3) James E. Bailey and David F. Ollis, “Biochemical Engineering Fundamentals”, 2/e, McGraw Hill. Singapore. 1986
4) Atkinson, B, Mavituna, F, “Biochemical Engineering and Biotechnology Handbook” 2/e, Macmillan Publishers Ltd, New York, 1992.

21UCHO710	Solid Waste Management	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

1. To provide students with a comprehensive understanding of integrated solid waste management from an environmental and public health perspective.
2. To study the detailed engineered system of solid waste management system.

Course Outcomes (COs):

Description of the course outcome: At	**Mapping to POs (1-12)/ PSOs (13-15)**

the end of the course student will be able to		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Review the components and characteristics of a solid waste management system.	6	7	3
CO-2	Identify the various collection, transfer and transport mechanisms of municipal solid waste management.	6	3,7	-
CO-3	Explain various processing, material and energy recovery facilities.	14	3	
CO-4	Describe different methods and safety precautions used in disposal of MSW.	6,7	14	
CO-5	Explain types of hazardous solid waste and discuss safe methods of disposal of hazardous waste & their management principles.	6,7	14	3

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	-	-	1.5	-	-	3.0	2.5	-	-	-	-	-	-	2.3	-

Course content:

Unit I

Introduction to Solid Wastes: Definition, Characteristics, Types of solid waste, Physical, Chemical and Biological properties of Municipal Solid Waste, Overview of materials flow in society and 4R concept of solid waste management. Evolution of SWM, Effect on health and environment. Legislation and government agencies. **08 Hrs.**

Unit II

Engineered Systems for Solid Waste Management: Generation of solid waste, Quantities of solid Waste, Methods to measure solid waste quantities, Solid waste generation and collection, Factors affecting solid waste generation rate, Onsite handling, Storage and Processing, Transfer and transport, Collection system and devices. **08 Hrs.**

Unit III

Processing Techniques and Recovery of Energy: Objectives of waste processing, component separation and volume reduction, various processing technologies — biological and chemical conversion methods, Composting, Factors affecting composting, Aerobic composting and anaerobic Digestion, Details of energy recovery system, heat recovery, gasification, pyrolysis and

refuse derived fuels (RDFs). Municipal incinerators, Grates and Furnances, Material and Energy recovery operations. **08 Hrs.**

Unit IV

Disposal of Solid Wastes: Various disposal methods, landfills — site selection, site infrastructure, essential components of landfill; types of landfilling methods, landfill planning –leachate management and gas control; Environmental monitoring systems for landfill sites, closure and post-closure plans for landfills, landfill site rehabilitation, reclamation and remediation. **08 Hrs.**

Unit V

Hazardous Wastes: Definition, identification and classification of hazardous solid waste, Origin and reduction at source, Collection and handling, Management issues and planning methods, Environmental Act, E-waste handling and disposal, Biomedical waste.

Industrial Solid Waste Management: Major industries and management methods used in typical industries – Coal fired power stations, textile industry, oil refinery, distillery, sugar industry, and radioactive waste generation units.

07 Hrs.

Reference Books:

1) George Tchobanoglous, “Integrated Solid waste Management-Engineering Principles and Management issues”, McGraw Hill, 1993.
2) Howard Peavy, “Environmental Engineering”, McGraw Hill,1986.
3) Dutta, “Industrial Solid waste Management and landfilling practice”, Narose Publication, 1999.

21UCHO711 Advanced Waste Water Treatment (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

1. To create awareness on the water pollution aspects and understand the kinetics and the designing system of the plant.
2. To understand the different parameters, treatment methods and control techniques of water pollution.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1,12)/ PSO (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Cognize the different characteristics of waste water and regulatory standards with basic design criteria	-	14	3, 6, 7

	for waste water treatment			
CO-2	Comprehend the reaction kinetics, reactor selection and its process analysis.	13, 14	3, 6, 7	5
CO-3	Design and operational concepts of secondary treatment systems	13, 14	3, 6, 7	-
CO-4	Design and operational concepts of tertiary treatment systems	13, 14	3, 6, 7	-
CO-5	Learn the wastewater treatment criteria based on the regional requirement to understand the sewage management of the city.	3, 6, 7	14, 15	-

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	-	-	2.0	-	-	2.0	2.0	-	-	-	-	-	3.0	2.6	2.0

Course content:

Unit-I

Introduction of Wastewater Treatment: Flow measurements and Composition. Characterization -properties and analysis of wastewater. Rural wastewater systems: waste treatability studies-a bench scale and pilot scale. Effluent standards for discharge to water bodies and land applications- state and central. Theoretical principles and design considerations - screens, equalization basin, grit chamber, primary and secondary settling tanks. **07 Hrs.**

Unit-II

Microbiology of Waste Treatment: Growth and inhibition of bacteria. Kinetics of Biological growth Batch culture substrate limited growth, Cell growth and substrate utilization. Effects of endogenous metabolism and kinetics Monod's and Michaclis menton kinetics and their applications. Determination of biokinetic constants in batch and continuous system. **08 Hrs.**

Unit-III

Secondary Waste Water Treatment: Aerobic, anaerobic, suspended and attached growth systems. Activated sludge process standard type and modifications. Aerators. Trickling filter, Aerated lagoon, Stabilization ponds, bio-towers, RBC. Treatment disposal of sludge- Sludge characteristics, Concentration. Anaerobic sludge digestion. Aerobic Sludge digestion, Sludge conditioning, Dewatering and drying. Incineration and wet oxidation. Reactor configurations. Case studies. **08 Hrs.**

Unit-IV

Tertiary Waste Water Treatment: Introduction, Need of Tertiary Waste Water Treatment, Purpose of Advanced Waste Water Treatment. Nitrogen and Phosphorus Nitrogen Removal: Nitrification, Denitrification Simultaneous nitrification and denitrification Phosphorus Removal. Membrane Bioreactor with

Membrane Module Submerged in the Bioreactor. Electro-coagulation, Electro dialysis, Reverse osmosis, Ion exchange, Adsorption, absorption, Evaporators. Case studies. **08 Hrs.**

Unit-V

Sewage Treatment and Disposal: Introduction, importance of sewage, Characteristics of sewage, Sampling and analysis of sewage, Sewage treatment and disposal: Skimming, Grit chamber, Sedimentation tanks, Septic tank, Secondary treatment-types of filters, rate of filter loading, Activated sludge process, sludge digestition, Sludge disposal. **08 Hrs.**

Reference Books:

1) Metcalf and Eddy. "Waste water Engineering: Treatment and Reuse". McGrew Hill Publication. ISBN-10: 9780070495395. 4/e. 2017
2) A. F. Gaudy and E. T. Gaudy. "Microbiological for environmental Scientist and engineers" McGraw Hill 1/e. 1980.
3) T. McGhee. "Water Supply and Sewerage", McGraw Hill. 6/e. 1991. ISBN-10: 0070609381
4) G. S. Bridie and J.S. Brides. "Water Supply and Sanitary Engineering". Dhanpat Rai & Sons 2010. ISBN-10: 8187433795.

21UCHO712	Nanotechnology	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

1. To provide students with the knowledge of techniques used for synthesis and surface modification of nanomaterials.
2. To understand the structural, morphological, and surface composition of nanomaterials and their applications.

Course Outcomes (COs) :

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1,12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the fundamentals of nanoscience and nanotechnology	-	2	1
CO-2	Analyze physical and chemical methods used for synthesis and processing of nanomaterials	13	2	1
CO-3	Compare and select suitable techniques for characterization of a given nanomaterial	1	2	-
CO-4	Use different techniques to process different types of nanocomposites and know the limitations of each process	1, 13	2	5

CO-5	Learn the importance and applications of Nanotechnology in chemical industries	-	7	6

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	2	2	-	-	1	1	1	-	-	-	-	-	3	-	-

Course Content:

Unit-I

Introduction to Nanotechnology: Nanomaterials and its classification, Zero dimensional, one-dimensional and two dimensional nanostructure materials - classification of solids: conductor, semiconductors, insulator, types of semiconductor, doping, diodes, current flow in semiconductors, ceramics and nanocomposites, Properties of individual nanoparticles, Methods of synthesis, Reactivity of nanoparticles. **07 Hrs.**

Unit-II

Methods of Synthesis of Nanomaterials: Ball Milling, physical and chemical vapour deposition methods and Electro deposition, Solution based Synthesis of Nanoparticles, Inert gas condensation, Arc discharge, RF plasma, Plasma arc technique, Ion sputtering, Laser ablation, Laser pyrolysis and Molecular beam epitaxy, co-precipitation, sol-gel method, chemical reduction, photochemical synthesis, electrochemical synthesis, Spray pyrolysis method, flame spray pyrolysis, gas phase synthesis. **08 Hrs.**

Unit-III

Characterization Techniques: Optical Microscopy, Electron Microscopy, Secondary electron scattering, back scattering, Scanning Probe Microscopes, Focused Ion Beam Technique, X-ray imaging, Transmission Electron Microscope (TEM), Scanning Probe Microscope (SPM)- Atomic Force Microscope (AFM), Scanning Tunneling Microscope (STM), UV-VIS Spectrophotometers, IR/FTIR Spectrophotometers, and Raman spectroscopy.

08 Hrs.

Unit-IV

Nanocomposites and their Applications: Need for composite materials. Classification of composites; Matrix: Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC); Reinforcement: particle reinforced composites, Fibre reinforced composites. Applications of composites. Fibre production techniques for glass, carbon and ceramic fibres.

08 Hrs.

Unit-V

Nanomaterials For Chemical Industry: Nanocatalysts, Smart materials, Heterogenous nanostructures and composites, Nanoparticles for water

purification-Photocatalytic mechanism, general pathways and kinetics-Treatment of Arsenic, Removal of Heavy metal ions by Iron and polymeric based nanoparticles, Magnetic Nanoparticles, Nanoscale carbon for contaminant separation -Nanostructures for Molecular recognition (Quantum dots, Nanorods, Nanotubes), Molecular Encapsulation and its applications – Nanoporous zeolites, Self assembled Nanoreactors. **08 Hrs.**

Reference Books:

1) M. H. Fulekar, “Nanotechnology importance and applications”, I. K. International Publishing House Pvt. Ltd., New Delhi, 2013.
2) Manasi Karkare, “Nanotechnology, Fundamentals and Applications”, I.K. International Publishing, New Delhi, 2008.
3) Jr. Poole, P. Charles and J. W. Frank, “Introduction to nanotechnology”, John Wiley & Sons, 2003.
4) G. Cao, “Nanostructures and Nanomaterials: Synthesis, properties and applications”, Imperial College Press, 2004.
5) C. C. Koch, “Nanostructured Materials: Processing, Properties and Applications”, 2/e 2007.

VIII Semester

21UCHL800	Technical Seminar	(0-0-2)1

Contact Hours: 26

Course Learning Objectives (CLOs):

1. To provide platform to focus on knowledge of technical data collection, communication skills and report writing.
2. To develop intellectual and professional competence and work on the chosen topic to improve skills in writing and oral presentation.

Course Outcomes (COs):

Description of the course outcome: At the end of the course student will be able to		**Mapping to POs (1-12) /PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Review and acquire knowledge on the chemical engineering topic outside the scope of curriculum	14	6,7,8,9,12	4, 5
CO-2	Outline and consolidate the required information on chosen topic	9	6,7,8	-
CO-3	Organize the technical matter in the required format and compile the same	12	9	-
CO-4	Interpret and communicate the topic with proper justification and conclusion	9, 10	-	-

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	-	-	-	1.0	1.0	2.0	2.0	2.0	2.5	3.0	-	2.5	-	3.0	-

Course content:

Technical Seminar/ Independent study: The students are expected to learn how to carry out literature survey to locate the state of the art technology in engineering domain of their interest. They are required to carry out selection of an emerging topic beyond the syllabus relevant to the branch of study, understand the concept, analyze and present effectively for 15-20 minutes followed by 5 minutes of questions and answers before their classmates and faculty. They can also present the technical innovative/novel work carried out in the laboratory. They are also required to learn the effective communication and modalities of technical interactions. Further, they have to submit the seminar material in the form of a paper in IEEE format. All the students are required to attend all the session throughout the semester.

Procedure to conduct technical Seminar:

- All the students are informed to select a topic from the field of their interest from their branch or relevant to their branch and register the topic with the faculty(ies) In charge of Seminar.
- Two faculty members assigned to carry out this activity. The faculty

members prepare the schedule of the seminar spread over the entire semester and display the same in the notice board.

- Change of seminar topic is not allowed once registered, however in the case of genuine reasons only once change of topic may be permitted.
- Based on the number of hours mentioned in the scheme, 4-6 students shall present the seminar in one slot of 2/3 hours.
- The faculty members shall conduct the seminar session every week as per the schedule in the slot mentioned on the time table and carry out the evaluation.
- Attendance is compulsory for all the students for all the seminars.
- The students are required to submit two hard copies of report not exceeding 6 pages and one soft copy of seminar report one week prior to their date of presentation.
- Report shall be in IEEE format viz A4 size paper, Title**:** Bold, Times new Roman Font 14, Sub heading & Body of the text**:** Times new Roman font 12. Margin for left should be 1 ½.
- Student name, USN, seminar date should be mentioned on the report.
- Presentation is for about 15-20 minutes, followed by 5 minutes for questions and answers.
- Typical evaluation methodology: The seminar shall be evaluated for maximum 50 marks. The breakup of marks shall be:
  Presentation: a) 40 marks b) Report: 10 marks.

For presentation, the following points not limited to may be considered.
Concept, understanding, depth of the knowledge, originality of the topic, Quality of PPT, communication skills etc.
For report evaluation, the following points not limited to may be considered
Adherence to IEEE format, relevance of topic, subject depth, and originality in writing etc.

The seminar is aimed at as an educative program for the students. This is because, the students shall listen to 60- 70 seminars on different topics from emerging areas is as good as undergoing a course on latest happenings in the related branch of Engineering.

The departments going for **independent study** in place of technical seminar shall plan, prepare the modalities, and take the approval from Dean (AP).

Reference Books/Material:

Offline/online chemical engineering and its related field Journals.

Books in the area of chemical engineering and its related field.

21UCHL801	Major Project Phase– 2	(0-0-18) 9

Contact Hours: 234

Course Learning Objectives (CLOs):

1. To identify the problems in thrust areas of chemical engineering.
2. To plan experimental or theoretical work using multidisciplinary knowledge.
3. To apply the science, mathematical computational engineering and economics knowledge for solution of the problem selected.
4. To use various advanced instruments for the analysis with techniques.
5. To interact with industries, research centers and other colleges.
6. To understand the principle to work in teams and the concept of leadership.
7. To learn flow sheeting, designing and report writing skills.

Course Outcomes (COs):

Description of the course outcome: At the end of the course student will be able to		**Mapping to POs (1-12) /PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify the topic of chemical engineering or integrated problems (allied fields).	2,10	8, 12	6, 7, 14
CO-2	Compare the literature review and select suitable materials and methodologies for selected topic.	3,4,5,15	8,11,12	7, 10, 14
CO-3	Interpret the experimental results with discussion and economic analysis.	11,15	8,10,12	9
CO-4	Prepare a precise report on the work done with proper guidelines and references.	10	8,15	9
CO-5	Organize and present the work carried out to justify the results obtained with conclusion	9, 10, 12	8, 11	2, 4

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	-	2.0	3.0	2.0	3.0	1.0	1.0	2.0	1.66	2.4	2.33	2.0	-	1.0	2.66

Course Content:

Major Project phase-2 is the continuation from phase –I in which the students are expected to go for material collection, survey, visits, data collection, preliminary design, analysis, model development, code writing, field work etc. The same project team formed for phase –I will continue the work under the

guidance of the same faculty member. For all the projects, problems may be domain specific or interdisciplinary also in nature. A committee consisting of minimum 3 faculty members of which guide is a member shall evaluate at the end for CIE. There is a viva voce examination which shall be examined by two examiners one internal and one external to the college appointed by COE based on the suggestions by the respective HoD.
The reference materials for the project work are as listed below but not limited to:

Reference materials/books:

1. Engineering books.
2. Journals.
3. Manuals and data sheets.
4. Software packages.
5. Previous project reports.
6. Product information brochures.
7. Interaction with academia and industrial experts.
8. Internet etc.

21UCHL802	**Internship-2**	**(4 Weeks) 3**

Contact Hours: 30 days

Course Learning Objective (CLO):

1. The purpose of internship is student should be able to learn how to apply the knowledge acquired during internships in his future workplace.
2. The student should demonstrate to work in the interdisplinary approach and in a team with good communication skills.

Course Outcomes (COs):

Description of the course outcome: At the end of the course student will be able to		**Mapping to POs (1-12)/PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Analyze and gain knowledge on the recent developments in the area of chemical and allied engineering and integrate his theoretical knowledge with practical processes.	13, 15	11, 12	4, 6, 7
CO-2	Enhance his communication skills to work in interdisciplinary teams in industry.	9, 10	-	-
CO-3	Realize professional and ethical responsibility to work in a team and project management.	6, 7, 8	11, 12	-

POs/PSOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -13	PSO -14	PSO -15
Mapping Level	-	-	-	1.0	-	2.0	2.0	3.0	3.0	3.0	2.0	2.0	3.0	-	3.0

Internship: The students are to undergo internship in Private industries/ R&D organizations/Centres of Excellence/Laboratories of Reputed Institutions/ Govt. & Semi Govt. organizations, PSUs, construction companies, entrepreneurial organizations, inter departments within the college etc. to get an exposure to the external world for a period of 4 weeks in the summer vacation after VI sem and before start of VII semester. The students are to prepare a report on the internship work carried out. The internal faculty shall monitor the student and award CIE marks. There is a SEE in which the student shall present his work before a panel of examiners consisting of HoD, Guide and one faculty member during VIII semester. The performance shall be communicated to the CoE office and the same shall reflect in the VIII semester grade card