Course Title: Elements of Chemical Engineering		Semester	1/2
Course Code	1BECHE105/205	**CIE Marks**	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	**SEE Marks**	100
Total Hours of Pedagogy	120 h	**Total Marks**	100
Credits	3-0-0 (Total 3)	**Exam Hours**	3
Examination type (SEE)	**Theory**		

Course Outcomes (Course Skill Set)

After completing the course, the students will be able to ....

CO1: Understand the relevance of chemicals engineering and role of a Chemical Engineer.

CO2: Identify the modern chemical engineering plants and importance of simulation.

CO3: Evaluate the dimensionless analysis and its applications.

CO4: Evaluate and asses the environmental & safety aspects in Chemical Engineering.

Module-1: Introduction to Chemical Engineering & Role of a Chemical Engineer 8 Hours

Introduction: Chemical Engineering in Everyday life, History of Chemical Engineering, Major Chemical Engineering Contributions to Society, Significance of chemical engineering in food, health, energy and environment. Sustainable development framework; United Nations SDGs, Emerging Technologies to implement sustainable development goals.

Module-2: Modern chemical engineering plants 8 Hours

Batch processing and continuous processing, transition from batch to continuous processing, Basic principles of chemical processes; Unit processes and unit operations; Case studies: Manufacture of paint, Sulfuric acid and Soda ash. Measurement of temperature, pressure, flow and level in a process.

Module-3: Role and importance of Natural Sciences in Chemical Engineering 8 Hours

Introduction, Ideal gas law, Infinitesimal Control Volume, Macroscopic Control Volume, Closed Systems and Open Systems, Conservation of Mass and energy and related numerical, Fundamentals of mass transfer, Fick's law of diffusion. Heat transfer, modes of heat transfer and related numerical.

Module-4 : Fluid flow phenomena and Dimensional Analysis 8 Hours

Types of fluids - shear stress and velocity gradient relation, Types of fluid flow, Measurement of fluid flow: Rotameter, pitot tube. Dimensionless Numbers, Primary and derived quantities, Dimensional homogeneity, Methods of dimensional analysis (Rayleigh's) and its applications, related numerical.

Module-5: Safety in Chemical Process Industries 8 Hours

Safety in Chemical Process Industries, Lessons for the Management, Importance of Quantitative Information, Case Study 1: Extinction of Different Species of Vultures; Case Study 2: Environmental Hazards of a Green Project. Case study 3: Bottling plant of Coco-Cola. Basic safety and process management (Process design for safety, introduction to HAZOP and safety management processes).

Suggested Learning Resources: (Textbook/Reference Book):

Textbooks:

1. Pushpavanam S, Introduction to Chemical Engineering, PHI Learning Private Limited, New Delhi, 2010.
2. Morton Denn, Chemical Engineering: An Introduction, Cambridge University Press, 2011.

Reference books:

1. W. L. McCabe, J. C. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill, New York, 2021.
2. Walter L. Badger, Julius T. Banchero , Julius T. Bancheo, Introduction To Chemical Engineering, Tata McGraw-Hill, 1955.
3. Richard M. Felder and Ronald W. Rousseau, Elementary Principles of Chemical Processes, John Wiley & Sons, 3 rd Edition, 2005.
4. Himmelblau, D.M., Basic Principles and Calculations in Chemical Engineering, 6 th Edition, Prentice Hall of India, New Delhi, 1997.
5. Uche, N. Introduction to Chemical Engineering. Scrivener Publishing, Wiley, 2019
6. Ghoshal, S.K., Sanjal, S.K. and Datta, S. Introduction to Chemical Engineering. Tata McGraw-Hill Publication, 2017.
7. Introduction to Sustainable Engineering, Rag. R.L. and Ramesh Lakshmi Dinachandran, PHILearning Pvt. Ltd., 2ndEdn, 2016

Web links and Video Lectures (e-Resources):

1. **https://nptel.ac.in/courses/103108097**
2. **https://onlinecourses.nptel.ac.in/noc25_ch07/preview**
3. **https://www.youtube.com/watch?v=SdP3BbCt4Ak**

Teaching-Learning Process (Innovative Delivery Methods):

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching-learning process and facilitate the achievement of course outcomes. The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching-learning process and facilitate the achievement of course outcomes.

1. Flipped class
2. Chalk and talk
3. NPTEL and other videos for theory topics
4. Partial Delivery of course by Industry expert/ industrial visits
5. ICT-Enabled Teaching.
6. Activity based learning.
7. Keep fundamentals as the core teaching content.
8. Present recent trends as short “industry snapshot” segments at the end of each module (e.g., 15–20 minutes), not as examinable depth topics.
9. Use case studies, videos, or demonstrations for the advanced concepts so students see applications without getting bogged down in mechanisms.
10. Make the trends part of assessments via assignments, mini-seminars, or group presentations, so the main lecture hours focus on the basics.

Assessment Structure:

- The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage.
- To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks.
- To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks.

- Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks

Continuous Comprehensive Assessments (CCA):

CCA will be conducted for a total of 25 marks. It is recommended to include a maximum of two learning activities aimed at enhancing the holistic development of students. These activities should align with course objectives and promote higher-order thinking and application-based learning.

- Learning Activity 1: Case Studies Presentations related to implementation SDGs (15 Marks)
- Learning Activity 2: Material Selection and Justification for a chosen Real-world Engineering Product (Marks: 10 Marks)

Rubrics for Learning Activity -1 (Based on the nature of learning activity, design the rubrics for each activity): (15 Marks)

Performance Indicators	Superior	Good	Fair	Needs Improvement	Unacceptable
Understanding of Case (5Marks) (PO 1)	Demonstrates deep understanding (05)	Good understanding (4)	Adequate understanding. (3)	Limited understanding (2)	No clear understanding. (0-1)
Analysis & Critical Thinking (10 Marks) (PO 2)	Thorough, logical analysis with strong reasoning and innovative insights. (9-10)	Clear analysis with mostly logical reasoning. (7-8)	Basic analysis with some reasoning gaps. (5-6)	Weak analysis; mostly descriptive without reasoning. (3-4)	No clear analysis or reasoning. (0-2)
Documentation & Presentation Skills (10 Marks) (PO 9)	Documentation is complete, accurate, well structured, follows all formatting guidelines. Well-structured, clear, confident delivery; excellent visuals. (9-10)	Documentation is mostly complete and accurate, well organized, follows formatting guidelines with minor deviations. Good structure, clear delivery; visuals mostly effective. (7-8)	Documentation covers most required elements but has some inaccuracies or omissions. Average structure; delivery clear but lacks engagement. (5-6)	Documentation is incomplete with noticeable inaccuracies. Poor organization; visuals unclear. (3-4)	Documentation is largely missing or irrelevant, lacks structure. Unclear, disorganized presentation. (0-2)
Q&A Handling (5 Marks) (PO 9)	Confident, accurate, and concise responses. (5)	Good responses with minor gaps. (4)	Adequate responses; some uncertainty. (3)	Weak or hesitant responses. (2)	Unable to answer questions. (0-1)

Rubrics for Learning Activity 2: Sustainable Product Selection and Justification for a chosen Real-world Engineering Product (10 Marks) (To be conducted for 20 marks and the marks obtained shall be reduced to 10) Students will select one real-world engineering product (e.g., tooth paste, pharma products, food products, petroleum products, Drinking water plant, ground water pollution, and they will justify the choice of product based on properties, advantages, disadvantages, and application suitability, etc.,

Performance Indicators	Excellent	Good	Satisfactory	Needs Improvement	Poor
Material Selection & Relevance (10 Marks) (PO 1)	Chosen materials perfectly match the product requirements; strong justification using properties & industry relevance. **(9-10)**	Mostly relevant materials with good justification. **(7-8)**	Materials somewhat match requirements; justification partial. **(5-6)**	Poor material-product match; weak reasoning. **(3-4)**	Irrelevant material choice; no justification . **(0-2)**
Technical Content Accuracy (5 Marks) (PO 2)	All properties, types, advantages / disadvantages, and applications are correct and well-explained. **(5)**	Mostly accurate with minor errors. **(4)**	Adequate content; a few gaps or inaccuracies. **(3)**	Several inaccuracies; missing key aspects. **(2)**	Mostly incorrect or missing technical details. **(0-1)**
Organization & Presentation (5 Marks) (PO 10)	Well-structured, clear flow, good visuals/tables, and concise explanation. **(5)**	Clear structure; minor improvements needed. **(4)**	Acceptable structure but some clutter. **(3)**	Poor organization; difficult to follow. **(2)**	Disorganized; lacks clarity. **(0-1)**

Suggested Learning Activities may include (but are not limited to):

- Course Project
- Case Study
- Presentation Programming
- Assignment Tool/Software Exploration
- Literature Review
- Open Book Test (preferably at RBL4 and RBL5 levels)
- GATE-based Aptitude Test Assignment (at RBL3, RBL4, or RBL5 levels)
- Any other relevant and innovative academic activity
- Use of MOOCs and Online Platforms

Suggested Innovative Delivery Methods may include (but are not limited to):

1. Flipped Classroom
2. Problem-Based Learning (PBL)
3. Case-Based Teaching Simulation and
4. Virtual Labs Partial Delivery of course by Industry expert/ industrial visits
5. ICT-Enabled Teaching
6. Role Play