

## COURSE OUTCOMES

The following course outcomes demonstrate how the under graduate course in Chemical Engineering curriculum support the program's *outcomes*.

Course	Course Outcomes
Applied Engineering Chemistry	<p>Basic knowledge of chemistry required for any chemical engineer to demonstrate an ability to-</p> <ol style="list-style-type: none"> <li>1. Apply basic chemistry concepts to chemical process industries.</li> <li>2. Understand models used in studying and explaining the structure, and behaviour of atoms, molecules, solids, liquids and gases</li> </ol> <p>Demonstrate knowledge of the principles and distinguishing characteristics of ionic and molecular compounds based upon physical properties</p>
Mathematics	<p>The student will demonstrate ability to apply fundamental knowledge of mathematics required to analyse moderate chemical engineering systems.</p>
Process Calculations	<p>The student will demonstrate ability to</p> <ol style="list-style-type: none"> <li>1. Use the mole concept and perform calculations involving concentration expressed as mass and molar concentration</li> <li>2. Solve problems related to the quantitative aspects of chemical change; the principles of Stoichiometry</li> <li>3. Apply the gas laws to solve problems related to ideal gases and mixtures</li> <li>4. Perform calculations on vapour gas systems and use humidity charts</li> </ol> <p>Apply material and energy balances with and without chemical reaction in steady and unsteady state processes</p>
Mechanical Operations	<p>Graduate will demonstrate understanding of</p> <ol style="list-style-type: none"> <li>1. unit operation and their role in Chemical Engineering industries</li> <li>2. Characteristics of particulate solids, Principles of size reduction, crushing and grinding equipment.</li> <li>3. Mixing of solids and separation methods for different types of mixtures like solid-solid, solid-gas, solid-liquid</li> <li>4. Size enlargement: scope and applications, size enlargement techniques</li> </ol> <p>Conveying of bulk solids, classification and selection of conveyors for chemical process industries.</p>
Fluid Flow Operation	<p>The student will demonstrate ability to</p> <ol style="list-style-type: none"> <li>1. Understand fluid properties, static and kinetics and fluid flow regimes</li> <li>2. Specific knowledge regarding fluid-flow phenomena observed in engineering systems, such as flow in a pipe, boundary-layer flows, drag, etc.</li> <li>3. Apply basic fluid-flow principles and appropriate simplifying assumptions to produce a mathematical model of a physical fluid-flow system.</li> <li>4. Understand flow measuring, pumping and compressing systems</li> </ol>

	Solve fluid flow problems using softwares
Chemical Engineering Thermodynamics	<p>The graduate will have an ability to</p> <ol style="list-style-type: none"> <li>1. Understand Internal Energy, Kinetic Energy, Potential Energy, Work and Heat</li> <li>2. The First and Second Law of Thermodynamics and their application in engineering systems</li> <li>3. Find thermodynamic information for pure fluids as well as fluid mixtures and use it to perform thermodynamic calculations oriented to the analysis and design of chemical processes</li> <li>4. Estimate the thermodynamic properties, such as enthalpies, entropies, Gibbs energies, fugacity coefficients, and activity coefficients of pure fluids as well as fluid mixtures</li> </ol> <p>Predict equilibrium compositions of mixtures under phase and chemical-reaction equilibria</p>
Heat Transfer	<p>Students will demonstrate an ability to</p> <ol style="list-style-type: none"> <li>1. Understanding of the basic concepts of conduction, convection and radiation heat transfer,</li> <li>2. Apply the concepts of heat transfer and associated thermal boundary conditions to transform the physical system into a mathematical model, selecting an appropriate solution technique and evaluating the significance of results.</li> </ol> <p>Understand various types of heat Transfer equipments</p>
Chemical Reaction Engineering	<p>The student will demonstrate ability to</p> <ol style="list-style-type: none"> <li>1. To interpret batch and differential reactors data to obtain reaction rate expressions.</li> <li>2. Calculate volume of batch and flow reactors in constant- and variable-volume systems.</li> <li>3. Size isothermal and non-isothermal reactors for homogeneous and heterogeneous reactions</li> <li>4. Analyze multiple reactions carried out both isothermally and non-isothermally in flow, batch and semi batch reactors.</li> </ol> <p>Describe the steps in a catalytic mechanism and how one goes about deriving a rate law, mechanism, and rate-limiting step that are consistent with experimental data</p>
Chemical Technology –I	<p>Student will be able to explain the basic history, current issues, and trends in process industries. The students are informed about some basic industries with the help of process diagrams, material of construction used, chemical and physical processes involved including the equipments used, their safety precautions in design and operation. This shall give them first hand information about the environment in industries and prepare them well for industries</p>
Human Values & Professional Ethics	<p>No human being is perfect without the basic knowledge of human values and ethics in professional life. Basic inputs given in the course prepares the student to face the real life problems. This is very important for working in a team in the present day context.</p>
Industrial Sociology / Industrial Psychology	<p>The student will demonstrate ability to</p> <ol style="list-style-type: none"> <li>1. Understand the Nature and Scope of Industrial sociology and Psychology with Characteristics of the factory system and Work Environment</li> <li>2. Understand a variety of explanations accounting for human behaviour (in evolutionary and/or contemporary contexts)</li> <li>3. An understanding of the need for high ethical standards in the practice of engineering, including the</li> </ol>

	<p>responsibilities of the engineering profession towards people and the environment.</p> <ol style="list-style-type: none"> <li>Identify and employ various research designs and their appropriate application to the study of social life, Performance Management, Training &amp; Development</li> <li>Identify the role of Motivation and Job satisfaction, stress management. Organizational culture, Leadership &amp; group dynamics</li> </ol> <p>The ability to communicate effectively with the engineering community and with society at large handling contemporary issues, grievance and Industrial disputes</p>
General Proficiency	<p>The performance of the student is continuously monitored by the class coordinators in discipline, participation in extra activities, general behaviour as an individual and in a team, his attendance etc. Based on overall evaluation, GP marks are awarded. This helps him to mould into a good professional.</p>
Engineering and Managerial Economics	<p>The course shows how economic principles can be applied to a company's decision making in terms of economic viability. In particular a student will be able to:</p> <ol style="list-style-type: none"> <li>Understand demand analysis, forecasting, Market Structure, and various market conditions. Laws of returns and cost curves.</li> <li>Understand various policies to develop market structures.</li> </ol> <p>Understand the various types and phases of a business cycle.</p>
Computer based Numerical Methods	<p>Be aware of the use of numerical methods in modern scientific computing the graduate would be familiar with:</p> <ol style="list-style-type: none"> <li>finite precision computation</li> <li>solutions of nonlinear equations in a single variable</li> <li>numerical interpolation and approximation of functions</li> <li>numerical integration and differentiation</li> <li>numerical solution of ordinary differential equations</li> </ol> <p>calculation and interpretation of errors in numerical methods</p>
Mass Transfer Operations	<p>The student will demonstrate ability to</p> <ol style="list-style-type: none"> <li>Solve diffusion equation for concentration and flux as a function of position in rectangular with various boundary conditions.</li> <li>Apply fundamentals of phase equilibrium to calculate compositions in equilibrium in liquid/liquid, solid/liquid, and liquid/vapor separation units.</li> <li>Identify and use the correct engineering correlations of diffusion and mass transfer coefficients to model a separation process</li> </ol> <p>Analyse a multi-stage equilibrium separation processes, simultaneous phase equilibrium and mass balances in continuous separation processes (absorbers, strippers, and distillation columns) and sizing continuous separation units.</p>
Process Instrumentation	<p>The student will demonstrate ability to:</p> <p>Understand principles involved in the measurement and control of industrial processes; instruments and devices available for designing process control systems.</p>

Industrial Management	<p>The need of Managerial skills is very much needed in every technocrat and thus basic inputs are given in this industrial management course to run the organisation. Human resource management is sometimes more important than the technical and financial management in industries. Proper understanding of this aspect is very important for success in life.</p> <p>The student will be able to understand:</p> <ol style="list-style-type: none"> <li>1. The development, application and scope of industrial management.</li> <li>2. The principles of management, production planning, specifications and requirements.</li> <li>3. The models used for inventory control.</li> <li>4. The concept and various methods used in quality control management.</li> </ol> <p>The control of environmental pollution by using proper managerial techniques.</p>
Departmental Elective –I (Energy Management)	<p>The energy cost is rising very steeply in all the industries and in some of the industries this is as high as 20 to 25 % of the production cost. All the industries are thus looking seriously at this aspect and giving due attention on Energy Mgt. as per specific need. Steel, paper, cement are some basic industries but their power consumptions are also very high. Energy specialists are in great demand thus this course is very important for chemical Engineers.</p>
Departmental Elective –II Optimization Techniques in Chemical Engineering	<p>No process can be operated under free conditions and optimum operation is needed in every operation. This requires proper analysis of the process data and proper modelling can lead to optimum conditions and optimum operation. Proper knowledge of mathematical tools for a particular process must be known to the students. Many standard programs are available and some may have to be developed for specific cases.</p>
Process Dynamics & Control	<p>The student will demonstrate ability to</p> <ol style="list-style-type: none"> <li>1. Develop fundamental and empirical models for dynamic processes.</li> <li>2. Implement dynamic models with or without controllers</li> <li>3. Analyse properties, e.g., stability, speed of response, frequency response, etc., of dynamic models and processes</li> <li>4. Analyse PID controllers and more advanced controllers to achieve desired performance.</li> <li>5. Understand various complex control schemes, characteristics and application of control valves.</li> </ol> <p>Understand various controller designs, and methods of controller tuning.</p>
Process Equipment Design	<p>The student will demonstrate the ability</p> <ol style="list-style-type: none"> <li>1. To make student understand the principles and theories combined with a practical knowledge of the limits imposed by environmental, safety and health concerns to design of new process and expansion and revision of the existing process.</li> <li>2. Understand various mechanical properties of materials to be used as material of construction, resistance of metals to corrosion under varying conditions of temperature and pressure.</li> <li>3. Conveniently use various codes and standards in design and their application in designing new processes.</li> <li>4. Design various equipments such as tall vessel, unfired pressure vessels internal or external pressure and with various heads and closures including nozzles, openings and reinforcements, Bolts, flanges, gaskets</li> </ol>

	<p>5. Process and mechanical design of selected equipment like Heat Exchanger, Distillation column, Evaporator, Adsorption column, Reactors and Dryers and Crystallizers.</p> <p>The use of softwares for design of equipments.</p>
General Proficiency	The performance of the student is continuously monitored by the class coordinators in discipline, participation in extra activities, general behaviour as an individual and in a team, his attendance etc. Based on overall evaluation, GP marks are awarded. This helps him to mould into a good professional.
Open Elective- I (Quality Management)	The need of quality production is very much needed in every industry and thus basic inputs are given in this course to run the organisation to maintain quality on sustained basis. Quality management is sometimes most important in industries. Proper understanding of this aspect is very important for the success in competitive market.
Departmental Elective –III (Environmental Pollution Monitoring and Control)	<p>The graduate would be able to</p> <ol style="list-style-type: none"> <li>1. Build a scientific literacy which will permit a greater understanding industrial processes, products and environmental concerns and how everyday life depends on chemical phenomena</li> <li>2. water pollution and environmental noise assessment.</li> <li>3. To develop an understanding of the sources of air pollution, water pollution and environmental noise.</li> <li>4. Compare and contrast the various laboratory- and field-based techniques used in pollution monitoring for the assessment and control of air, land and water pollution.</li> </ol> <p>an understanding of the monitoring and modelling techniques used in air pollution</p>
Departmental Elective –IV Process Utility and Safety In Chemical Plants	Completion of this course, the student will understand the importance of health, safety and the environment in process industries. Steam, power, water, air are extensively used in process industries and their efficient operation is imperative for economic and safe operation is essential for the survival of industries. Case studies indicating their importance are given to the students. The various equipments such as compressors, blowers, boilers, vacuum pumps, pipe lines, pumps are discussed in detail which is important for chemical engineers.
Process Modelling & Simulation	<p>The student will be able to:</p> <ol style="list-style-type: none"> <li>1. Understand various types of models such as empirical models, hybrid models etc.</li> <li>2. Develop mass balance, energy balance and momentum balance equation for various chemical process systems.</li> <li>4. Develop various models for various systems such as reactor, distillation column, heat exchangers and analyse their behaviour.</li> <li>3. Solve various types of equations including linear, non-linear, ordinary and partial differential equations</li> <li>5. apply commercial softwares to simulate various processes of chemical industries such as refineries, petrochemical plants, biodiesel plants etc.</li> </ol>
Plant Design & Economics	<p>The graduate would be able to</p> <ol style="list-style-type: none"> <li>1. Develop plant layout drawings that will help in installation procedures of new process plants.</li> <li>2. Understand the start-up and shutdown procedures of various process plants.</li> <li>3. Understand the basic engineering fundamentals that include process selection, flow sheet preparation and economics of the particular process plant.</li> </ol>

	<p>4. Understand the basic concepts of cost estimation and profitability analysis of process plants.</p> <p>5. Understand process equipment design concepts Perform various optimization techniques to optimize various parameters such as heat duty of heat exchanger, production rate of various process plants.</p>
<p>Open Elective- II (Non Conventional Energy Recourses)</p>	<p>Wind energy, solar energy, tidal waves are such energies which are available from natural resources and are classified as Non conventional energy resources which are normally based on fossil fuels or petroleum resources. This is also giving an opportunity to students to work as entrepreneurs with small investments or help NGOs for use of solar energy in different forms.</p>
<p>Departmental Elective –V (Advanced Separation Technology)</p>	<p>The student will demonstrate the ability to</p> <ol style="list-style-type: none"> <li>1. Understand equilibrium and rate governed multistage separation processes.</li> <li>2. Understand characterization of membranes and separation processes such as reverse osmosis, dialysis, ultra filtration, and electrodialysis.</li> <li>3. Determine the rate of permeate flux for gas permeation through polymeric membranes.</li> <li>5. Study chromatographic separation techniques and molecular sieve separation techniques.</li> </ol>
<p>Departmental Elective –VI (Petroleum Refining Technology)</p>	<p>The student will able to:</p> <ol style="list-style-type: none"> <li>1. Posses knowledge of origin occurrence and exploration of crude oil</li> <li>2. Understand composition and Characterisation for various types of crude oil.</li> <li>3. Demonstrate a knowledge of petroleum products and quality control</li> <li>4. understand processing of crude oil into finished fuels and other products including lube oil, bitumen and asphalt</li> </ol>
<p>Transport Phenomena</p>	<p>The student will able to:</p> <ol style="list-style-type: none"> <li>1. Understand analogy between momentum, heat and mass transfer the basic laws of fluid flow, heat transfer and mass transfer.</li> <li>2. apply of Navier's strokes equation in fluid flow heat transfer and mass transfer problems</li> <li>3. Able to find the stress distribution and velocity profiles for a fluid flow inside a shell or annulus.</li> <li>4. To find the friction factors for flow in tubes, for flow around spheres, for packed beds column.</li> <li>5. Develop temperature distribution profiles inside a shell, solid surface and extended surfaces such as fins.</li> <li>6. Study of diffusion in homogenous and heterogeneous chemical reactions.</li> </ol>