Chemical engineering syllabus

Chemical engineering examinations

Group A - Compulsory examinations (six required)

16-Chem-A1 Process Balances and Chemical Thermodynamics

The analysis of industrial and chemical processes; mass conservation and energy conservation; thermochemistry; properties of pure substances; properties of solutions; energy and the first law of thermodynamics; the second law of thermodynamics and entropy; applications of the laws of thermodynamics to problems in the behaviour of fluids, flow processes, power cycles, refrigeration and heat pumps, phase equilibria and chemical reaction equilibria.

Textbooks (most recent edition is recommended):


16-Chem-A2 Unit Operations and Separation Processes (formerly Mechanical and Thermal Operations)

Incompressible and compressible fluid flow. Flow through packed beds, fluidization. Particle size distribution. Mechanical operations such as mixing and blending, filtration and sedimentation. Thermal operations such as evaporation and crystallization. Application of equilibrium theory and rate considerations for absorption, adsorption, distillation, drying, extraction, membrane separation, leaching.

Textbooks (most recent edition is recommended):


16-Chem-A3 Heat and Mass Transfer

Theory and practice of conductive, convective, and radiative heat transfer; design of heat exchangers; heat transfer involving phase change. Diffusion and permeability; mass transfer through stagnant and moving films; the concept of equilibrium stages; estimation and use of overall heat and mass transfer coefficients in the design of process equipment.

Textbooks (most recent edition is recommended):


16-Chem-A4 Chemical Reactor Engineering

Application of the principles of chemical kinetics and other rate phenomena to the design of chemical reactors. Dynamics in chemical systems, including chemical kinetics, catalysis and transport processes. Theory of idealized isothermal reactors including batch, plug flow, and continuous stirred tank reactors for single and multiple reactions. Residence time distributions and their effect on conversion. Simple adiabatic and non-isothermal reactors with homogeneous and heterogeneous reactions; thermal run-away reactions.

Textbooks (most recent edition is recommended):

16-Chem-A5 Chemical Plant Design and Economics

Structure of chemical process systems and systematic methods for capital and operating cost calculations. Economic factors in design, economic balances, capital and operating cost estimation techniques, assessment of alternative investments and replacements, and application of compound interest calculations. Simple optimization theory. Evaluation of process alternatives. Equipment and materials selection. Factors such as energy, safety, hygiene, and environmental protection. Familiarity with computer process simulation. Intrinsically safe design. Risk analysis. The use of heuristics in design of chemical processes.

Textbooks (most recent edition is recommended):

16-Chem-A6 Process Dynamics and Control


Textbooks (most recent edition is recommended):

Group B - Optional examinations (three required)

16-Chem-B1 Transport Phenomena

The application of integral and differential techniques for solving problems involving mass, energy and/or momentum transport through solids and within fluids. Steady and unsteady state processes. Molecular transport. Convective transfer of heat and mass involving laminar and turbulent fluid flows.

Textbooks (most recent edition is recommended):

16-Chem-B2 Environmental Engineering


Textbooks (most recent edition is recommended):

16-Chem-B3 Simulation, Modelling, and Optimization

The analysis and modelling of chemical processes using either a mechanistic or an empirical input/output approach. Subsystem modelling to reduce complex processes to simpler component parts. Linearization of non-linear processes. Optimization methods; direct search, climbing and elimination techniques, linear and non-linear programming.

Textbooks (most recent edition is recommended):
• P. Venkataraman, Applied Optimization with Matlab Programming John Wiley.

16-Chem-B4 Biochemical Engineering

Basic microbiology and chemistry of cells, biochemical kinetics, enzymes, metabolic pathways, energetics, transport phenomena and reactor design as applied to biochemical reactors, scale-up, fermentation technology.

Textbooks (most recent edition is recommended):

16-Chem-B5 Pulp and Paper Technology


Textbooks (most recent edition is recommended):

16-Chem-B6 Petroleum Refining and Petrochemicals


Textbooks (most recent edition is recommended):

16-Chem-B7 Extractive Metallurgy


Textbooks (most recent edition is recommended):


16-Chem-B8 Polymer Engineering

Basic polymer structures and characterization of polymer physical, chemical, and mechanical properties. Polymerization reactions and kinetics; chain formation and co-polymerization. Polymerization processes: bulk, suspension, solution, and emulsion polymerizations. Polymer flow behaviour describing non-Newtonian and visco-elastic effects. Polymer processing including extrusion, moulding and film production. Polymer systems: additives, blends, composites, and fibre reinforcement.

*Textbooks (most recent edition is recommended):*
- J. Fried, *Introduction to Polymer Science and Technology*. Prentice Hall.

16-Chem-B9 Advanced Materials

Properties, production of and uses of composites, engineered plastics, biopolymers, special coatings, and nanostuctured materials with emphasis on structure property relationships.

*Textbooks (most recent edition is recommended):*
- No Referenced Textbooks

16-Chem-B10 Life Cycle Assessment (LCA)

Concepts of life cycle assessment. Applications to energy utilization, environment, sustainable development and process analysis and optimisation.

*Textbooks (most recent edition is recommended):*
- No Referenced Textbooks

16-Chem-B11 Nuclear and Nuclear Chemical Processes

The properties of actinides; radioactivity; processes of mining, refining and enrichment of uranium; reactor materials and design; reprocessing chemistry; waste management.

*Textbooks (most recent edition is recommended):*
- No Referenced Textbooks