

Syllabus for Chemical Engineering Master's

Section 1: Subject Knowledge

Please Note: A Total of 40 Questions will be asked, combining the following topics, with the difficulty level commensurate to a Master's Candidate.

Unit I: Engineering Mathematics

Linear Algebra, Calculus, Differential equations, Complex variables, Probability and Statistics, Numerical Methods.

Unit II: Process Calculations and Thermodynamics

Steady and unsteady mass and energy balances for multiphase, multicomponent, reacting, and non-reacting systems. Concepts of tie components, recycle, bypass, purge calculations, Gibb's phase rule, and degree of freedom analysis, First and second laws of thermodynamics, Properties of pure substances and mixtures, Phase equilibria and chemical reaction equilibrium.

Unit III: Fluid Mechanics and Mechanical Operations

Fluid statics, surface tension, Newtonian and non-Newtonian fluids, and transport properties, shell balances, continuity and motion equations, energy balances, dimensional analysis, pipeline flow, pumps, compressors, boundary layer theory, and turbulent flow (velocity profiles, pressure drop).

Unit IV: Heat Transfer

Energy equation, steady/unsteady heat conduction, convection, and radiation. Thermal boundary layers, heat transfer coefficients, boiling, condensation, evaporation, and process calculations for heat exchangers and evaporators. Design of double-pipe, shell-and-tube heat exchangers, and single/multiple-effect evaporators.

Unit V: Mass Transfer

Fick's laws, molecular diffusion, and mass transfer coefficients. Topics include film, penetration, and surface renewal theories, transfer analogies, HTU/NTU concepts, and stage efficiencies. Design and operation of distillation, absorption, leaching, extraction, drying, humidification, dehumidification, adsorption, and membrane separation equipment.

Unit VI: Chemical Reaction Engineering

Theories of reaction rates, kinetics of homogeneous reactions, and interpretation of kinetic data. Ideal and non-ideal reactors, residence time distribution, enzyme kinetics, non-isothermal reactors, heterogeneous catalytic reactions, diffusion effects in catalysis, and catalyst deactivation models.

Unit VII: Instrumentation and Process Control

Measurement of process variables, sensors, transducers, and P&ID symbols. Modeling, linearization, transfer functions, dynamic responses, process reaction curves, controller modes, control valves, and transducer dynamics. Covers closed-loop system analysis, stability, frequency response, controller tuning, cascade, and feed-forward control.

Unit VIII: Plant Design and Economics

Principles of process economics and cost estimation including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow, optimization in process design and sizing of chemical engineering equipment such as heat exchangers and multistage contactors.

Unit IX: Chemical Technology

Inorganic chemical industries, fertilizers, natural products industries, petroleum refining and petrochemicals, and polymerization industries.

Section 2: Fundamental Skills

Please Note: A Total of 24 Questions will be asked, combining the following topics, with the difficulty level commensurate to a Masters Candidate.

Unit I: Data Analysis

Unit II: Math and Statistics

Unit III: Lab Skills

Unit IV: Reading and Writing

Section 3: Specific Skill Proficiency

This section has multiple skills. You can select the ones you are proficient in from the enrollment form. You can select a maximum of 4 skills.