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राष्ट्रीय प्रौद्योगिकी संस्थान दुगापुर
NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR
MAHATMA GANDHI AVENUE, DURGAPUR-713209 (West Bengal), INDIA

Syllabus of Ph.D. Admission Test for the Department of Chemical Engineering

COMPULSORY

Section 1: Engineering Mathematics

Linear Algebra: Matrices, determinants, eigenvalues, and systems of equations.

Calculus: Limits, differentiation, integration, and multiple integrals.

Differential Equations: Ordinary differential equations (first and second order), introduction to partial differential equations, and Laplace transforms.

Probability and Statistics: Probability distributions, mean, variance, hypothesis testing, and regression.

Section 2: Basic Sciences and Environment

Basic Physics: Laws of motion, fundamentals of thermodynamics, optics, and wave mechanics.

Basic Chemistry: Physical chemistry, chemical equilibrium, reaction kinetics, and basic concepts of organic and inorganic chemistry.

Environmental Science: Structure of the atmosphere and its layers; global warming, ozone depletion, acid rain; water resources and pollution; types of pollutants and their impact on air and water.

Section 3: Chemical Engineering Fundamentals

Process Calculations and Thermodynamics: Mass and energy balances under steady and unsteady state conditions; Gibbs phase rule and degree of freedom analysis; laws of thermodynamics; phase equilibria; vapor-liquid equilibrium (VLE); and chemical reaction equilibrium.

Fluid Mechanics and Mechanical Operations: Fluid statics, Bernoulli equation, flow measurement devices, pumps, dimensional analysis, flow through packed and fluidized beds; particle size analysis, filtration, centrifugation, and cyclone separators.

Heat Transfer: Modes of heat transfer—conduction, convection, and radiation; boiling and condensation; heat exchangers (double pipe and shell-and-tube); evaporators.

Mass Transfer: Fick's laws of diffusion; diffusion in fluids; mass transfer theories; operations such as distillation, absorption, extraction, drying, and adsorption; HTU and NTU concepts.

Chemical Reaction Engineering: Theories of reaction rates; ideal reactors (batch, CSTR, PFR); non-ideal reactors; residence time distribution (RTD); non-isothermal reactors; heterogeneous catalysis.

OPTIONAL

(Candidates must attempt exactly ONE of the following options.)

Option 1: Advanced Chemical Engineering

Advanced thermodynamics (equations of state, fugacity, excess properties); advanced reactor design (non-ideal and catalytic reactors); transport phenomena involving combined momentum, heat, and mass transfer.

Option 2: Basic Sciences

Physical chemistry (thermodynamics, electrochemistry, spectroscopy); reaction kinetics (rate laws, mechanisms, activation energy); basic biochemistry (biomolecules and enzyme kinetics).

Option 3: Interdisciplinary Areas

Environmental engineering (wastewater treatment, pollution control, remediation); energy systems (conventional fuels and renewable sources such as solar, wind, biomass, tidal, and geothermal); basic biochemical engineering (enzyme and cell kinetics, bioreactors, fermentation).