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

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

COMPULSORY

Section 1: Engineering Mathematics

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

Section 2: Basics of physics and Chemistry

Law of motion, multibody dynamics, optics and wave mechanics
Organic chemistry, inorganic Chemistry and Physical Chemistry

Section 3: Environmental Science

Constituents of our Environment & the Natural Resources: Atmosphere—its layers, their characters; Global warming, Ozone depletion, Acid rain, etc., Hydrosphere - Its constituents, Oceans, Groundwater, Surface waters.

Pollution: Pollutants and their role in air and water pollution.

Section 4: Process Calculations and Thermodynamics

Steady and unsteady state mass and energy balances including multiphase, multi-component, reacting and non-reacting systems. Use of tie components; recycle, bypass and purge calculations; Gibb's phase rule and degree of freedom analysis.

First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Refrigerants and their properties, Refrigeration and Liquefaction. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

Section 5: Fluid Mechanics and Mechanical Operations

Fluid statics, Newtonian and non-Newtonian fluids, shell-balances including differential form of Bernoulli equation and energy balance, Macroscopic friction factors, dimensional analysis and similitude, flow through pipeline systems, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds, Turbulent flow: fluctuating velocity, universal velocity profile and pressure drop.

Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitation and mixing; conveying of solids.

Section 6: Heat Transfer

Steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations. Design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.

Section 7: Mass Transfer

Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption.

Section 8: Chemical Reaction Engineering

Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

Section 9: Conventional and Non-conventional Energy resource

Solid, Liquid and Gaseous fuels, Wind energy, solar energy, tidal energy, geothermal energy, energy from bio mass, ocean energy

Section 10: Chemical and biochemical Engineering

Free and immobilized enzymatic kinetics and its application, cell growth kinetics and its applications, bio reactors

OPTIONAL: (Candidates must attempt any one)

1. Waste water treatment
2. Advanced separation
3. Fuel and Combustion
4. Bio-Energy synthesis
5. Nano materials : Development and characterization
6. Computational Fluid Dynamics
7. Process Optimization