

उ०प्र० लोक सेवा आयोग,
संख्या-७६६/१/ई-४/२०१९-२० टी०सी०-।
प्रयागराज: दिनांक ०१ अक्टूबर २०२०

विज्ञापित

सम्मिलित राज्य अभियंत्रण सेवा (सामान्य चयन/विशेष चयन परीक्षा-२०१९ का (विज्ञापन संख्या-ए-५/ई-१/२०१९) के क्रम में एतद्वारा सूचित किया जाता है कि सहायक निदेशक कारखाना पद हेतु केमिकल इंजी० एवं इण्डस्ट्रीयल इंजी० के पाठ्यक्रम को समाहित करते हुए परीक्षा योजना निम्नवत् है:-

परीक्षा योजना

सम्मिलित राज्य अभियंत्रण सेवा परीक्षा हेतु वस्तुनिष्ठ प्रकार के निम्नवत् दो प्रश्नपत्र होंगे:-

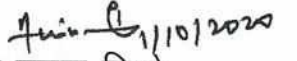
प्रथम प्रश्न पत्र

विषय	प्रश्नों की संख्या	अंक	कुल अंक	समय
१-सामान्य हिन्दी	२५ (प्रत्येक प्रश्न ३ अंक)	७५	३७५	२.३० (ढाई) घण्टा
२-मुख्य विषय (सिविल इंजी०-।, मैके० इंजी०-।, विद्युत इंजी०-।, कृषि इंजी०-।, केमिकल इंजी०-।, इण्डस्ट्रीयल इंजी०-।	१०० (प्रत्येक प्रश्न ३ अंक)	३००		

द्वितीय प्रश्न पत्र

विषय	प्रश्नों की संख्या	अंक	कुल अंक	समय
१-सामान्य अध्ययन	२५ (प्रत्येक प्रश्न ३ अंक)	७५	३७५	२.३० (ढाई) घण्टा
२-मुख्य विषय (सिविल इंजी०-।।, मैके० इंजी०-।।, विद्युत इंजी०-।।, कृषि इंजी०-।।, केमिकल इंजी०-।।, इण्डस्ट्रीयल इंजी०-।।	१०० (प्रत्येक प्रश्न ३ अंक)	३००		

केमिकल इंजी० एवं इण्डस्ट्रीयल इंजी० का पाठ्यक्रम आयोग की वेबसाइट <http://uppsc.up.nic.in> पर उपलब्ध है।


(अरविन्द कुमार मिश्र)
परीक्षा नियंत्रक।

Syllabus for the post of Assistant Director (Factory)

for one of the prescribed subjects as

INDUSTRIAL ENGINEERING

Paper – I.

Note: Answer any Five questions, at least two from each part.

PART 'A'

- (A) **Statics and Dynamics:** Suspension cables, Friction, Trusses, Principle of virtual work; Kinematics of rigid bodies – plane motion, absolute motion; Kinetics of rigid bodies – plane motion, force, mass and acceleration, work and energy, impulse and momentum.
- (B) **Theory of Machines:** Velocity and acceleration of links; Cams; Gears and gear trains; Clutches; Belt drives; Brakes and dynamometers; Flywheel and governors; Balancing of rotating and reciprocating masses and multi-cylinder engines; Free, forced and damped vibrations; Critical speed.
- (C) **Mechanics of Solids:** Stress and strain in two dimensions; Mohr's circle; Strain rosettes; Torsion of circular shafts; Stresses and deflection due to bending of beams; Castigliano's theorem; Shrink fit; Stability of columns.
- (D) **Materials Science:** Atomic structure; Crystal systems; Imperfections; Polymers; Elastomers and ceramics; Mechanical behaviour of materials; True and conventional stress-strain curves for common engineering materials; Strain hardening; Fracture, creep and fatigue.

PART 'B'

- (A) **Manufacturing Science & Production Processes:** Merchant's theory; Taylor's equation; Machinability; Conventional manufacturing processes – Casting and welding, the related defects; Unconventional manufacturing processes – EDM, ECM and ultrasonic machining; Forming processes – High velocity forming, explosive forming; Surface roughness and its measurement; Gauges, Comparators, Jigs and fixtures.
- (B) **Basic Production Management:** Scientific Management; Work analysis – time and motion study, work sampling; Value engineering; Line balancing and work station design.
- (C) **Basic Operations Research:** Graphical and simplex method for linear programming; Transportation and assignment models; Elementary queueing theory.
- (D) **Basics of Project Management:** Need for management of projects, CPM and PERT methods, Project costing; Project crashing; Slack and float determination; Resource allocation problem – resource leveling and resource balancing.

Paper – II

Note: Answer any Five questions, at least two from each part.

PART 'A'

- (A) **Thermodynamics:** Applications of first and second law of thermodynamics; Detailed analysis of thermodynamic cycles.
- (B) **Fluid Mechanics:** Reynold's transport theorem and its applications; Ideal fluid flow; Velocity distribution for laminar and turbulent flow in pipes; Dimensionless analysis and similitude; Forces on immersed bodies and boundary layer over a flat plate.
- (C) **Heat Transfer:** Conduction in the presence of heat sources and sinks; One-dimensional unsteady conduction; Time constant for thermocouples; Momentum and energy equations for boundary layers on a flat plate; Dimensionless numbers; Free and forced convection; Nature of radiant heat; Basic radiation heat transfer.
- (D) **Energy Conversion:** Combustion phenomenon in S.I. and C.I. engines; Carburetion and fuel injection; Classification of hydraulic turbines and specific speed; Centrifugal and reciprocating pumps; High pressure boilers.

PART 'B'

- (E) **Refrigeration and Air-Conditioning:** Vapour compression, vapour absorption and air refrigeration systems; Properties of important refrigerants; Psychrometric properties and relations; Use of psychrometric chart; Estimation of cooling load.
- (F) **Quality and Reliability:** Quality needs and parameters; Statistical quality control charts – \bar{x} , R , p , σ , c and u charts, operating characteristics curve; Quality assurance – single and double sampling plans, sampling with rectification, operating characteristic curve, average sample size; Reliability – measurement for parallel and series systems; Life expectancy; Types of maintenance.
- (G) **Production Planning and Control:** Types of production systems; Plant and machinery layout considerations and techniques; Aggregate planning; Inventory planning and control models for discrete demand and single-period stochastic demand; service level and safety stock; Materials classification schemes; MRP, MRP-II, CRP; Scheduling and sequencing methods; JIT production system; KANBAN systems; Productivity.
- (H) **Engineering and Managerial Economics:** Economic evaluation techniques – present worth, future worth, annuity, IRR, ERR methods; Depreciation techniques; Financial statements – balance sheet, profit and loss account, financial ratios; Financial instruments – shares, debentures, bonds; Financial instruments' evaluation.

Post: Assistant Director (Factory)

Syllabus for Chemical Engineering Paper – I

Note: In all five questions should be answered by the candidates, with at least two from each part

Part - A

1. **Material and Energy Balances:** Engineering Dimensions and Units; Gas Laws and Vapor Pressure; Conservation of Mass and Energy; Material Balance with and without Reactions and Recycle

Operations Involving Particulate Solids: Properties and Handling of Particulate Solids; Size Reduction- Crushing and Grinding and Related Equipment; Particle Classification; Mixing of Solids and Pastes; Sedimentation and Settling; Centrifugal Separators

2. **Thermodynamics:** Perfect Gas Laws; Real Gases; General Energy Equations; Change of States; Laws of Thermodynamics; Concept of Chemical Equilibrium; Free Energy and its Applications; Fugacity and Activity Coefficients
3. **Fluid Flow Operations:** Pressure Measuring Devices; Viscosity of Fluids; Equations of Fluid Flow for Compressible and Incompressible Fluids; Laminar and Turbulent Flow in Pipes; Reynolds Number; Pressure Loss; Economic Pipe Selection; Metering of Fluid Flow; Similarity Between Energy, Mass, and Momentum Transfer, Non-Newtonian Fluids; **Compressors, Pumps, Fans and Blowers:** Classification; Properties; Characteristic Curves; Parallel and Series Operations; Noise; Agitation and Mixing of Liquids
4. **Heat Transfer Operations:** **Conduction:** Basic Concepts; Film Coefficients; Composite Wall; Log Mean Values; Lagging Materials and Critical Insulation Thickness; **Convection:** Forced and Natural Convection; Film Coefficients, Heat Exchangers; Heat Transfer to Fluids with Phase Change; **Radiation:** Laws and Factors Governing Radiative Heat Transfer; Combination of Heat Transfer Modes; Unsteady-state Heat Transfer

Part B

1. **Mass Transfer Operations:** Diffusion; Convective Mass Transfer; Phase Equilibrium; Mass Transfer with Phase Change; **Evaporation and Drying:** Evaporation Equipment and Operation Methods; Heat Transfer Coefficient in Evaporators; Single, Double and Multiple Effect Evaporators; **Drying:** Water Vapor Pressure and Humidity; Psychrometric Charts; Equilibrium Moisture Content of Materials; Methods of Drying; Constant and Falling Rate Drying Curves; Equipment for Drying; **Crystallization:** Solubility Curves; Crystallization; Crystallizers
2. **Gas-Liquid and Vapor- Liquid Separation Processes:** Types of Separation Processes and Methods; Equilibrium between Phases; Single and Multiple Equilibrium Stages; Mass Transfer between Phases; Humidification; Absorption, Driving Force, Packed Absorption Tower, Bubble Plate Absorption Tower, Absorption Tray Efficiencies; **Vapor-Liquid Separation Processes:** Vapor-Liquid Equilibrium; Constant Boiling Mixture; Distillation Methods; Volatility; Simple Distillation Methods; Distillation with Reflux and McCabe-Thiele Method; Distillation Tray Efficiencies; Azeotropic Mixtures
3. **Liquid-Liquid and Solid-Liquid Separation Processes:** Single and Multi-stage Stage Liquid-Liquid Extraction Processes; Equipment for Liquid-Liquid Extraction; Filtration- General Relationships; Constant Pressure and Constant Rate Filtration; **Liquid-Solid Leaching:** Basic Concepts and Equipment; Equilibrium Concepts; Single and Multi-stage (Counter-current) Leaching
4. **Chemical Reactions and Reactors and Process Control:** Zero, First, Second and Non-linear Order Reactions; Half-Life and Doubling Time; Consecutive Reactions; Mixed Batch Reactors; Plug-Flow Reactors; Completely Mixed-Flow Reactors; Mixing Models; Comparison of Reactor Performance; **Process Control and Instrumentation:** First and Second Order Systems; Physical and Block Diagrams; Input, Controlling, and Actuating Means; Final Control Elements; Input Functions and Their Type; Oscillatory Element; Control and Measurement of Concentration, Flow, Level, Pressure, Temperature Control Systems; Mechanical Dampers; Distillation Column Control; Computer Aided Process Control

Post: Assistant Director (Factory)

Syllabus for Chemical Engineering Paper - II

Note: In all five questions should be answered by the candidates, with at least two from each part.

Part A

1. **Process Equipment and Plant Design:** Cylindrical and Spherical Vessels; Theories of Failures; Types of Formed Heads; Crown and Knuckle Radius; Static and Dynamic Stresses; Longitudinal and Circumferential Stresses; Joint Efficiency
2. **Materials of Construction:** Corrosion and Application of Corrosion Resistant Materials; Polyethylene, Polypropylene; Poly Vinyl Chloride; Rubber; Teflon; Glass; Cast Iron; Lead; Stainless Steel; Monel; Hestelloy; Nickel Alloys; Titanium Alloys; Insulating Materials
3. **Energy Resources and Conservation:** Renewable and Non-renewable Energy Resources; Solar Energy; Fossil Fuels-Classification and Composition; Physico-chemical Characteristics and Energy Content of Coal, Petroleum, and Natural Gas; Wind Energy; Biomass and Biogas; Energy Use Pattern and Future Energy Needs; Energy Conservation Policies; **Combustion:** Ultimate Analysis of Coal; Proximate Analysis of Coal; Analysis of Fuel Gas; Heating Value of Fuels; Combustion Chemistry and Equations; Combustion of Solid, Liquid and Gaseous Fuels; Air for Combustion
4. **Inorganic Industries: Steam and Water:** Water Treatment; Distribution of Water; Saturated and Superheated Steam; **Inorganic Industries:** Acids: Hydrochloric, Hydrofluoric, Hydrobromic, Sulfuric, Nitric Acids; Cement and Lime; Chloralkali; Nuclear; Explosives and Propellants; Fertilizers

Part B

1. **Organic Industries:** Petroleum Refining; Petrochemicals- Methane, Ethylene, Acetylene, Propylene, Butene; Polymerization Techniques; Chemicals from Aromatics; ^{Herbicides} Pesticides and Insecticides; Paint and Varnish; Oils, Soap and Detergents; **Fermentation Industries and Herbal Products:** Production of Alcohols; Mint and Essential Oils; Flavor and Fragrance
2. **Industrial Pollution Control- Wastewater Treatment:** Sources, Type and Effects of Pollutants; Collection and Transport, Preliminary and Primary Treatment, Secondary Treatment, Tertiary Treatment, Sludge Treatment and Disposal, Selection of Treatment Strategies; Design of ETP for Industrial Wastewater Effluent from Paper, Tannery, Sugar, Distillery, Dyeing, Fertilizer, Pharmaceutical and Pesticide Industries;
3. **Industrial Pollution Control-Air Pollution, Solid Wastes and Noise Pollution:** Major Air Pollutants, Sources and Effects of Air Pollutants, Air Quality Standards; Air Quality Control- Treatment of Gaseous and Particulate Emissions, Dispersion of Pollutants; **Solid Waste:** Generation, Collection and Characterization of Solid Wastes; Reuse, Recycling and Combustion of Solid Wastes, Hazardous Wastes and their Management; **Noise Pollution:** Measurement of Noise; Effect on Human Health and Work Efficiency; Noise Abatement and Control
4. **Hazard and Risk Analysis and Safe Working Practices and Personnel Protection:** Hazard Analysis; Risk Assessment and Management; Hazard and Operability Studies: **Fire and Fire Hazard:** Fire Prevention and Fire Fighting in Chemical Plants; **Safe Working Practices and Personnel Protection:** Handling, Storage and Transportation of Materials; Intrinsic and Extrinsic Safety; Safe Working Practices; Importance of Good House-keeping; Work-place Safety; Personnel Protection Equipment; **Engineering Decisions:** Decisions Based on Technical, Cost/Effectiveness, Cost/Benefit, Risk, Environmental and Ethical Decisions

Herbicides