JAMMU & KASHMIR ENERGY DEVELOPMENT AGENCY (JAKEDA)

SYLLABUS FOR WRITTEN TEST FOR JUNIOR ENGINEERS IN VARIOUS DISCIPLINES

S. No	Examination Type	Subjects	No. of Questions	Marks	Duration
1	Multiple Choice Questions	General Intelligence and Reasoning General Awareness (Common to all disciples)	20	20	2 hrs
2		Discipline oriented	80	80	

GENERAL INTELLIGENCE & REASONING:

The test may include questions on analogies, similarities, differences, space visualization, problem-solving, analysis, judgment, decision making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning, verbal and figure classification, arithmetical number series etc. The test will also include questions designed to test your ability to deal with abstract ideas and symbols and their relationships, arithmetical computations and other analytical functions and logical sequencing.

GENERAL AWARENESS:

Questions will be aimed at testing your general awareness of the environment around you and its application to society. Questions will also test your knowledge of current events and of matters of everyday observations and experiences in their scientific aspect. The test will also include questions relating to India and its neighboring countries especially pertaining to History, Culture, Geography, sports, Economic Science, fine Arts, General Polity mainly relating to India and neighboring countries.

(CIVIL ENGINEERING)

1. BUILDING MATERIALS:

Physical and Chemical properties, Classification, Standard Tests, Uses and manufacture/quarrying of materials e.g. building stones, silicate based materials, Cement (Portland), Asbestos products, Timber and Wood based Products, Laminates, bituminous materials, Paints, Varnishes.

2. ESTIMATING, COSTING, AND VALUATION:

Estimate, Glossary of technical terms, Analysis of rates, Methods, and unit of measurement, Items of work – Earthwork, Brickwork (Modular & Traditional bricks), RCC work, Shuttering, Timber work, Painting, Flooring, Plastering.

Boundary wall, Brick building, Water Tank, Septic tank, Bar bending schedule. Centre line method, Midsection formula, Trapezoidal formula, Simpson's rule.

The cost estimate of Septic tank, flexible pavements, Tube well, isolated and combined footings, Steel Truss, Piles and pile caps.

Valuation – Value and cost, scrap value, salvage value, assessed value, sinking fund, depreciation and obsolescence, methods of valuation.

3. SURVEYING:

Principles of surveying, measurement of distance, chain surveying, working of prismatic compass, compass traversing, bearings, local attraction, plane table surveying, theodolite traversing, adjustment of theodolite, Levelling, Definition of terms used in levelling, contouring, curvature and refraction corrections, temporary and permanent adjustments of dumpy level, methods of contouring, uses of contour map, tachometer survey, curve setting, earthwork calculation, advanced surveying equipment.

4. SOIL MECHANICS:

Origin of soil, phase diagram, Definitions- void ratio, porosity, a degree of saturation, water content, a specific gravity of soil grains, unit weights, density index and interrelationship of different parameters, Grain size distribution curves and their uses.

Index properties of soils, Atterberg's limits, ISI soil classification, and plasticity chart. the Permeability of soil, a coefficient of permeability, determination of the coefficient of permeability, Unconfined and confined aquifers, effective stress, quicksand, consolidation of soils, Principles of consolidation, the degree of consolidation, pre-consolidation pressure, normally consolidated soil, e-log p curve, computation of ultimate settlement. Shear strength of soils, direct shear test, Vane shear test, Triaxial test.

Soil compaction, Laboratory compaction test, Maximum dry density and optimum moisture content, earth pressure theories, active and passive earth pressures, Bearing capacity of soils, plate load test, standard penetration test.

5. HYDRAULICS:

Fluid properties, hydrostatics, measurements of flow, Bernoulli's theorem and its application, and turbines.

6. IRRIGATION ENGINEERING:

Definition, Necessity, Benefits, III effects of irrigation, types, and methods of irrigation. Hydrology – Measurement of rainfall, runoff coefficient, rain gauge, losses from precipitation – evaporation, infiltration, etc. Water requirement of crops, duty, delta and base period, Kharif and Rabi Crops, Command area, Time factor, Crop ratio, Overlap allowance, Irrigation efficiencies. Different type of canals, types of canal irrigation, loss of water in canals. Canal lining – types and advantages.

7. WATER POWER ENGINEERING:

Power generation through storage (dams) and diversion (barrages); run-of the river schemes with and without pondage;

storage schemes; tidal power plants; hydroelectric plant layouts for open flow diversion schemes and pressure diversion system or their combinations; underground projects with pressure diversion systems;

Reservoir type intakes â trash rack; intakes for embankment dams; water conducting systems â open channels, fore-bays, tunnels, surge tanks, penstocks, valves and anchor blocks;

Layout and sections of tunnels; tunnel deign basics; construction methods for tunnels; penstock components

8. STRUCTURAL ENGINEERING:

Theory of structures: Elasticity constants, types of beams – determinate and indeterminate, bending moment and shear force diagrams of simply supported, cantilever and over hanging beams.

Moment of area and moment of inertia for rectangular & circular sections, bending moment and shear stress for a tee, channel and compound sections, chimneys, dams and retaining walls, eccentric loads, slope deflection of simply supported and cantilever beams, critical load and columns, Torsion of circular section

9. CONCRETE TECHNOLOGY:

Properties, Advantages, and uses of concrete, cement aggregates, the importance of water quality, water cement ratio, workability, mix design, storage, batching, mixing, placement, compaction, finishing and curing of concrete, quality control of concrete, hot weather and cold weather concreting, repair and maintenance of concrete structures, Roller Compacted concrete and its Use.

10. RCC DESIGN AND STEEL DESIGN:

RCC beams-flexural strength, shear strength, bond strength, the design of singly reinforced and doubly reinforced beams, cantilever beams. T-beams, lintels.

One-way and two-way slabs, isolated footings.

Reinforced brickworks, columns, staircases, retaining walls, water tanks (RCC design questions may be based on both Limit State and Working Stress methods).

Steel Design: Steel design and construction of steel columns, beams roof trusses plate girders

(ELECTRICAL ENGINEERING)

1. Electric Circuits:

Basic concepts: Concepts of resistance, inductance, capacitance and various factors effecting them., Circuit laws: ohms law KCL, KVL, node and mesh analysis, resonance, ideal current and voltage sources, Source conversions Thevenin's, Norton's and Superposition and Maximum Power Transfer theorems Simple Circuit solution using network theorems. Sinusoidal steady-state analysis, Transient response of dc and ac networks. Three phase circuits; Two port networks, Power and power factor in ac circuits.

2. Control Systems:

Basic control system components; block diagram and Signal flow graphs, reduction of block diagrams. Feedback principle, Open loop and closed loop (feedback) systems, Transient and Steady state analysis of linear time invariant systems, Stability Analysis, State space model, State transition matrix.

3. Electrical and Electronic Measurements:

Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; Extension of range, measurement of voltage, current, power (active/reactive), energy and power factor; instrument transformers; digital voltmeters and multi-meters; phase, time and frequency measurement; oscilloscopes; Transducers, Megger, Error analysis.

4. Analog & Digital Electronics:

Energy bands in Semiconductors, Characteristics of diodes, BJT, MOSFET; Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: Biasing, Equivalent circuit and Frequency response; Oscillators and Feedback amplifiers; Operational amplifiers: Characteristics and applications; Simple active filters, VCOs and Timers, Binary, decimal, octal, hexadecimal, BCD number systems and their conversions, Binary and hexadecimal addition, subtraction multiplication,1's and 2's complement methods of addition/subtraction. Boolean algebra, minimization of Boolean functions; logic gates, Combinational and Sequential logic circuits, Multiplexer, De multiplexer, Schmitt trigger, Sample and hold circuits, A/D and D/A converters, 8085Microprocessor: Architecture, Programming and Interfacing.

5. Power Electronics and Drives:

Characteristics of semiconductor power devices: Diode, Thyristor, Triac, GTO, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost converters; Single and three phase configuration of uncontrolled rectifiers, Line commutated thyristor based converters, Bidirectional ac to dc voltage source converters, Issues of line current harmonics, Power factor, Distortion factor of ac to dc converters, Single phase and three phase inverters, Sinusoidal pulse width modulation.

6. Electrical Machines:

Single phase transformer – equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers – connections, parallel operation; auto-transformer, Energy conversion principles, Electro-mechanical energy conversion; DC machines–types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors–principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines – cylindrical and salient pole machines, performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors. Braking of DC and AC motors; Types of losses and efficiency calculation of electric machines.

7. Power Systems:

Power generation concepts, ac and dc transmission concepts; models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators; corona and radio interference; per unit quantities, voltage and frequency control, distribution systems; power factor correction; Load flow methods. economic operation; symmetrical components, Symmetrical and unsymmetrical fault analysis; principles of over-current, differential and distance protection; Generator, feeder, transformer and bus-bar protection, Lightning protection; solid state relays and circuit breakers; Sub-Station Practices, Load frequency control, Tariffs, Earthing. Utilization of Electrical energy: Illumination, electrical heating and welding, electroplating. System Stability concepts, Equal area criterion.

8. Electromagnetic Fields:

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart’s law, Ampere’s law, Curl, Faraday’s law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations.

(MECHANICAL ENGINEERING)

1. Theory of Machines and Machine Design:

Four bar linkage and link motion, Flywheels and fluctuation of energy, Power transmission by belts-V-belts and Flat belts. Gears-Type of gears, gear profile and gear ratio calculation. Cams. Governors-Principles and classification. Design of keys, shafts, Riveted joint, couplings.

2. Engineering Mechanics and Strength of Materials:

Laws of forces, Equilibrium of Forces, Moment of Inertia, Laws of motion. Friction. Concept of simple machines, M A, V R, %age. Concepts of stress and strain, Elastic limit and elastic constants. Bending moments and shear force diagram. Stress in composite bars. Torsion in circular shafts. Columns: Euler's and Rankine's theories. Thin walled pressure vessels.

3.Thermal Engineering and Refrigeration & Air-conditioning:

Thermodynamics: Heat, work and temperature, First and second laws of thermodynamics. Carnot, Rankine, Otto and Diesel Cycles. P-v & P-T diagrams H_2O. Saturated, wet & superheated steam. Definition of dryness fraction of steam, degree of superheat of steam. Rankine cycle of steam: Simple Rankine cycle, plot on P-V, T-S, h-s planes, Rankine cycle efficiency with & without pump work. Concept of COP, Carnot Cycle, Vapour compression cycle. Refrigerants. Psychometry, DBT, WBT, DPT.

4. Fluid Mechanics & Machinery:

Properties & Classification of Fluids, Newton's law of viscosity, Fluid Statics, Measurement of Fluid Pressure by Manometers, U-tube, Inclined tube. Fluid Kinematics: Stream line, laminar & turbulent flow, external & internal flow, continuity equation. Dynamics of ideal fluids: Bernoulli's equation, Total head; Velocity head; Pressure head. Measurement of Flow rate, Basic Principles & working of Venturimeter, Pitot tube, Orifice meter. Hydraulic Turbines & Centrifugal Pumps

5. Material Science & Production Engineering:

Structure of metals, Space lattice, Unit cell, BCC, FCC etc., Iron carbon diagram, Classification of Steels: mild steel & alloy steel. Heat treatment of steel. Welding – Arc Welding, Gas Welding, Resistance Welding, Special Welding Techniques i.e. TIG, MIG. Brazing & Soldering, Welding Defects & Testing. Foundry & Casting methods, defects, different casting processes. Forging, Extrusion etc. Metal cutting principles, cutting tools. Basic Principles of machining with Lathe, Milling, Drilling, Shaping, Grinding. Machine tools & manufacturing processes.

6. Metrology and Automobile Engineering:

Tools used in Linear Measurements, Angular Measurement, Surface finish. Limits, fits & Tolerance, Error, Classification of Automobiles. Transmission, Steering, Braking, Suspension system. IC Engine Performance, IC Engine Combustion process, Cooling and Lubrication system in I.C Engine

7. Industrial Management and CAD/CAM:

Planning, Organizing, Leading, Controlling. Inventory Control, Inspection & Quality Control. Basic concepts of CAD/CAM. NC, DNC, CNC machines.

(Renewable Energy)

Non Conventional energy sources:

Non Conventional energy sources :Renewable energy sources, Potential, solar radiation, Atmospheric phenomena, calculation of solar radiation on horizontal and inclined surfaces , Measurement of solar radiation, Low temperature applications, Solar distillation ,Heat pump, Solar refrigerator ,Passive space conditioning, Solar thermal power generation ,Photovoltaic, wind energy ,Physical and thermo chemical methods of bioconversion, Biological methods, Renewable energy economics. Hydropower Energy, Present status of Hydro Power, Magneto-hydro-dynamic (MHD) Energy conversion,

Energy Economics and Planning

Energy Economics and Planning System economics, Reference energy systems, Econometrics, Statistical approach, Langrangian multiplier, Input–output economics, Macroeconomic growth models, Dynamic models of the economy and simple theory of business fluctuations, Multiple linear and non linear regression analysis, Environmental repercussions and economic structure ,Social costs , Decision and uncertainty. Economics in Renewable Energy Systems.

Energy auditing Energy audit concepts

Energy auditing Energy audit concepts, Measurements, Mass and energy balances, Evaluation of energy, Conservation opportunities, Presentation of report, Environmental concepts, Elements measurements, Impact assessment, Energy and material analysis, Energy conservation aspects in buildings, HVAC systems and power plants.

Power plant engineering Economics

Power plant engineering Economics of power generation Choice of power plant; Load & Load duration curves; Load factor; Diversity factor; Load deviation curve; Load management; Number and size of generating unit; Cost of electrical energy;

Tariff-Power factor improvement. Different types of power generation, Hydropower plant Mass curve and storage capacity; Classification; Components; Turbines- Characteristics and their selection; Governor; Plant layout and design; Auxiliaries; Underground, automatic, remote controlled, and pumped storage plants.

Biomass &Bio-Energy Systems

Biomass &Bio-Energy Systems Thermo-chemical conversions: Direct Combustion, Technology of Biomass gasification, Pyrolysis and Liquefaction, Bio-Chemical Conversion: anaerobic digestion, alcohol production from biomass, Chemical conversion process: hydrolysis and hydrogenation, Biomass Gasifiers: History, Principle, Design of Biomass Gasifiers, updraft gasifier, down draft gasifier, zero carbon biomass gasification plants, Gasification of plastic-rich waste, Municipal Waste based Bio-gas plants, Bio gas as fuel for transportation, Lighting,

Solar energy

Solar energy utilization Solar radiation and modeling, solar collectors and types: flat plate, concentrating solar collectors, advanced collectors and solar concentrators, selective coatings, solar water heating, solar cooking, Solar Photovoltaic Power Plant: Planning and Design Estimating power and energy demand, site selection, land requirements, choice of modules, economic comparison, balance of systems, off grid systems, grid interface, preparing DPR, Supporting structures, mounting and installation, junction boxes, battery storage, power condition unit, selection of cables and balance of systems, planning with software, maintenance and schedule, SCADA system, sensor, data logger, monitoring, data management, analysis and performance, Financial analysis, life cycle costing, Environmental Analysis and social costs, worksheet, customer care. Financing models of Renewable energy - Solar Farms

Environmental Impact of renewable energy

Environmental Impact of renewable energy sources Environmental impacts of fossil fuel based power generation, Renewable electricity and key elements, Hydropower and its constraints, Wind energy: technology and economics, Resources, systems and regional strategies, Solar thermal power, Photovoltaic technology, Biomass power, tidal power, OTEC, Global climate change, CO2 reduction potential of renewable energy, Social considerations, standalone systems and grid integration.

Wind Energy Systems

Wind energy conversion Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics. WECS design Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip loss Correction. Design of wind turbine Wind turbine design considerations;

Small hydro systems

Small hydropower systems Overview of micro, mini and small hydro systems; Hydrology; Elements of pumps and turbine; Selection and design criteria of pumps and turbines; Site selection and civil works; Speed and voltage regulation; Investment issues load management and tariff collection; Distribution and marketing issues:

Energy storage

Need for energy storage; Different modes of energy storage Potential energy; Pumped hydro storage; KE and Compressed gas system; Flywheel storage, compressed air energy storage; Electrical and magnetic energy storage; Capacitors, electromagnets and battery storage systems; Chemical Energy storage; Thermao-chemical, photochemical, bio-chemical, electrochemical, fossil fuels and synthetic

fuels and hydrogen storage SHS mediums; Stratified storage systems; Rock-bed storage systems;

Basic Electrical Engineering

Power circuits and electrical machinery, AC circuit analysis, Three phase circuits, Power circuits components and energy conservation devices, Variable speed drives, Demand controls.