

AMMU & KASHMIR ENERGY DEVELOPMENT AGENCY (JAKEDA)

SYLLABUS FOR WRITTEN TEST FOR ASSISTANT 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 disciplines)	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)

Engineering Mechanics: Statics; unit and dimensions SI units, vectors, coplanar and non coplanar force systems, equations of equilibrium, free body diagrams, static friction, virtual work, distributed force systems, first and second moments of area, mass moment of Inertia.

Kinematics and Dynamics: Velocity and acceleration in Cartesian and curvilinear coordinate systems, equations of motion and their integration, principles of conservation of energy and momentum, collision of elastic bodies, rotation of rigid bodies about fixed axis, simple harmonic motion.

Strength of Materials: elastic, isotropic and homogeneous materials, stress and strain, elastic constants, relation among elastic constants, axially loaded determinate and indeterminate members, shear force and bending moment diagrams, theory of simple bending, shear stress distribution, stitched beams.

Deflection of Beams: Macaulay method, Mohr theorems, Conjugate beam method, torsion, torsion of circular shafts, combined bending, torsion and axial thrust, close coiled helical springs Strain Energy, strain energy in direct stress, shear stress, bending and torsion.

Thin and thick cylinders, columns and struts, Euler and Rankine loads, principal stresses and strains in two dimensions- Mohr circle-theories of elastic failure.

Structural Analysis; indeterminate beams, propped, fixed and continuous beams, shear force and bending moment diagrams, deflections, three hinged and two hinged arches, ILD

Trusses: Method of joints and method of sections, deflections of plane pin jointed Trusses .

Rigid Frames: analysis of rigid frames and continuous beams by theorem of three

moments, moments distribution method, slope deflection method, Kani method and column analogy method, matrix analysis; Rolling loads and influence lines for beams and pin-jointed girders.

Soil Mechanics: Classification and identification of soils, phase relationships; surface tension and capillary phenomena in soils, laboratory and field determination of coefficient of permeability; seepage forces, flow nets, critical hydraulic gradient, permeability of stratified deposits; Theory of compaction, compaction control, total and effective stresses, pore pressure coefficient, shear strength parameters in terms of total and effective stress, Mohr- Coulomb theory; total and effective stress analysis of soil slopes: active and passive pressures, Rankine and Coulomb theories of earth pressure, pressure, distribution on trench sheeting, retaining walls, sheet pile walls; soil consolidation, Terzaghi one-dimensional theory of consolidation, primary and secondary settlement.

Foundation Engineering: Exploratory program for sub-surface investigations, common types of boring and sampling, field test and their interpretation, water level of observations; Stress distribution beneath loaded areas by Boussinesq and Steinbrenner methods, use of influence charts, contact pressure distribution determination of ultimate bearing capacity by Terzaghi, Skempton and Hansen's methods; allowable bearing pressure beneath footings and rafts; settlement criteria, design aspects of footings and rafts; bearing capacity of piles and pile groups, pile load tests, under reamed piles for swelling soil; Well foundations, conditions of statical equilibrium, vibration analysis of single degree freedom system, general considerations for design of machine foundations; earthquake effects on soil Foundation systems, liquefaction.

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.

Fluid Mechanics; Fluid properties, fluid statics, forces on plane and curved surfaces. Stability of floating and submerged bodies

Kinematics: Velocity streamlines continuity equation, accelerations, irrotational and rotational flow, velocity potential and stream functions, flow net, separation and stagnation.

Dynamics: Euler's equation along stream line, energy and momentum equations, Bernoulli's theorem, applications to pipe flow and free surface flows, free and forced vortices. Dimensional Analysis and similitude Buckingham's Pi theorem, dimensionless, parameters, similarities, undistorted and distorted models.

Boundary layer on a flat plate, drag and lift on bodies.

Laminar and Turbulent flows: Laminar flow through pipe and between parallel plates, transition to turbulent flow, turbulent flow through pipes, friction factor variation, energy loss in expansions, contraction and other non-uniformities, energy grade line and hydraulic grade line, pipe networks, water hammer.

Compressible flow: Isothermal and isentropic flows, velocity of propagation of pressure wave, Mach number, subsonic and supersonic flows, shock waves.

Open channel flow: Uniform and non uniform flows, specific energy and specific force, critical depth, flow in contracting transitions, free overall, weirs, hydraulic jump, surges, gradually varied flow equation and its integration, surface profiles.

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 design basics; construction methods for tunnels; penstock components

Surveying : General principles; sign conventions, chain surveying, principles of plane table surveying, two point problem, three point problem, compass surveying, traversing; bearings local, attraction, traverse compilations, corrections.

Levelling: Temporary and permanent adjustments; fly- levels, reciprocal levelling, contour levelling; volume computations, refraction and curvature corrections.

Theodolite: Adjustments traversing, heights and distances, tachometric surveying. Curve setting by Chain and by theodolite; horizontal and vertical curves. Triangulation and base-line measurements; Satellite stations, trigonometric levelling, astronomical surveying, celestial co-ordinates, solution of spherical triangles, determination of azimuth, latitude, longitude and time. Principles of aerial photogrammetry, hydrographic surveying.

(Electrical Engineering)

Primary and secondary cells, Dry accumulators, Solar Cells, Steady state analysis of d.c. and a.c. network, network theorems; network functions, Laplace techniques, transient response; frequency response; three- phase networks; inductively coupled circuits.

Mathematical modelling of dynamic linear systems, transfer functions, block diagrams; stability of control systems.

Electrostatic and magnetostatic field analysis; Maxwell's equations. Wave equations and electromagnetic waves.

Basic methods of measurements, standards, error analysis; indicating instruments, cathode ray oscilloscope, measurement of voltage; current; power resistance, inductance, capacitance, frequency, time and flux, electronic meters.

Vacuum based and Semi conductor devices and analysis of electronic Circuits; single and multistage audio, and radio, small signal and large signal amplifiers: oscillators and feed back amplifiers; wave shaping circuits and time base generators: multi-vibrators and digital circuits; modulation and demodulation circuits, Transmission line at audio, radio and U.H.

Frequencies; Wire and Radio communication.

Generation of e.m.f. and torque in rotation machine; motor and generator characteristics of d.c. synchronous and induction machines, equivalent circuits; commutation starters; phaser diagram, losses, regulation, power transformers.

Modelling of transmission lines, steady, state and transient stability, surge phenomena and insulation coordination; protective devices and schemes for power system equipment.

Conversion of a.c. to d.c. and d.c. to a.c. controlled and uncontrolled power, speed control techniques for drives. Thermal runaway and early effect, transistor biasing, TRIAC DIAC SCR UJT ,Cathode ray oscilloscope, Basic Operation Of millimeters, Potentiometer and its applications, D'Arsons val galvanometer, uses

of moving coil ammeter, voltmeter, classification of PF power amplifiers, classification of amplifiers, Class A, Class B, Class AB, Class C Amplifiers, input output characteristics of an basic amplifier circuits, logic gates, p-n Junction diode, fabrication of optical fiber, losses in optical fiber.

(MECHANICAL ENGINEERING)

Statics: Simple applications of equilibrium equations.

Dynamics: Simple applications of equations of motion, simple harmonic motion, work energy, power.

Theory of Machines: Simple examples of links and mechanism. Classification of gears, standard gear tooth profiles, Classification of bearing. Function of fly wheel. Types of governors. Statics and dynamic balancing. Simple examples of vibration of bars. Whirling of shafts.

Mechanics of solids: Stress, strain, Hook's Law, elastic moduli, Bending moments and shearing force diagrams for beams. Simple bending and torsion of beams springs, thinwalled cylinders Mechanical properties and material testing.

Manufacturing Science: Mechanics of metal cutting, tool life, economics of machining, cutting tool materials. Basic machining processes, types of machine tools, transfer lines, shearing, drawing, spinning, rolling, forging, extrusion. Different types of casting and welding methods.

Production Management: Method and time study, motion economy and work space design, operation and flow process charts. Product design and cost selection of manufacturing process. Break even analysis, Site selection, plant layout, Materials handling, selection of equipment for job, shop and mass production, Scheduling, despatching routing.

Thermodynamics: Heat, work and temperature, First and second laws of thermodynamics, Carnot, Rankine, Otto and Diesel Cycles.

Fluid Mechanics: Hydrostatics Continuity equation. Bernoulli's theorem. Flow through pipes. Discharge measurement. Laminar and Turbulent flow, concept of boundary layer.

Heat Transfer: Heat transfer by conduction, Convection and Radiation. One

dimensional steady state conduction through walls and cylinders. Fins, Concept of thermal boundary layer. Heat transfer, coefficient, Combined heat transfer, coefficient, Heat exchangers.

Energy Conversion: Compression and spark ignition engines, Compressors, fans and blowers. Hydraulic pumps and turbines Thermal turbo machines.

Boiler Flow of steam through nozzles layout of power plants.

Environmental Control Refrigeration cycles, refrigeration equipment- its operation and maintenance, important refrigerants, Psychometrics comfort, cooling and De-humidification.

(Renewable Energy)

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, Magneto-hydro-dynamic (MHD) Energy conversion,

Primary and secondary cells, Dry accumulators, Solar Cells, Steady state analysis of d.c. and a.c. network, network theorems; network functions, Laplace techniques, transient response; frequency response; three- phase networks; inductively coupled circuits.

Mathematical modelling of dynamic linear systems, transfer functions, block diagrams; stability of control systems.

Electrostatic and magnetostatic field analysis; Maxwell's equations. Wave equations and electromagnetic waves.

Basic methods of measurements, standards, error analysis; indicating instruments, cathode ray oscilloscope, measurement of voltage; current; power resistance, inductance, capacitance, frequency, time and flux, electronic meters.

Energy Economics and Planning System economics, Reference energy systems, Econometrics, Statistical approach, Lagrangian 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, 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 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 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 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 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; Prandtl'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; Thermochemical, 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.