

## SYLLABUS FOR WRITTEN TEST OF JKSPDC 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 disciplines)	20	20	2 hrs
2		Discipline oriented	80	80	

As per the Official JKSPDC JE Syllabus, you are supposed to have decent reasoning and knowledge of Current affairs and General Knowledge.

### **GENERAL INTELLIGENCE & REASONING:**

**15 Marks**

Questions of both verbal and non-verbal type. 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 the your ability to deal with abstract ideas and symbols and their relationships, arithmetical computations and other analytical functions.

### **GENERAL AWARENESS:**

**05 Marks**

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, Economic Science, General Polity.

## **A. CIVIL ENGINEERING**

### **1. BUILDING MATERIALS:**

**05Marks**

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:**

**05 Marks**

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, Mid-section 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:**

**05 Marks**

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:**

**10 Marks**

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, IS1 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:**

**10 Marks**

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

**6. CONSTRUCTION EQUIPMENT, PLANNING AND MANAGEMENT**

**05Marks**

Weight Batcher, Mixer, vibrator, batching plant, concrete pump. Earthwork Equipment: Power shovel, hoe, dozer, dumper, trailers and tractor, rollers, sheep foot rollers, pumps.

**7. IRRIGATION ENGINEERING:**

**05Marks**

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.

**8. WATER POWER ENGINEERING:**

**10Marks**

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

**9. STRUCTURAL ENGINEERING:**

**10 Marks**

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

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### 10. CONCRETE TECHNOLOGY:

05 Marks

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.

### 11. RCC DESIGN AND STEEL DESIGN:

10 Marks

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

## B. ELECTRICAL ENGINEERING

### 1. Electric Circuits:

20 Marks

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:

05 Marks

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:

05 Marks

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:**

**07 Marks**

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, 8085 Microprocessor: Architecture, Programming and Interfacing.

**5. Power Electronics and Drives**

**07 Marks**

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:**

**20 Marks**

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:**

**12 Marks**

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

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control, Tariffs, Earthing. Utilisation of Electrical energy: Illumination, electrical heating and welding, electroplating. System Stability concepts, Equal area criterion.

### **8. Electromagnetic Fields:**

**4 Marks**

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.

## C.MECHANICAL ENGINEERING

### **1. Theory of Machines and Machine Design:**

**10 Marks**

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:**

**20 Marks**

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:**

**12 Marks**

Thermodynamics: Heat, work and temperature, First and second laws of thermodynamics. Carnot, Rankine, Otto and Diesel Cycles. P-v & P-T diagrams H<sub>2</sub>O. 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. Psychrometry, DBT, WBT, DPT.

### **4. Fluid Mechanics & Machinery:**

**12 Marks**

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

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Principles & working of Venturimeter, Pitot tube, Orifice meter. Hydraulic Turbines & Centrifugal Pumps

### **5. Material Science & Production Engineering: 10 Marks**

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: 10 Marks**

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: 06 Marks**

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

## D. INSTRUMENTATION ENGINEERING

### **1. Basics of Circuits and Measurement Systems: 05 Marks**

Kirchoff's laws, mesh and nodal Analysis. Circuit theorems. One-port and two-port Network Functions. Static and dynamic characteristics of Measurement Systems. Error and uncertainty analysis. Statistical analysis of data and curve fitting.

### **2. Transducers, Mechanical Measurement and Industrial Instrumentation: 05 Marks**

Resistive, Capacitive, Inductive and piezoelectric transducers and their signal conditioning. Measurement of displacement, velocity and acceleration (translational and rotational), force, vibration and shock. Measurement of pressure, flow, temperature and liquid level. Measurement of pH, conductivity, humidity, hydrazine, silica, dissolved O<sub>2</sub>. Units and standards of measurement.

### **3. Analog Electronics: 10 Marks**

Characteristics of diode, BJT, JFET and MOSFET. Diode circuits. Transistors at low and high frequencies, Amplifiers, single and multi-stage. Feedback amplifiers. Operational amplifiers, characteristics and circuit configurations. Instrumentation amplifier. Precision rectifier. V-to-I and I-

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to-V converter. Op-Amp based active filters. Oscillators and signal generators. Voltage stabiliser and regulator circuits. Inverter and converter circuits.

### **4. Digital Electronics:**

**10 Marks**

Combinational logic circuits, minimization of Boolean functions. IC families, TTL, MOS and CMOS. Arithmetic circuits. Comparators, Schmitt trigger, timers and mono-stable multi-vibrator. Sequential circuits, flip-flops, counters, shift registers. Multiplexer, S/H circuit. Analog-to-Digital and Digital-to-Analog converters. Basics of number system. Microprocessor applications, memory and input-output interfacing. Microcontrollers.

### **5. Signals and Systems:**

**05 Marks**

Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, z-transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.

### **6. Communications:**

**20 Marks**

Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM. Basic Network topology and Network hardware. LAN / WAN configurations. UTP and OFC Links and components. Serial and parallel communication, Shielding and grounding. IEEE standards and broadband.

### **7. Electrical and Electronic Measurements:**

**10 Marks**

Bridges and potentiometers, measurement of R,L and C. Measurements of voltage, current, power, power factor and energy. A.C & D.C current probes. Extension of instrument ranges. Q-meter and waveform analyzer. Digital voltmeter and multi-meter. Time, phase and frequency measurements. Cathode ray oscilloscope. Instrument Transformer.

### **8. Control Systems and Process Control:**

**10 Marks**

Feedback principles. Signal flow graphs. Transient Response, steady-state-errors. Routh and Nyquist criteria. Bode plot, root loci. Time delay systems. Phase and gain margin. State space representation of systems. Mechanical, hydraulic and pneumatic system components. Synchro pair, servo and step



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motors. On-off, cascade, P, P-I, P-I-D, feed forward and derivative controller, Fuzzy controllers. Multi-state variable and Adaptive controls. System modeling, Digital controls, Distributed digital controls, control loops based on computers.

### **9. Analytical, Optical and Biomedical Instrumentation:**

**05 Marks**

Mass spectrometry. UV, visible and IR spectrometry. X-ray and nuclear radiation measurements. Optical sources and detectors, LED, laser, Photo-diode, photo-resistor and their characteristics. Interferometers, applications in metrology.

## E. AUTOMATION ENGINEERING

### **1.Computer Controlled Systems:**

**10 Marks**

Multivariable control, Singular values- Stability norms, Robustness- Robust stability-  $H_2 / H_\infty$  Theory, Interaction and decoupling- Relative gain analysis, Decoupling control, Programmable logic controllers, SCADA, DCS, Real time systems, Supervisory control- direct digital control Distributed control- PC based automation.

### **2. Process Control & Automation:**

**12 Marks**

Process Modeling, Transfer function-State space models-Time series models, Feedback & Feedforward Control, PID design and tuning, Cascade control- Selective control loops-Ratio control-Control, State feedback control- LQR problem- Pole placement, Process Interactions Singular value analysis-tuning of multi loop PID control systems-decoupling control, Realtime optimization, Model predictive control- Batch Process control-Plant-wide control & monitoring, Introduction to Fuzzy Logic in Process Control, Introduction to OPC, Comparison of performance different types of control with examples on software packages.

### **3.SCADA Systems And Applications:**

**12 Marks**

Introduction to SCADA, Monitoring and supervisory functions, SCADA applications in Utility Automation, SCADA System Components, RTU, IED, PLC, Communication Network, SCADA Server, SCADA/HMI Systems, Various SCADA architectures, single unified standard architecture -IEC 61850, SCADA Communication, open standard communication protocols

### **4. Electric Circuits:**

**10 Marks**

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.

**5. Control Systems:**

**06 Marks**

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.

**6. Analog & Digital Electronics:**

**10 Marks**

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, 8085 Microprocessor: Architecture, Programming and Interfacing.

**7. Electrical Machines:**

**10 Marks**

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.

**8. Power Systems:**

**Marks 10**

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. Utilisation of Electrical energy: Illumination, electrical heating and welding, electroplating. System Stability concepts, Equal area criterion.