Advt No. 3 of 2024

Junior Engineer (Department of Water Supply and Sanitation)

Plan of Written Examination

All the aspirants are informed as under with respect to the written test to be conducted for the recruitment for the post of **Junior Engineer (Department of Water Supply and Sanitation) in Advt No. 3 of 2024** :-

1. *The Exam will be conducted in MCQ (Multiple Choice Questions) format. OMR sheet will be used for answering the questions.*
2. *The Exam would be of 2 hours duration.*
3. *The Exam will consist of two parts (Part A and Part B) as follows:-*

Part	Topic	No. of Questions	Marks (Each Question carries 1 mark)	Type of Questions
A	Questions from General Knowledge and Current Affairs, Punjab History and Culture, Logical Reasoning and Mental ability, Punjabi, English, ICT, (Annexure-1)	40	40	MCQs (Multiple Choice Questions)
B	Questions from the Subject (Annexure-2)	80	80	MCQs (Multiple Choice Questions)
Total		**120**	**120**	

4. **There will be negative marking. Each question carries 1 mark. For every wrong answer, 1/4th mark i.e. 0.25 mark would be deducted. The question(s) not attempted will receive no credit or discredit.**
5. For the post of Junior Engineer **(Department of Water Supply and Sanitation)** Part B contains questions from the subjects namely Civil, Mechanical and Electrical Engineering. **Candidate can attempt any one of the above mentioned subjects.**
6. Tentative syllabus for the written examination for the recruitment of **Junior Engineer (Department of Water Supply and Sanitation) in Advt No. 3 of 2024** is annexed at **Annexure-2.**

Annexure - 1

Part A - General Knowledge, *Punjab History and Culture,* Logical Reasoning Mental Ability, Punjabi, English and ICT.

Sr. No.	***Indicative Contents of Syllabus***	***Weightage (Approx.)***
1.	***General Knowledge and Current affairs of National and International importance including:*** *(i) Polity issues,* *(ii) Environment issues,* *(iii) Current Affairs,* *(iv) Science and Technology,* *(v) Economic issues,* *(vi) History of India with special reference to Indian freedom struggle movement.* *(vii) Sports,* *(viii) Cinema and Literature.* *(ix) Geography*	*10*
2.	***Punjab History and Culture:-*** *Physical features of Punjab and its ancient history. Social, religious and economic life in Punjab. Development of Language & literature and Arts in Punjab, Social and culture of Punjab during Afgan/Mughal Rule, Bhakti Movement, Sufism, Teachings/History of Sikh Gurus and Saints in Punjab. Adi Granth, Sikh Rulers, Freedom movements of Punjab.*	*5*
3.	***Logical Reasoning & Mental Ability:*** *(i) Logical reasoning, analytical and mental ability.(05 Marks)* *(ii) Basic numerical skills, numbers, magnitudes, percentage, numerical relation appreciation. (03 Marks)* *(iii) Data analysis, Graphic presentation charts, tables, spreadsheets. (02 Marks)*	*10*
4.	***ਪੰਜਾਬੀ:-*** ਸ਼ੁੱਧ-ਅਸ਼ੁੱਧ, ਸ਼ਬਦਜੋੜ, ਅਗੇਤਰ ਅਤੇ ਪਿਛੇਤਰ, ਸਮਾਨਾਰਥਕ/ਵਿਰੋਧੀਸ਼ਬਦ, ਨਾਂਵ, ਪੜਨਾਂਵ ਅਤੇ ਕਿਰਿਆ ਦੀਆਂ ਕਿਸਮਾਂ ਤੇ ਸਹੀ ਵਰਤੋਂ, ਲਿੰਗ ਅਤੇ ਵਚਨ, ਪੰਜਾਬੀ ਅਖਾਣ ਤੇ ਮੁਹਾਵਰੇ, ਅੰਗਰੇਜੀ ਤੋਂ ਪੰਜਾਬੀ ਅਨੁਵਾਦ ਅਤੇ ਬਹੁਤੇ ਸ਼ਬਦਾਂ ਦੀ ਥਾਂ ਇੱਕ ਸ਼ਬਦ ਆਦਿ।	*5*
5.	***English:-*** *Basic Grammar, Subject and Verb, Adjectives and Adverbs, Synonyms, Antonyms, One Word Substitution, Fill in the Blanks, Correction in Sentences, Idioms and their meanings, Spell Checks, Adjectives, Articles, Prepositions, Direct and Indirect Speech, Active and Passive Voice, Correction in Sentences, etc.*	*5*
6.	***ICT:-*** *Basics of computers, Network & Internet, Use of office productivity tools Word, Excel, Spreadsheet & PowerPoint.*	*5*
	Maximum Marks	**40**

Annexure-2

Part-B

I. Subject Syllabus Civil Engineering

Number of Questions - 80 **Maximum Marks- 80**

1) ENGINEERING DRAWING: Lettering Technique and Practice, Dimensioning Techniques (Necessity of dimensioning, method and principles of dimensioning etc.), Scales (need and importance of scales. Drawing of plain and diagonal scales etc.), Projections, Sections, Symbols and Conventions.

2) APPLIED MECHANICS: Introduction, Laws of forces, Moment, Friction, Centre of Gravity etc.

3) FLUID MECHANICS: Introduction, Properties of Fluids, Hydrostatic Pressure, Measurement of Pressure, Fundamentals of Fluid Flow (Types of Flow, Discharge, hydraulic energy, Bernoulli's theorem etc.), Flow Measurements (brief description with simple numerical problems, Venturimeter, Pitot tube, Orifice, Current meters, Notches etc.), Flow through Pipes (Definition of pipe flow; Reynolds number, laminar and turbulent flow, Critical velocity and velocity distributions in a pipe for laminar flow, Head loss in pipe lines, Hydraulic gradient line and total energy line, Pipes in series and parallel, Water hammer phenomenon etc.), Flow through open channels (uniform and non-uniform flow, discharge through channels using Chezy's formula and Manning's formula, Most economical sections, rectangular, trapezoidal and circular etc.), Hydraulic Pumps and motors (types, uses and efficiency etc.)

4) SURVEYING: Basic principles of surveying, Concept and purpose. Instruments used for taking these measurements etc, Chain surveying, Compass surveying, Levelling, Planc Table Surveying, Total Station Method, Auto Level, Contouring, Theodolite Surveying, Tacho-metric surveying, Curves, Digital Survey, Introduction to the use of Modern Surveying equipment and techniques, Total Stations etc.

5) CONSTRUCTION MATERIALS & BUILDING CONSTRUCTION: General characteristics of stones, Requirements of good building stones, Identification of common building stones, Bricks and Tiles, Cement (Various types of Cements, Properties of cement etc.), Lime, Timber and Wood Based Products, Paints and Varnishes, Miscellaneous Materials etc., Introduction to Building Construction, Foundation, Walls, Masonry, Arches and Lintels, Doors, Windows and Ventilators, Damp Proofing and Water Proofing, Floors, Roofs, Stairs, Anti Termite Measures, Building Planning etc. Concrete, uses of concrete in comparison to other building materials, Ingredients of Concrete. Properties of Concrete, proportioning for Normal Concrete, Introduction to Admixtures for improving performance of concrete, Special Concretes (Concreting under special conditions, difficulties and precautions before, during and after concreting, Ready mix concrete, Fibre reinforced concrete, Polymer Concrete, Fly ash concrete, Sillica fume concrete etc.), Concreting Operations (Storing of Cement, Storing of Aggregate, Batching, Mixing,

Transportation of concrete, Placement of concrete, Compaction, Curing, Jointing, Defects in concrete etc.).

6) STRUCTURAL ENGINEERING: Simple stresses and strains, Elasticity, Hooke's Law, Moduli of Elasticity and Rigidity. Stresses and strains of homogeneous materials and composite sections. Types of beams and supports and loads, Concept of bending moment and shear force. Bending moment and shear force diagrams for simple cases. Deflection in beams, Moment area theorem, Bending and shear stresses in circular, rectangular, T and L sections, Introduction to I.S:456 (latest edition), Design of singly and doubly Reinforced beams, Design of Columns-Types of Columns. Short and long column, load carrying capacity, effective length of column, lateral and helical ties. I.S. Specifications for reinforcement detailing. Design of slabs types of slabs, one way slab, two way slab, I.S. specifications for Reinforcement detailing method of design as per I.S. code. Design of foundations-isolated footing rectangular footing, square footings, circular footings. Design of tension members in structural steel, gross area, net area, tension splice, Design of compression members, columnsplice, load carrying capacities. Design of beams in structural steel, Basic concept of prestressed concrete, advantages of prestressed concrete in comparison with RCC application of prestressed to various building elements, bridges, water tanks and precast elements, Materials, Prestressing Methods, Bending and Shear Capacity, Losses in Prestressing etc.

7) EARTHQUAKE RESISTANT BUILDING CONSTRUCTION: Elements of Engineering Seismology. Performance of building during earthquakes and Mode of failure, Special construction method, tips and precautions to be observed while planning, designing and construction of earthquake resistant building, Introduction to IS: 4326, IS: 13828, IS: 1893(Part 1), 154326 and IS: 13920 (latest edition), Seismic Provision of Strengthening and Retrofitting Measures for Traditionally- Built Constructions, Brick and RCC Structures, Provision of reinforcement detailing in masonry and RC constructions.

8) WATER SUPPLY AND WASTE WATER ENGINEERING: Water Supply- Water requirement, Rate of demand and supply, Per capita consumption, Population Forecasting etc., Physical, Chemical and bacteriological properties, Standard of potable water as per Indian Standard etc.. Water Treatment including Sedimentation, Coagulation, flocculation, Filtration, disinfection of water, chlorination, Water treatment plants, R.O.s etc., Different types of pipes, fire hydrants, water meters their working and uses, Distribution system etc., Laying out Pipes

Waste Water Engineering-Definition of terms in sanitary engineering. Surface drains, Types of sewage, Sewerage, Laying and Construction of Sewers, Sewage characteristics (Properties of sewage as per IS standards), Natural Methods of Sewerage Disposal, Sewage Treatment, BOD, COD, Building Drainage (Different sanitary fittings and installations, Traps, seals, Testing of house drainage etc.), Drains and Sewers, Traps, inspection chamber, Septic Tank and Soak Pit, Bath room and W.C. connections etc.

9) SOIL AND FOUNDATION ENGINEERING: Physical Properties of Soils, Classification and Identification of Soils, Permeability and its importance, Effective Stress, Strength Characteristics of Soils, Compaction, Bearing Capacity of soil, Concept of shallow and deep foundation; types of shallow foundations and their suitability. Factors affecting the

depth of shallow foundations, deep foundations, type of piles and their suitability; pile classification on the basis of material, pile group and pile cap etc.

10) TRANSPORTATION ENGINEERING: Introduction of Transportation Engineering, Traffic Engineering, Road materials, Geometric design. Design of flexible and rigid pavements, Road maintenance, Railway Engineering Rails, Sleepers, ballast. points and crossing, Track laying and track maintenance.

11) IRRIGATION ENGINEERING: Introduction to irrigation, methods of irrigation, tube well irrigation, tank irrigation, sprinkler irrigation, drip irrigation, water logging, design of irrigation canals and irrigation outlets.

12) ENVIRONMENTAL ENGINEERING: Importance of Environmental Engineering, Water Pollution (Causes lakes and its preventing measure, BIS standards for water quality etc.), Air Pollution, Noise Pollution, Effects of mining, blasting and deforestation, Land Use (land use and natural disasters, landslides etc.) soil degradation problems - erosion, water logging, soil pollution etc.), Environmental Impact Assessment, Legislation to Control Environmental Pollution (Indian legislative acts for water, land and air pollution control provisions, scope and implementation etc.), Renewable Source of Energy etc. of rates (CSR)

13) QUANTITY SURVEYING AND VALUATION: Introduction to quantity surveying and its importance, duties of quantity surveyor, types of estimates, measurement, preparation of detailed and abstract, estimates from drawings, calculation of quantities of materials, analysis contractorship, preparation of tender document based on Common Schedule of Rates (CSR).

14) REPAIR AND MAINTENANCE OF BUILDINGS: Need for maintenance, agencies causing deterioration (sources, causes, effects), investigation and diagnosis of defects, defects and their root causes, materials for repair, maintenance and protection, remedial measures for building defects, surface preparation techniques for repair, crack repair methods, repair of surface defects of concrete, repair of corrosion in RCC elements, repair of DPC against rising dampness, repair of walls, waterproofing of wet areas and roofs, repair of joints in buildings etc.

15) CONSTRUCTION MANAGEMENT AND ACCOUNTS: Construction Planning, CPM, PERT, site organization, Construction Labour (Labour Welfare Fund Act 1936 (as amended), Payment of Wages Act 1936 (as amended), Minimum Wages Act 1948 (as amended), control of progress, inspection and quality control, accidents and safety in construction, accounts, public work accounts, request for quotation, bill of quantities, measurement book, indent book, material at site register.

16) BASICS OF MANAGEMENT: Introduction, Leadership, Motivation, Ethics and Values, Team related skills sympathy, empathy, co-operation, concern, lead and negotiate, work well with people from culturally diverse background, Communication in group conversation and listening skills, Task Initiation, Task Planning, Task execution, Task close out, Customer Relationship Management (CRM), Need, various types of customers, customer satisfaction, life- long customer, Customer Satisfaction Index (CSI) and its significance, Elementary knowledge of Income Tax, Sales Tax, Excise Duty, Provident Fund, Employees State Insurance Act, Labour welfare schemes, Labour laws,

worker and public safety techniques, systems of wage payment, incentives, Factory Act 1948 with special reference to health, safety and welfare measures, working hours, annual leave with wages, Payment of Wages Act 1936, Minimum Wages Act 1948, safeguards in construction practices, Introduction to Total Quality Management (TQM), Community Participation in Water Supply and Sanitation, Roll of Women in Water Supply and Sanitation etc.

II. Subject Syllabus Electrical Engineering

Number of Questions - 80 **Maximum Marks- 80**

Basic concepts :

Concepts of resistance, inductance, capacitance, and various factors affecting them.Concepts of current, voltage, power, energy and their units. Circuit law : Kirchhoff's law, Simple Circuit solution using network theorems. Magnetic Circuit : Concepts of flux, mmf, reluctance, Different kinds of magnetic materials, Magnetic calculations for conductors of different configuration e.g. straight, circular, solenoidal, etc. Electromagnetic induction, self and mutual induction. AC Fundamentals: Instantaneous, peak, R.M.S. and average values of alternating waves, Representation of sinusoidal wave form, simple series and parallel AC Circuits consisting of R.L. and C, Resonance, Tank Circuit. Poly Phase system – star and delta connection, 3 phase power, DC and sinusoidal response of R-Land R-C circuit. Measurement and measuring instruments: Measurement of power (1 phase and 3 phase, both active and re-active) and energy, 2 wattmeter method of 3 phase power measurement. Measurement of frequency and phase angle.Ammeter and voltmeter (both moving oil and moving iron type), extension of range wattmeter, Multimeters, Megger, Energy meter AC Bridges.Use of CRO, Signal Generator, CT, PT and their uses.Earth Fault detection.

Electrical Machines :

(a) D.C. Machine – Construction, Basic Principles of D.C. motors and generators, their characteristics, speed control and starting of D.C. Motors. Method of braking motor, Losses and efficiency of D.C. Machines.

(b) 1 phase and 3 phase transformers – Construction, Principles of operation, equivalent circuit, voltage regulation, O.C. and S.C. Tests, Losses and efficiency.Effect of voltage, frequency and wave form on losses. Parallel operation of 1 phase /3 phase transformers. Auto transformers.

(c) 3 phase induction motors, rotating magnetic field, principle of operation, equivalent circuit, torque-speed characteristics, starting and speed control of 3 phase induction motors. Methods of braking, effect of voltage and frequency variation on torque speed characteristics. Fractional Kilowatt Motors and Single Phase Induction Motors: Characteristics and applications. Synchronous Machines

- Generation of 3-phase e.m.f. armature reaction, voltage regulation, parallel operation of two alternators, synchronizing, control of active and reactive power. Starting and applications of synchronous motors.

Generation, Transmission and Distribution –

Different types of power stations, Load factor, diversity factor, demand factor, cost of generation, inter-connection of power stations. Power factor improvement, various types of tariffs, types of faults, short circuit current for symmetrical faults.

Switchgears – rating of circuit breakers, Principles of arc extinction by oil and air, H.R.C. Fuses, Protection against earth leakage / over current, etc. Buchholz relay, Merz-Price

system of protection of generators & transformers, protection of feeders and bus bars. Lightning arresters, various transmission and distribution system, comparison of conductor materials, efficiency of different system.Cable – Different type of cables, cable rating and derating factor.

Estimation and costing :

Estimation of lighting scheme, electric installation of machines and relevant IE rules. Earthing practices and IE Rules. Utilization of Electrical Energy : Illumination, Electric heating, Electric welding, Electroplating, Electric drives and motors.

Electronics :

Working of various electronic devices e.g. P N Junction diodes, Transistors (NPN and PNP type), BJT and JFET. Simple circuits using these devices. Industrial and Digital Electronics and PLCM

III. Subject Syllabus Mechanical Engineering

Number of Questions - 80 **Maximum Marks- 80**

1. ENGINEERING DRAWING – Lettering techniques, Dimensioning techniques, Scales (types, R.F., length of scales), Orthographic projections and Isometric projections.
2. ENGINEERING MATERIALS - Ferrous Materials, Processes of Iron making and Steel making. Classification of Cast Iron and Steel. Non Ferrous Materials: Properties, Classification, Uses and alloys of Aluminium and Copper. Heat Treatment: Purpose of heat treatment, Heat treatment processes- hardening, tempering, annealing, normalizing, Case hardening and surface hardening. Plastics: Classification as thermoplastic and thermoset and their applications. Methods of Plastic coatings. Classification and Properties of Ceramics and Composites.
3. APPLIED MECHANICS - Laws of forces, Moment of a force, Levers: simple and compound, Couple: its properties and effects, Friction: Laws, types, calculation of frictional force. Centre of Gravity: concept and calculation. Simple Machines: simple and compound, calculation of effort, velocity ratio, mechanical advantage and efficiency.
4. METROLOGY AND INSTRUMENTATION - Types of Errors, Precision, accuracy, sensitivity, hysteresis, response time, repeatability, calibration, interchangeability. Linear and Angular Measurement: Verniercallipers, Micrometre, Slip gauges, Bore gauge, Bevel protector and Sine bar. Construction and Principle of operation of Mechanical comparators. Measurement of Surface Finish: Primary and Secondary texture. Concept CLA, RMS and RA value. Construction and Principle of operation of Tomlinson surface meter and Taylor surface talysurf. Measurements of Screw threads: external and core diameters, measurement of pitch and angle of threads with gauges. Construction and Principle of operation of Tool maker's microscope.
5. WORKSHOP TECHNOLOGY – Welding (Conventional and Modern techniques), Pattern Making, Moulding and Casting techniques and defects. Metal Forming Processes: Press Working, Forging, Rolling Extrusion and Drawing. Various types of single point cutting tools and their uses, Single point cutting tool geometry. Lathe operations:- Plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling, form turning, spinning. Cutting parameters of lathe: Speed, feed and depth of cut for various materials and for various operations, machining time. Principle of drilling, Various

operations performed on drilling machines – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping. Speeds and feeds during drilling, Types of drills and their features, nomenclature of a drill. Principle of boring, boring tools, boring bars and boring heads. Principle of broaching, Elements of broach tool, broach tooth details, nomenclature, types, and tool material. Types of broaching machines. Grinding (Various elements of grinding wheel – Abrasive, Grade, structure, Bond. Truing, dressing, balancing and mounting of wheel. Grinding methods – Surface grinding, cylindrical grinding and centreless grinding). Ultrasonic machining (USM), Electro chemical machining (ECM), Electrical Discharge Machining (EDM), Laser beam machining (LBM) and Plasma arc machining (PAM) and welding.

6. HYDRAULICS - Properties of fluid: mass density, weight density (specific weight), specific volume, capillarity, specific gravity, viscosity, compressibility and surface tension. Pressure and its Measurement, Flow of Fluids, Bernoulli's theorem and its applications. Operation and application of hydraulic systems: hydraulic ram, hydraulic jack, hydraulic brake and hydraulic press. Turbines: impulse and reaction type. Construction and working of Pelton wheel, Francis turbine, Propeller and Kaplan turbines. Construction, working and operation of centrifugal pump, reciprocating pump, vane, screw and gear pumps.

7. STRENGTH OF MATERIALS - Concept of load, stress and strain, Elasticity, Elastic limit and limit of proportionality, fatigue, creep and stress concentration. Longitudinal and circumferential stresses in seamless thin walled cylindrical shells. Resilience, proof resilience and modulus of resilience, Strain energy due to direct stresses. Types of Beams and loads on beams, Determination of Bending Moment and Shearing Force in beams due to concentrated and U.D.L. Concept of Bending stresses, moment of resistance determination of maximum bending stress in beams of rectangular, circular, and T section. Types of columns and their modes of failure, Concept and determination of buckling load, crushing load, Slenderness ratio, Strength of column by Euler Formula and RankineGordon formula. Concept of torsion and Power transmitted by shaft, determination of twisting moment, shear stresses using torsion equation.

8. THERMODYNAMICS - Fundamental Concepts i.e. Zeroth law of thermodynamics, definition of properties like pressure, volume, temperature, enthalpy, internal energy, thermodynamic systems – closed, open, isolated, adiabatic, homogeneous and heterogeneous, macroscopic and microscopic, properties of system – intensive and extensive, thermodynamic equilibrium, quasi – static

process, reversible and irreversible processes, Types of thermodynamic processes – isochoric, isobaric, isothermal, hyperbolic, isentropic, polytropic and throttling processes. First law of thermodynamics and its applications. Uses of steam, classification of boilers, comparison of fire tube and water tube boilers. Construction features of Lancashire boiler, Nestler boiler, Babcock & WilcoxBoiler. Modes of heat transfer, Fourier's law, steady state conduction, Natural and forced convection. Working principle of two stroke and four stroke cycle, SI engines and CI engines, Otto cycle, diesel cycle and dual cycle. Concept of carburetion, Air fuel ratio in various engines, Working of Fuel injection pump, Common rail direct injection (CRDI). Air cooling and water cooling system, use of thermostat, radiator and forced circulation in water cooling.

9. THEORY OF MACHINES - Types of belt drives and types of pulleys, Concept of velocity ratio, slip and creep; crowning of pulleys, Ratio of driving tensions, power transmitted, centrifugal tension, and condition for transmission of maximum horsepower, Gear terminology, types of gears and their applications; simple and compound gear trains. Principle and applications of flywheel, Turning - moment diagram of flywheel for different engines, Fluctuation of speed and fluctuation of energy, Coefficient of fluctuation of speed and coefficient of fluctuation of energy. Principle of governor, description and working of Watt, Porter and Hartnell governor. Hunting, isochronism, stability, sensitiveness of a governor. Concept of longitudinal, transverse and torsional vibrations, Damping of vibrations.

10. AUTOMOBILE ENGINEERING – Clutch, Gear box, Propeller shaft, Differential, Toe in, toe out, camber, caster, kingpin inclination, Wheel balancing and alignment, Types of steering gears - worm and wheel, rack and pinion, Power steering- Hydraulic and Electrical, Braking system: mechanical, hydraulic, air and vacuum brake, Suspension System - Coil spring, leaf spring, Air suspension, Shock absorber.