

Syllabus for written test to the post of Junior Engineer, Goa University

SECTION A (40 Marks)

A.1 Knowledge of Konkani

(10)

- A. कोंकणी व्याकरण : नाम, सर्वनाम, विशेषण, क्रियापद, वाक्यविचार, लिंग, वचन, काळ, विभक्ती (Konkani Grammar)
- B. कोंकणी शुद्धलेखनाचे नेम (Konkani Orthography)
- C. कोंकणी आंकडे (Konkani Numbers)
- D. कार्यालयीन: इंग्लीश – कोंकणी, कोंकणी – इंग्लीश उतरावळ. (Administrative Terminology)

A.2 Knowledge of English

(10)

Understanding and knowledge of English Language, vocabulary, grammar, sentence structure, spot the error, fill in the blanks, synonyms, antonyms, spelling/detecting mis-spelt words, idioms & phrases, one word substitution, improvement of sentences, active/passive voice of verbs, conversion into direct/indirect narration, shuffling of sentence parts, shuffling of sentences in a passage, close passage & comprehension passage.

A.3 Basic Mathematics:

(10)

Numerical computation, Numerical estimation, Numerical reasoning and Data interpretation, Logical reasoning, Patterns.

A.4 General Awareness:

(10)

Questions will be aimed at testing the candidate's general awareness of the environment around him/her and its application to society. Questions will also be designed to test knowledge of current events and of such matters of everyday observations and experience in their scientific aspect as may be expected of any educated person. The test will also include questions relating to India and its neighbouring countries especially pertaining to History, Culture, Geography, Economic Scene, General Polity and Scientific Research, etc. These questions will be such that they do not require a special study of any discipline.

SECTION B (30 Marks)

B.1 MATHEMATICS: -

(10)

Co-ordinate Geometry/Analytic Geometry: Applications of Co-ordinate Geometry, Coordinate systems, *Straight Line*- Distance between two points, Internal & external division of a line, Area of triangle, Slope of line, Angle between two lines, Various forms of equation of line-parallel to axis, point-slope form, slope intercept form, two point form, intercepts form & normal form, General equation of line, Distance of a point from a line, Equations of circle, Equations of tangent & normal to circle.

Trigonometry: Applications of Trigonometry, Radian, Radian & degree, Area of sector & length of an arc, Trigonometric ratios of any angle & Trigonometric identities, Trigonometric ratio of allied angles, compound angles, & Multiple angles, Sum & product formulae, Sine, Cosine rules, Solution of triangles.

Matrices: Definition and Notations, Elements of Matrix, Types of matrices, Special matrices - Square, Diagonal, Row, Column, Scalar Unit, Zero or null, upper and lower triangular matrices, Symmetric, Skew symmetric matrices. Addition, Subtraction and multiplication of matrices, Inverse of matrix using Adjoint method only Application of matrices in solving simultaneous equations in 2 or 3 variable.

B.2 APPLIED PHYSICS:-

(10)

Properties of matter: Definition of Elasticity, Stress, Strain and Elastic limit, Hooke's Law, Definition of Young's modulus, Bulk modulus, Rigidity modulus, Determination of Young's modulus by Searle's method, Behaviour of wire under continuously increasing stress, Definition of Yield Point, Breaking Stress, and Factor Of Safety, Adhesive and Cohesive forces, Angle of contact, Concept and definition of Surface Tension, Surface Tension by Capillary rise method, Application of Surface Tension, Definition and explanation of Viscosity, Statement of Newton's law of viscosity, Terminal Velocity, Stokes Law, Determination of Viscosity by Stokes method, Streamlined and Turbulent flow, Definition of Critical Velocity, Reynolds Number.

Heat: Definition of specific heat and units of specific heat, Modes of transfer of heat transfer, Conduction, Convection and Radiation, Law of thermal conductivity, Definition of coefficient of thermal conductivity, Determination of coefficient of thermal conductivity of a good conductor, Statement of Charles's law, Boyle's law and Gay Lussac's law, Derivation of general gas equation.

Electrostatics: Coulomb's Law of Electrostatics, Electric Field, Intensity of Electric Field, Electric Potential and its unit, Potential difference between two points (no derivation), Potential of a sphere, Potential of Earth, Definition and units of Capacitance, Principle of Capacitor, Capacitors in series, Capacitors in Parallel.

Current Electricity: Ohms law, General equation of Ohms law, Factors affecting resistance, specific resistance and units, Effect of temperature on resistance, Law of resistance in series and parallel, Internal resistance and EMF of the cell, Potential drop along a uniform wire, Principle of potentiometer, Comparison of EMF of a given cell by single cell method, Comparison of EMF of a given cell by sum and difference method, Use of meter bridge to determine the unknown resistance.

B.3 APPLIED CHEMISTRY: -

(10)

Atomic Structure and Chemical Bonding: Fundamental particles and their characteristics, Energy levels - definition, designation of energy levels, Bohr- Bury's laws for distribution of electrons in shells, concept and shape of orbitals (s and p only), Quantum numbers- designation, definition, values, Aufbau and Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, orbital electronic configuration of elements with atomic number 1 to 20, Lewis and Langmuir concept of stable configuration. Concept of electrovalent, covalent and co-ordinate bond, Formation, properties and examples of electrovalent compound (NaCl, MgO, CaI₂) covalent compound (Cl₂, O₂, N₂, CO₂), coordinate compound (O₃, SO₂).

Electrochemistry: Arrhenius theory of electrolytic dissociation, Degree of Ionisation- definition, factors affecting degree of ionisation, Nature of solute and solvent, concentration of solution, and temperature, Strong and weak electrolytes - definition and examples, Concept of the terms involved in electrolysis conductor, insulator, electrolyte, non-electrolyte, electrolysis, electrodes, electrolytic cell, cathode, anode and current density, electrochemical series concept and significance, Mechanism of electrolysis, Ionisation, primary reactions at the cathode, activity series of cations, primary reactions at the anode, activity series of anions, electrolysis of i. Fused NaCl using carbon electrodes, ii. aqueous NaCl using Pt electrodes iii. aqueous CuSO₄ using Pt electrodes iv. aqueous CuSO₄ using Cu electrodes.

Corrosion and Its Control: Definition, Atmospheric corrosion (direct chemical corrosion) - definition, Oxidation corrosion, the nature of the oxide film, stable, unstable and volatile, mechanism of oxidation corrosion, corrosion due to other gases, Immersed corrosion (electrochemical corrosion) - definition, factors necessary for electrochemical corrosion, Galvanic cell corrosion, concentration cell corrosion metal ion concentration and differential aeration. Mechanism of electrochemical corrosion- Hydrogen evolution mechanism, Oxygen absorption mechanism, Protection of metals from corrosion; galvanising, tinning, metal spraying, proper designing, using pure metals, using metal alloys, Cathodic protection- sacrificial anode and impressed current, Modifying the environment- De-aeration, De-activation, De-Humidification and alkaline neutralization.

Water and its treatment: Hard and soft water, types of hardness and its causes, disadvantages of hardness of water (i) for industrial use - dyeing, textile, sugar, paper, bakeries, (ii) in boilers for steam generation with special reference to sludge and scale formation, zeolite and ion exchange process for water softening, desalination by electro dialysis and reverse osmosis, concept of pH.

SECTION C (30 Marks)

i. Civil Engineering

Section 1: Engineering Mathematics

Calculus: Functions of single variable; Limit, continuity and differentiability; Mean value theorems, local maxima and minima; Taylor series; Evaluation of definite and indefinite integrals, application of definite integral to obtain area and volume; Partial derivatives; Total derivative; Gradient, Divergence and Curl, Vector identities; Directional derivatives; Line, Surface and Volume integrals. Numerical Methods: Error analysis. Numerical solutions of linear and non-linear algebraic equations; Newton's and Lagrange polynomials; numerical differentiation; Integration by trapezoidal and Simpson's rule; Single and multi-step methods for first order differential equations.

Section 2: Structural Engineering

Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Frictions and its applications; Centre of mass; Free Vibrations of undamped SDOF system. Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, Transformation of stress; buckling of column, combined and direct bending stresses. Construction Materials and Management: Construction Materials: Structural Steel – Composition, material properties and behaviour; Concrete - Constituents, mix design, short-term and long-term properties. Construction Management: Types of construction projects; Project planning and network analysis - PERT and CPM; Cost estimation.

Section 3: Environmental Engineering

Water and Waste Water Quality and Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment.

Section 4: Transportation Engineering

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments. Geometric design of railway Track – Speed and Cant. Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design. Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes

Traffic Engineering: Traffic studies on flow and speed, peak hour factor, accident study, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Traffic signs; Signal design by Webster's method; Types of intersections; Highway capacity.

Details about the Written Test

I) Question Paper Format

1. The Written Test Question paper will be of total 100 marks of 2 hours duration. All Questions will be Compulsory and they will be of Multiple Choice Question (MCQ) type. Candidate will have to mark the correct answer on the OMR sheet. Instructions for filling the OMR sheet shall be provided separately.
2. The Written Test Question paper shall consist of three main Sections – SECTION A, SECTION B and SECTION C. SECTION A will be of 40 marks, SECTION B will be of 30 marks and SECTION C of 30 marks.
3. SECTION A shall have the following sub-sections and consist of total 40 Questions. Each correct answer shall be awarded +1 mark and an incorrect answer shall be awarded negative $\frac{1}{4}$ th mark. An un-attempted question shall be awarded zero mark.
 - A.1 Knowledge of Konkani (10 questions)
 - A.2 Knowledge of English (10 questions)
 - A.3 Basic Mathematics (10 questions)
 - A.4 General Awareness (10 questions)
4. SECTION B shall comprise of the following sub-sections and consist of total 30 Questions. Each correct answer shall be awarded +1 marks and an incorrect answer shall be awarded negative $\frac{1}{4}$ mark. An un-attempted question shall be awarded 0 mark.
 - B.1 MATHEMATICS: - (10 questions)
 - B.2 APPLIED PHYSICS (10 questions)
 - B.3 APPLIED CHEMISTRY (10 questions)
5. SECTION C shall comprise of the following sub-sections i.e. i Civil or ii Electrical. This will be consisting of total 15 Questions. Each correct answer shall be awarded +2 marks and an incorrect answer shall be awarded negative $\frac{1}{2}$ mark. An un-attempted question shall be awarded 0 mark.
 - i. Civil Engineering Position (15 Questions)
 - Or
 - ii. Electrical Engineering Position (15 Questions)

II) Shortlisting Criteria based on Performance in Written Test

Note: Only those candidates who score a minimum of 4 marks out of 10 in Section A.1 (40% in Konkani Language) will be considered for shortlisting.

The list will be prepared by sorting in descending order, the total score obtained by the candidates in the Written Test.