RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS FOR SCREENING TEST FOR THE POST OF JUNIOR GEOPHYSICIST- ELECTRONICS GROUND WATER DEPARTMENT

1. **Engineering Physics-**

   Quantum Mechanics: Introduction to Quantum Mechanics, Wave-particle duality, Matter waves, Wave function and basic postulates, Time dependent and time independent Schrodinger's Wave Equation, Physical interpretation of wave function and its properties, Applications of the Schrodinger's Equation: Particle in one dimensional and three dimensional boxes.

   Coherence and Optical Fibers: Spatial and temporal coherence: Coherence length; Coherence time and 'Q' factor for light, Visibility as a measure of Coherence and spectral purity, Optical fiber as optical wave guide, Numerical aperture; Maximum angle of acceptance and applications of optical fiber.

   Laser: Einstein's Theory of laser action; Einstein's coefficients; Properties of Laser beam, Amplification of light by population inversion, Components of laser, Construction and working of He-Ne and semiconductor lasers, Applications of Lasers in Science, engineering and medicine.

2. **Basic Electrical & Electronics Engineering-**

   DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, Series-Parallel circuits, Node voltage method, Mesh current method, Superposition, Thevenin's, Norton's and Maximum power transfer theorems.

   AC Circuits: Representation of sinusoidal waveforms, peak and r.m.s values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase AC circuits consisting of R, L, C, RL, RC and RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

   Material Science & Semiconductor Physics: Bonding in solids: covalent and metallic bonding, Energy bands in solids: Classification of solids as Insulators, Semiconductors and Conductors, Intrinsic and extrinsic semiconductors, Fermi dirac distribution function and Fermi energy, Conductivity in semiconductors, Hall Effect: Theory, Hall coefficient and applications.

3. **Electronic Measurement and Instrumentation-**

   Measuring Instruments: Moving coil, moving iron, electrodynamic and induction instruments- construction, operation, torque equation and errors. Applications of instruments for measurement of current, voltage, single-phase power and single-phase energy. Errors in wattmeter and energy meter and their compensation and adjustment. Testing and calibration of single-phase energy meter by phantom loading.

Polyphase Metering: Blondel's Theorem for n-phase, p-wire system. Measurement of power and reactive kVA in 3-phase balanced and unbalanced systems: One-wattmeter, two- wattmeter and three-wattmeter methods. 3-phase induction type energy meter. Instrument Transformers: Construction and operation of current and potential transformers. Ratio and phase angle errors and their minimization. Effect of variation of power factor, secondary burden and frequency on errors. Testing of CTs and PTs. Applications of CTs and PTs for the measurement of current, voltage, power and energy.

Measurement of Resistances: Classification of resistance. Measurement of medium resistances – ammeter and voltmeter method, substitution method, Wheatstone bridge method. Measurement of low resistances – Potentiometer method and Kelvin's double bridge method. Measurement of high resistance: Price's Guardwire method. Measurement of earth resistance.

4. **Digital Electronics-**
Decimal, binary, octal and hexadecimal number systems, Interconversion of decimal, binary and hexadecimal numbers, BCD numbers, BCD addition and subtraction. AND, OR, NOT, NAND, NOR, and exclusive OR gates, NAND and NOR gates as universal gates. TTL logic circuits, comparison of TTL, ECL and CMOS. De Morgan's theorems, standard POS and SOP forms, min-term and max-term representation of Boolean functions, simplification of Boolean functions using K-maps. Half and full adders, half and full subtractors, multiplexer, demultiplexer, encoder, decoder, BCD-to-seven segment decoder. R-S, J-K, master-slave and edge triggered J-K, T and D Flip-flops. Shift registers, ring counters, ripple and synchronous counter, modulo- N counter, decade counter, digital-to-analog converter, analog -to- digital converter.

5. **Microprocessors-**
Evolution of microprocessors, organisation, architecture and pin description of 8085 microprocessor, addressing modes and instruction set, input / output interfacing devices (8255, 8251), simple programs for addition / subtraction. Microprocessor based data acquisition, frequency, temperature and voltage measurements using microprocessors.

6. **Electromagnetic Theory-**
Maxwell's equations, electromagnetic potential and wave equations, boundary conditions, long wavelength approximation, depth of penetration, electromagnetic field due to straight wire, rectangular and circular loops, elliptical polarisation, amplitude and phase relations, real (in phase) and imaginary components. Bieler Watson method, Dip angle methods- fixed vertical loop transmitter, broadside and shoot back methods, two frame method, compensator method, Turam method, Moving source- receiver methods- horizontal loop method, AFMAG and VLF methods, airborne EM systems- rotary field method, INPUT method, EM profiling and sounding. Principles of EM similitude and modelling, response of conducting sphere to uniform alternating magnetic field and infinitely long horizontal cylinder

to line source, response of sheet conductors to dip angle, Turam and horizontal loop EM systems, dip angle characteristic curves and phasor diagrams for horizontal loop EM system for sheets, effect of overburden on EM anomalies.

7. **Advanced Materials-**
   Smart materials, exhibiting ferroelectric, piezo-electric, opto-electric, semiconducting behavior, lasers and optical fibers, photoconductivity and superconductivity, nano-materials, synthesis, properties and applications, biomaterials, super alloys, shape memory alloys. Materials characterization techniques such as, scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, atomic absorption spectroscopy, differential scanning calorimetry.

8. **Remote Sensing and GIS-**
   Energy sources, principles of solar and terrestrial radiation, Laws of radiation, energy interactions, spectral patterns and signatures. Characteristics of aerial photographic imagery, photogrammetry, air photo interpretation for terrain evaluation. Application in geological mapping and mineral resource evaluation, concepts of GIS and applications: theory and principles, structural concepts, geological interpretation and its ambiguity, geological guides, characteristics for mineral resource. Watershed parameters, physiographic measurements, surface water, flood plain delineation, precipitation, ice and snow monitoring, evaporation and evapotranspiration, subsurface water information system and analysis. Developments of satellites and remote sensing developments in India. Development in remote sensing platforms, constant level and tethered balloons, aircrafts, rockets and satellites. Kepler's Laws of planetary motion, circular and elliptical orbits of satellites, polar, geosynchronous and geostationary satellites. Types of sensors, photographic and TV cameras, visible and infrared sensing, radiometer, side looking radar. Historical development, various meteorological satellite system, INSAT system, data acquisition system, Automatic Picture Transmission (APT). Remote sensing application in meteorology, visible and infrared pictures of clouds, recognition of various clouds and weather systems, estimation of surface temperature and cloud tops, vertical profiles of temperature and water vapour, wind estimation, role of weather satellites in global coverage of observation in synoptic and climatological studies.

9. **Digital Signal Processing-**
   Various types of signals, sampling theorem, aliasing effect, Fourier series and periodic waveforms, Fourier transform and its properties, Discrete Fourier transform and FFT, Auto and cross correlations, Power spectrum, Delta function, unit step function. Time domain windows. Z transform and properties, Inverse Z transform.

   Principles of digital filters, types of filters, moving average and recursive and non recursive filters Amplitude and phase response filters low pass, band pass and high pass filters, Processing of Random signals.

10. Geophysical Equipments-

Gravitymeters: Principles of gravitymeters, stable and unstable gravitymeters, Zero length spring, Calibration of gravitymeter, Magnetometers: Principles and operations of fluxgate, proton precession and optical pumping magnetometers. D.C. and A.C. resistivity meters. Time domain and frequency domain IP and EM equipments, Seismographs: Principle of electromagnetic seismograph, Short period, long period and Broad band sensors, Engineering seismograph. Principle and operation of GPR and antennae. Principle of geophone and hydrophone. Ionisation chamber, G-M counter, Scintillation meter, Gamma ray spectrometer.

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Pattern of Question Papers:

1. Objective Type Paper
2. Maximum Marks : 150
3. Number of Questions : 150
4. Duration of Paper : 2:30 Hours
5. All Questions carry equal marks
6. Medium of Screening Test: English
6. There will be **Negative Marking**

(For every wrong answer, one-third of marks prescribed for that particular question will be deducted).

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