Syllabus for the post of
Assistant Professor- Physics, Maharashtra Education Services, Group - A (Collegiate Branch)

Steps of Exam: Written Exam - 200 Marks Interview - 50 Marks

Level: - Degree
Medium: English
Nature of Paper - Objective Type

No. of Questions: - 100
No. of Marks: - 200
Duration: - 1 hour

Final merit list will be prepared by considering the marks obtained in Written test & Interview.

SYLLABUS

1. Electronics Semiconductor discrete devices (characteristic curves and physics of p-n junction). Schottky, Tunnel and MOS diodes, Bipolar junction transistor, junction field effect, transistor (JFET) Metal-oxide-Semiconductor. Field effect transistor (MOSFET), unijunction transistor and sillicon controlled rectifier (SCR), Opto-electronic devices (Photo-diode, solar cell, LED, LCD and photo transistor), Diffusion of impurities in sillicon, growth of oxide.

   Applications of semiconductor devices in linear and digital circuits-Zener regulated power supply, Transistor (bipolar, MOSFFT, JFET) as amplifier, coupling of amplifier stages (DC, RC and Transformer coupling), RC-coupled amplifier, dc and power amplifier Feedback in amplifiers and oscillators (phase swift, Hartley, Colpitts and crustal controlled) clipping and clamping circuits. Transistor as a switch OR, AND and NOT gates (TIL and CMOS gates). Multivibrators (using transistor) and sweep geneator (using transistors, UJT and SCR).

   Linear integrated circuits-Operational amplifier and its applications-Inverting and noninverting amplifier, adder, integrator, differentiator, waveform geneator, comparator and Schmittrigger, Butterwoth active filter, phase shifter, Digital integrated circuits-NAND and NOR gates building block, X-OR gate, simple combinational circuits-Half and full address, Flip-Flops, shift registers, counters, A/D and D/A coverters, semiconductor memories (ROM, RAM, and EPROM, basic, architecture of 8 bit microprocessor (INTEL 8085).

   Communication Electronics-Basic principle of amplitude frequency and phase modulation. Simple circuits for amplitude modulation and demodulation, digital (PCM) modulation and demodulation. Fundamentals of optical communication, Microwave Oscillators (reflex, klystron, megnetron and Gunn diode), Cavity resonaters. Standing wave detector.

2. Atomic and Molecular Physics : Atomic Physics-quantum states of an electron in an atom, Hydrogen atom spectrum, electron spin, Stern-Gerlach experiment, spin-orbit coupling, fine structure, spectroscopic terms and selection rules, hyperfine structure.

   Exchange symmetry of wave functions, Pauli exclusion priciples, periodic table, alkali-type spectra, LS and JJ coupling, Hund's rules and term reversal.

   Machanisms of line broadening.

   Zeeman, Paschen-Back and Stark effects.

   Inner-shell vacancy, X-rays and Auger transitions, Compton effect.

   Principles of resonance Spectroscopy (ESR and NMR)

   Molecular Physics-Covalent, ionic and Van der Waal's interaction, Born-Oppenheimer approximation.

   Heitler-London and molecular orbital theories of H_2.

   Rotation, rotation-vibration spectra, Raman Spectra, selection rules, nuclear spin and intensity alteration, isotope effects, electronics states of diatomic molecules, Franck-Condon principle.

   Laser-spontaneous and stimulated emission, optical pumping, population inversion,

coherence (temporal and spatial), simple description of ammonia maser, CO_2 and He-Ne lasers.

3. Condensed Matter Physics-Crystal classes and system, 2d and 3d lattices, bonding of common crystal structure; reciprocal lattice, diffraction and structure factor, elementary ideas about point defect and dislocations, short and long range order in liquids and solids, liquid crystals, quasicrystals and glasses.

   Lattice vibrations, phonons, specific heat of solids. Free electron theory. Fermi statistics, heat capacity and Pauli paramagnetic susceptibility.

   Electron motion in periodic potentials energy bands in metals, insulators and semiconductors, tight binding approximation, impurity levels in doped semiconductors.

   Dielectrics-Polarization mechanisms, Clausius-Mossotti equation, piezo, pyro and ferroelectricity.

   Dia and Para magnetism, exchange interactions, magnetic order, ferro, anti ferro and ferromagnetism.

   Superconductivity-basic phenomenology, Meissner effect, Type I and Type II super conductors, BCS pairing mechanisms, High Tc materials.

4. Nuclear and Particle Physics

   Basic nuclear properties-size, shape, charge distribution; spin and parity, binding, empirical mass formula, liquid drop model, nuclear stability and radioactive decay.

   Nature of nuclear force, elements of deuteron problem and low energy N-N scattering Charge Independence + charge symmetry of nuclear forces. Evidence for nuclear shell structure. Single particle shell model-its validity and limitations.

   Interactions of charged particles and X-rays with matter, Basic principles of particle detectors-ionization chamber, proportional counter and GM counters, solid state detectors-scintillation and semiconductor detectors.

   Radioactive decays- [α β γ] decays, their classifications and characteristics. Basic theoretical understanding.

   Nuclear reactions-Q values and kinematics of nuclear cross-sections, its energy and angular dependence, elementary ideas of reaction mechanisms, elementary ideas of fission and fusion.

   Particle Physics-Classificationof fundamental forces and elementary, particles, Isopin, strangeness, Gell-Mann-Nishijima formula.

   Quark model + SU (3) symmetry.

   C.T.P invariances in different interactions, weak interactions, parity-non conservation, K-meson complex and time reversal invariance, elementary ideas of geuge theory of strong and weak interactions.