STATE ELIGIBILITY TEST

PHYSICAL SCIENCES
SYLLABUS

SUBJECT CODE : 26

PAPER-II

SYLLABUS OF PAPER II SECTION A

1. General information on science and its interface with society to test the candidate's awareness of science, aptitude of scientific and quantitative reasoning.

2. COMMON ELEMENTARY COMPUTER SCIENCE (Applicable to all candidates offering subject areas).

   i) History of development of computers, Mainframe, micro's and Super Computer systems.

   ii) General awareness of computer Hardwar i.e. CPU and other peripheral devices (input/output and auxiliary storage devices)

   iii) Basic knowledge of computer systems software and programming language i.e. Machine language. Assembly language and higher level language.

   iv) General awareness of popular commercial software packages like LOTUS, DBASE, WORDSTAR, other Scientific application packages.

SECTION B PAPER II

1. Basic Mathematical Methods: Calculus: Vector algebra and vector clculus. Linear algebra, matrices. Linear differential equations. Fourier-series. Elementary complex analysis.

2. Classical Dynamics: Basic priciples of classical dynamics. Lagrangian and Hamiltonian formalisms. Summetries and conservation laws. Motion in the central field of force. Collisions and scattering. Mechanicsof a system of paticles. Small oscillations and normal modes. Wave motion, wave equation, phase velocity, group velocity, dispersion. Special theory of relativity- Lorents transformations, addtion of velocities, mass energy equivalence.

3. Electromagnetics : Electrostatics-Laplace and poisson equations, boundary value problems. Magnetostatics- Ampere's theorem, Biot Savart law, electromagnetic induction. Maxwell's equations infree space and linear isotropic media. Boundary condtions on the fields at interfaces. scaler

and vector potentials. Gauge invariance. Electromagnetic waves-reflection and refraction dispersion, interference, coherence, diffraction, polarization. Electrodynamics of charges particle in electric and magnetic fields. Radiation from moving charges, radiation from a dipole. Retarded potential.

4. Quantum Physics and Applications: Wave particle duality. Heisenberg's uncertainty principle. The schrodinger equation particle in box, Harmonic Oscillator, Tunnelling through a barrier. Motion in a central potential orbital angular momentum. Angular momentum algebra, spin . Addtion of angular momengta. Time independent perturbation theory. Fermi's Golden rule. Elementary theory of scattering in a Central potential. Phase shifts, partial wave analysis, Born approximation, identical particles, spin statistics connection.

5. Thermodynamic and Statistical Physics: Laws of thermodynamics and their consequences, Thermodynamic potentials and Maxwell's relations. Chemical potential phase equilibria. Phase space, microstates and macrostates. Partition function. Free energy and connection with thermodynamic quantities. Classical and quantum statistics. Degenerate electron gas. Blackbody radiation and Plank's distribution law. Bose Einstein condensation. Einstein and Debye models for Latticce specific heat.

6. Experimental Design: Measurement of fundamental constants: e,h,c. Measurement of high and low Resistances, L and C.

   Detection of X-Rays, Gamma rays, Charges particles, neutrons etc. lonization chamber, proportional counter, GM counter, scintillation detectors, solid state detectors. Emission and Absorption spectroscopy. Measurement of Magnetic field, Hall effect, magnetoresistance, X-ray and neutron Diffraction.

   Measurement of energy and time using electronic signals from the detectors and associated instrumentation. Signal processing, A/D conversion and multichannel analyzers, Time of flight technique, coincidence Measurements; true to chance ration correlation studies.

   Error Analysis and Hypothesis testing: Propagation of errors, Plotting of Graph, Distributions Least squares fitting, criteria for goodness of fitschi square test.

PAPER-III

1. Electronics: Physics of p-n junction. Diode as a circuit element; clippiong, clamping; Rectification, Zener regulated power supply.

   Transistor as a circuit element: CC, CB and CE configuration Transistor as a switch, or, and, NOT gates.

Feed back in Amplifier and its applications: Inverting, non-inverting Amplifier, adder, integrator, differentiator, wave from generator, comparator & schmidt trigger.

Digital- integrated Circuits: NAND & NOR gatges as building blocks, X-OR gate, simple combinational circuits, Half and Full adder, Flip- flop shift register counters.

Basic Principles of A/D & D/A converters: Simple applications of A/D and D/A converters.

2. Atomic and Molecular Physics: Quantum states of an electron in an atom. Hydogen atom spectrum, electron spin. Stern Gerlash experiment. Spin-orbit coupling, fine structure, relativistic correction, spectroscopic terms and selection rules, hyperfine structure. Exchange symmetry of wave functions. Pauli's exclusion principles, periodic tgable alkali, type spectra LS & JJ coupling, Zeeman, Paschen- Black and Stark effects.

   X-Rays and Augertransitions, compton effect. Principles of ESR, NMR.

   Molecular Physics Convalent, ion ic and Van der Wall's interaction.

   Rotation/vibration spectra. Raman Spectra, Selection rules, nuclear spin and intensity alternation, isotope effects, electronic states of diatomic molecules, Frank condon principle. Lasers-Spontaneous and stimulated emission, optical pumping, population inversion, coherence (temporal and spatial) simple description of Ammonia maser, CO2 and He Ne lasers.

3. Condensed Matter Physics: Crystal classes and systems, 2d and 3d lattices, Bonding of common crystal structure, reciprocal lattice, diffraction and structure factor, elementary ideas about point defects and dislocations.

   Lattice vibrations, phonons, specific heat of solids,free electron theory- Fermi statistics; heat capacity.

   Electron motion in periodic potential energy bands in metals, ensulators and semi-conductors; tight binding approximation; impurity levels in doped semi-conductors.

   Electronic transport from classical kinetic theory, electrical and thermal conductivity. Hall effect and thermo electric power transport in semi-conductors.

   Di-Electrics-Polarization mechanisms, clausius- Mossotti equation, Fiezo, Pyro and ferro electricity.

   Dia and Para magnetism; exchange interactions, magnetic order, ferro, anti ferro and ferrimagnetism. Super conductivity- basic phenmenology; Meissner effect, type-1 and type-2, super conductors, BCS pairing mechanism.

4. Nuclear and Particle Physics: Basic nuclear properties size shape, charge distribution spin and parity, binding, empirical mass formula, liquid drop model.

Nature of nuclear force, elements of two body problem, charge independence and charge symmetry of nuclear forces. Evidence for nuclear shell structure. Single particles shell model- its validity and limitations, collective model.

Interactions of charges particles and e.m. rays with matter. Basic principles of particle detectorsionization chamber; gas proportional counter and GM counter, scintillation and semiconductor detectors.

Radio activedecays (A.B.y.) basic theoretical understanding.

Nuclear reactions, elementary ideas of reactions mechanisms, compound nucleus and direct reactions, elementary ideas of fission and fusion.

Particle physics: Symetrics an conservation laws, classification of fundmental forces and elementary particles, iso-spin, strangeness, Gell Mann Nishijima formula, Quark Model, C.P.T invariance in different interations, Parity-nonconservation in weak interaction.

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