

**SYLLABUS****PHYSICAL SCIENCE****Note :**

**There are Three Papers for each of the subjects. Paper-I on Teaching and Research aptitude, Paper -II and Paper-III based on the syllabus of concerned subjects. Details are furnished below :**

**PAPER -I****Subject : General Paper on Teaching & Research Aptitude**

The test is intended to assess the teaching/research aptitude of the candidate. They are supposed to possess and exhibit cognitive abilities like comprehension, analysis, evaluation, understanding the structure of arguments, evaluating and distinguishing deductive and inductive reasoning, weighing the evidence with special reference to analogical arguments and inductive generalization, evaluating, classification and definition, avoiding logical inconsistency arising out of failure to see logical relevance due to ambiguity and vagueness in language. The candidates are also supposed to have a general acquaintance with the nature of a concept, meaning and criteria of truth, and the source of knowledge.

There will be 60 questions, out of which the candidates can attempt any 50. In the event of the candidate attempting more than 50 questions, the first 50 questions attempted by the candidate will only be evaluated.

1. The Test will be conducted in objective mode from SET 2012 onwards. The Test will consist of three papers. All the three papers will consist of only objective type questions and will be held on the day of Test in two separate sessions as

under :

Session	Paper	Number of Questions	Marks	Duration
First	I	60 out of which 50 questions are to be attempted	50%2=100	1¼ Hours
First	II	50 questions all of which are compulsory	50%2=100	1¼ Hours
Second	III	75 questions all of which are compulsory	75%2=150	2½ Hours

2. The candidates are required to obtain minimum marks separately in Paper-II and Paper -III as given below

Minimum marks (%) to be obtained			
Category	Paper-I	Paper-II	Paper-III
General	40 (40%)	40 (40%)	75 (50%)
OBC	35 (35%)	35 (35%)	67.5 (45%) rounded off to 68
PH/VH/ SC/ST	35 (35%)	35 (35%)	60 (40%)

Only such candidates who obtain the minimum required marks in each Paper, separately, as mentioned above, will be considered for final preparation of result.

However, the final qualifying criteria for eligibility for Lectureship shall be decided by Steering Committee before declaring of result.

3. The syllabus of Paper-I, Paper-II and Paper-III will remain the same.

## PHYSICAL SCIENCE

### PAPER - II

#### 1. Basic Mathematical Methods :

Calculus : Vector algebra and vector calculus, Linear algebra, matrices, Linear differential equations, Fourier-series, Elementary complex analysis.

#### 2. Classical Dynamics :

Basic principles of classical dynamics, Lagrangian and Hamiltonian formalisms, Symmetries and conservation laws, Motion in the central field of force, Collisions and scattering, Mechanics of a system of particles, Small oscillations and normal modes, Wave motion-wave equation, phase velocity, group velocity, dispersion. Special theory of relativity-Lorentz transformations, addition 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 in free space and in linear isotropic media. Boundary conditions on the fields at interfaces, Scalar and vector potentials, Gauge invariance, Electromagnetic waves-reflection and refraction, dispersion, interference, coherence, diffraction, polarization, Electrodynamics of a charged 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 a box., Harmonic Oscillator, Tunnelling through a barrier, motion in a central potential, Orbital angular momentum. Angular momentum algebra, spin. Addition of angular momenta. 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 microstates. Partition function, Free Energy and connection with thermodynamic quantities. Classical and quantum statistics, Degenerate electron gas. Blackbody radiation and Planck's distribution law, Bose-Einstein condensation. Einstein and Debye models for lattice specific heat.

#### 6. Experimental Design :

Measurement of fundamental constants; e.h.c. Measurement of High & Low Resistances, L and C.

Detection of X-rays, Gamma rays, charged particles, neutrons etc. Ionization 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, Vacuum Techniques; basic idea of conductance, pumping speed etc. Pumps; Mechanical Pump, Diffusion pump; Gauges; Thermocouple, Penning, Pirani, Hot Cathode. Low Temperature; Cooling a sample over a range upto 4K and measurement of temperature. Measurement of Energy and Time using electronic signals from the detectors and associated instrumentation; Signal processing, A/D conversion & multichannel analyzers, Time-of-flight technique; Coincidence measurements; true to chance ratio, correlation studies.

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

**PAPER - III****Syllabus of Paper-II and the Following****1. Electronics :**

Physics of p-n junction, Diode as a circuit element; clipping, 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 Amplifiers. Operational amplifier and its applications : inverting, non-inverting amplifier, adder, integrator, differentiator, wave form generator, comparator, & Schmidt trigger. Digital integrated circuits-NAND & NOR gates as building blocks, X-OR Gate, simple combinational circuits, Half & Full adder, Flip-flop, shift register, counters. Basic principles of A/D & D/A converters; Simple applications of A/D & D/A converters.

**2. Atomic & Molecular Physics :**

Quantum states of an electron in an atom. Hydrogen atom spectrum. Electron spin. Stern-Gerlach experiment. Spin-orbit coupling, fine structure, relativistic correction, spectroscopic terms and selection rules, hyperfine structure. Exchange symmetry of wave functions. Pauli's exclusion principle, periodic table alkali-type spectra, LS & JJ coupling, Zeeman, Paschen-Back and Stark effects. X-Rays and Auger transitions, Compton effect

Principles of ESR, NMR

Molecular Physics : Covalent, Ionic and Vander Waal'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, CO<sub>2</sub> and He-Ne Lasers.

**3. Condensed Matter Physics :**

Crystal classes and systems, 2d & 2d lattices, Bonding of common crystal structures, reciprocal lattice, diffraction and

structure factor, elementary ideas about point defects and dislocations.

Latics vibrations, Phonons, specific heat of solids, free electron theory-Fermi statistics; heat capacity.

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

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

Di-electrics-Polarization mechanisms, Clausius-Mossotti equation, Piezo, Pyro and ferro electricity.

Dia and Para magnetism; exchange interactions, magnetic order, ferro, anti-ferro and ferrimagnetism.

Super conductivity-basic phenomenology; Meissner effect, Type-1 & Type-2 Super conductors, BCS Pairing mechanism.

**4. Nuclear and Particle Physics :**

Basic nuclear properties-size, shape, charge distribution, spin & 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 particle shell model-its validity and limitations, collective model.

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

Radio-active decays (a By), basic theoretical understanding

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

**Particle Physics :** Symmetric and conservation laws, classification of fundamental forces and elementary particles, iso-spin, strangeness, Gell-Mann Nishijima formula, Quark model. C.P.T. invariance in different interactions, party-nonconservation in weak interaction.