DEVI AHILYA VISHWAVIDYALAYA, INDORE
INSTITUTE OF ENGINEERING & TECHNOLOGY
APPLIED PHYSICS

SYLLABUS FOR DOCTORAL ENTRANCE TEST (DET)
(Effective from 1st July 2017)

PART- A

Part-A shall consist of 50 objective type compulsory questions of (01) mark each based on research aptitude. It shall be of generic nature, intended to assess the research aptitude of the candidate. It will primarily be designed to test reasoning ability, data interpretation and quantitative aptitude of the candidate.

PART-B

Part-B shall consist of 50 objective type compulsory questions of (01) mark each based on the syllabus of the subject as follows:

1. **Classical Mechanics :** Elementary Principles, Mechanics of systems of particles. Constraints. D'Alembert's Principle and Lagrange's equations. Velocity Dependent potentials, variational principles and Lagranges equations : Hamilton's principle. Calculus of variations, Lagranges equation from Hamilton's principle, conservation theorems and symmetry properties.
2. **Statistical Mechanics :** Thermodynamic quantities, Macroscopic motion, relations between the derivative of thermodynamic quantities, Nerst theorem and quantum justification, the dependence of thermodynamic quantities on number of particles, thermodynamic potential, equilibrium of a body in an external field. Statistical distribution, Gibbs distribution, Maxwellian distribution, free energy in Gibbs distribution, partition function, the Boltzmann distribution, Bose Einstein distribution, Fermi Dirac distribution,
3. **Atomic and Molecular Physics** : Atomic spectra, Hydrogen spectrum, electron spin and vector atom model, Pauli's principle, doublet fine structure of alkali elements normal and anomalous Zeeman effect, explanation, Stern Gerlach expt., selection and intensity rules, various coupling schemes. Molecular spectra, Molecular spectra of diatomic molecules, rotation, vibration and electronic bands, isotropic effect and spin effect of the nucleus, anharmonicity of spectra, intensity of rotation, vibration and electronic bands.
4. **Quantum Mechanics** : Schrodinger's wave equation ; interpretation of wave function : probability current density ; one and three dimensional square well potential ; linear harmonic oscillator; hydrogen atom. WKB approximations ; boundary conditions in the quasi-classical case ; Bohr-Sommerfeld's quantization rule ; penetration through a potential barrier, α decay. Angular momentum, various communication relations ; eivenvalues and eigenfunctions of the angular

momentum ; spin ; spin operator ; Pauli's spin matrices. Perturbation theory, Perturbation independent of time ; first and second-order ; the effect of an electric field on the energy levels of an atom (Stark effect) ; perturbations depending on time ; first-order transitions ; constant perturbation ; Fermi's golden rule ; interaction of an atom with electromagnetic radiation.

5. **Solid State Physics** : Basics of crystal structures, symmetry, reciprocal lattice, Bravis lattice, imperfection in crystals, crystal diffraction, deBroglie hypothesis, x-ray diffraction, Bragg's law, Brillouin zones, XRD, power XRD, rotation XRD, correction to Bragg's law. Vibrations of crystals with monoatomic basis, two atoms per primitive basis, Energy levels and density of orbitals in one and three dimensions, electron motion in a magnetic field and hall effect thermal conductivity of metals, Superconductivity, Occurrence and destruction of superconductivity by magnetic fields ; Meissner effect, energy gap and isotope effect ; thermodynamics of superconducting transitions, London equation, coherence length, elementary ideas of BCS theory, flux quantization, type –I and II superconductors. Energy bands and semiconductor crystals.

6. **Lasers and Fibre Optics** : Principles of laser, gain and absorption coefficients, population inversion, population inversion in three and four level lasers, laser amplification, line broadening mechanisms, Ruby, He-Ne, CO_2, Nd-glass lasers. The optical fiber, comparison of optical fiber with other inter connectors, concept of an optical waveguide, rays and modes, principle of light guidance in optical wave guides, fiber types. Electromagnetic analysis of simplest optical waveguide ; basic wave guide equation, propagating modes of symmetric step index planar waveguide, TE modes of symmetric step index planar waveguide,

7. **Nuclear Physics** : Nuclear models, Introduction, degenerate gas model liquid drop model, X-particle model, shell model, spin orbit coupling model, collective and optical models, cyclotron, synchrocyclotron, electron and proton synchrotron, betatron, linear accelerator. Nuclear reactions, Conservation laws of nuclear reactions, reaction energies and Q value, threshold energy, binding energy and of value charged particle induced reactions, neutron induced reaction, photodisintegration, reaction cross section, theories of nuclear reactions.

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