Program	Ph.D.		
Syllabus	Entrance Exam Syllabus for Physics		
Examination Pattern	**Question Type**	**No. of Questions**	**Total Marks**
	1 Mark Domain Specific	35	35
	1 Mark Research Aptitude	35	35
	Total	**70**	**70**

Section – 1 - Weightage – 50%	
Sr. No.	**Topics**
1	**Mathematical Physics -** Vector Calculus: Linear vector space: basis, orthogonality and completeness; matrices; similarity transformations, diagonalization, Eigen values and Eigen vectors; linear differential equations: second order linear differential equations and solutions involving special functions; complex analysis: Cauchy-Riemann conditions, Cauchy's theorem, singularities, residue theorem and applications; Laplace transform, Fourier analysis; elementary ideas about tensors: covariant and contravariant tensors.
2	**Classical Mechanics** - Lagrangian Formulation: D'Alembert's principle, Euler-Lagrange equation, Hamilton's principle, calculus of variations; symmetry and conservation laws; central force motion: Kepler problem and Rutherford scattering; small oscillations: coupled oscillations and normal modes; rigid body dynamics: interia tensor, orthogonal transformations, Euler angles, Torque free motion of a symmetric top; Hamiltonian and Hamilton's equations of motion; Liouville's theorem; canonical transformations: action-angle variables, Poisson brackets, Hamilton-Jacobi equation.
3	**Special Theory of Relativity -** Lorentz transformations, relativistic kinematics, mass-energy equivalence.
4	**Electromagnetic Theory** - Solutions of electrostatic and magnetostatic problems including boundary value problems; method of images; separation of variables; dielectrics and conductors; magnetic materials; multipole expansion; Maxwell's equations; scalar and vector potentials; Coulomb and Lorentz gauges; electromagnetic waves in free space, non-conducting and conducting media; reflection and transmission at normal and oblique incidences; polarization of electromagnetic waves; Poynting vector, Poynting theorem, energy and momentum of electromagnetic waves; radiation from a moving charge.
5	**Quantum Mechanics** - Postulates of quantum mechanics; uncertainty principle; Schrodinger equation; Dirac Bra-Ket notation, linear vectors and operators in Hilbert space; one dimensional potentials: step potential, finite rectangular well, tunneling from a potential barrier, particle in a box, harmonic oscillator; two and three dimensional systems: concept of degeneracy; hydrogen atom; angular momentum and spin; addition of angular momenta; Variational method and WKB approximation, time independent perturbation theory; elementary scattering theory, Born approximation; symmetries in quantum mechanical systems.
6	**Thermodynamics and Statistical Physics** - Laws of thermodynamics; macrostates and microstates; phase space; ensembles; partition function, free energy, calculation of thermodynamic quantities; classical and quantum statistics; degenerate Fermi gas; black body radiation and Planck's distribution law; Bose-Einstein condensation; first and second order phase transitions, phase equilibria, critical point.
7	**Atomic and Molecular Physics** - Spectra of one-and many-electron atoms; spin-orbit interaction: LS and jj couplings; fine and hyperfine structures; Zeeman and Stark effects; electric dipole transitions and selection rules; rotational and vibrational spectra of diatomic molecules; electronic transitions in diatomic molecules, Franck-Condon principle; Raman effect; EPR, NMR, ESR, X-

	ray spectra; lasers: Einstein coefficients, population inversion, two and three level systems.
8	**Solid State Physics** - Elements of crystallography; diffraction methods for structure determination; bonding in solids; lattice vibrations and thermal properties of solids; free electron theory; band theory of solids: nearly free electron and tight binding models; metals, semiconductors and insulators; conductivity, mobility and effective mass; Optical properties of solids; Kramer's-Kronig relation, intra- and inter-band transitions; dielectric properties of solid; dielectric function, polarizability, ferroelectricity; magnetic properties of solids; dia, para, ferro, antiferro and ferri-magnetism, domains and magnetic anisotropy; superconductivity: Type-I and Type II superconductors, Meissner effect, London equation, BCS Theory, flux quantization.
9	**Electronics** - Semiconductors in Equilibrium: Electron and hole statistics in intrinsic and extrinsic semiconductors; metal-semiconductor junctions; Ohmic and rectifying contacts; PN diodes, bipolar junction transistors, field effect transistors; negative and positive feedback circuits; oscillators, operational amplifiers, active filters; basics of digital logic circuits, combinational and sequential circuits, flip-flops, timers, counters, registers, A/D and D/A conversion.
10	**Nuclear and Particle Physics** - Nuclear radii and charge distributions, nuclear binding energy, electric and magnetic moments; semi-empirical mass formula; nuclear models; liquid drop model, nuclear shell model; nuclear force and two nucleon problem; alpha decay, beta-decay, electromagnetic transitions in nuclei; Rutherford scattering, nuclear reactions, conservation laws; fission and fusion; particle accelerators and detectors; elementary particles; photons, baryons, mesons and leptons; quark model; conservation laws, isospin symmetry, charge conjugation, parity and time-reversal invariance.

Section – 2 - Weightage – 50%	
Sr. No.	**Topics**
1	**Research Aptitude -** Research: Meaning, characteristics and types; Steps of research, Methods of research; Research Ethics; Paper, article, workshop, seminar, conference and symposium.
2	**Reasoning (Including Mathematical) -** Number series; letter series; codes; Relationships; classification.
3	**Logical Reasoning -** Understanding the structure of arguments; Evaluating and distinguishing deductive and inductive reasoning; Verbal analogies: Word Analogy-Applied analogy; Reasoning Logical Diagrams: Simple diagrammatic relationship, multi-diagrammatic relationship; Venn diagram; Analytical Reasoning
4	**Data Interpretation -** Sources, acquisition and interpretation of data; Quantitative and qualitative data; Graphical representation and mapping of data.