

SECTION – A

(Common for all candidates)

Total Marks: 50

Ph.D. Entrance Examination Syllabus (Research Methodology)

Unit	Content
1	Basics of Research: Research: Meaning, Objective, Characteristics, Steps of research, Methods of research, Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.
2	Research Problem and Research Design: Introduction to Research Problem, Necessity of Defining the Problem, Selecting the Problem, Techniques Involved in Defining a Problem, Meaning and Types of Research Design, Important Concepts Relating to Research Design
3	Sampling Design: Census and sample survey, Implications of a Sample Design, Steps in sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of sample Designs, How to Select a Random Sample?, Random Sample from an Infinite Universe, Complex Random Sampling Designs
4	Data Collection and Analysis: Methods of Data Collection- Observation, Interview, Questionnaires, Schedules, Survey and Experimental. Selection of Appropriate Method for Data Collection, Different Techniques of Sampling such as Probability and Non-Probability, Basic Statistical Methods of Data Analysis such as Frequency distribution, Measures of central tendency, Measures of Dispersion, Coefficient of variation, correlation and regression.
5	Research Ethics and Morals: Environmental impacts and Ethical issues, Commercialization, Copy right, Royalty, Intellectual property rights and Patent law, Plagiarism, Citation, Referencing style and acknowledgement.

SECTION – B

Total Marks: 50

Ph.D. Entrance Examination Syllabus (Physics)

Elasticity

Classification of Elastic Material, Stress, Strain, Hook's law, Elastic Behavior of a Material, Factor affecting Elasticity, Classification of Elastic Modulus, Poisson's Ratio, Relation between Elastic Moduli, Twisting couple on a wire and solid shaft, Torsional Pendulum, Bending of beam, Cantilever.

Ultrasonic

Classification of Ultrasonic wave, Properties, Generation of ultrasonic, Velocity measurement, Absorption and Dispersion of ultrasonic, Applications, Acoustics Holography.

Laser

Principle of laser, Einstein's theory of stimulated emission, Population inversion and methods of achieving it, Threshold conditions, Types of laser, Determination of Wavelength of Laser using grating, Particle Size Determination by Laser, Application of Laser.

Fiber Optics:

Principle, Structure of optical fibers, Acceptance angle and Cone, Numerical Aperture and Acceptance Angle, Types of optical fibers, Fabrication of Optical fibers, Loss in optical fibers, Fiber optical communications, Splicing, Light Sources for optical fibers, Photo detectors, Fiber optical sensor, Classification of optical sensor, Fiber endoscope, Applications.

Electric and Magnetic field:

Electric charge, Coulomb Force, Electric field, Electric potential, Potential gradient, Homogeneous electric field, Equipotential surface, The magnetic field, Uniform magnetic field, The magnetic field strength, Lorentz equation, Fields, The flux of a vector field, the divergence of a vector field, The divergence theorem, Electric flux density, Gauss's law, Application of the gauss' theorem, Differential form of gauss theorem, The gradient of a scalar field, Potential, The line integral of vector field, Curl of a vector field, Stokes's theorem, Ampere's law, Poisson's equations, Laplace's Equation, Current and continuity Equation, Faraday's law, Displacement current, Absence of Magnetic charge.

Particle properties of wave:

Electromagnetic waves, Blackbody radiation, Photoelectric effect, X-Ray Spectrum, X-Ray absorption and Absorption coefficient, Interaction of X-ray with matter, X-ray diffraction, Compton's Effect, Pair production, Photons and gravity.

Wave properties of particle

De Broglie Wavelength, Phase velocity and Group Velocity, Particle Diffraction, Particle in a box, Uncertainty Principles.

Nuclear Physics

Nuclear Liquid drop model, Semi empirical mass formula, Shell model, Linear Particle accelerator, Cyclotron, The betatron, Synchrocyclotron or frequency modulated cyclotron, Synchrotron, G-M Counter, Motion of charged particle in electric and magnetic field, Bainbridge mass spectrograph, Aston mass spectrograph.

Super conducting Material

General properties of superconducting material, Types of super conductor, BCS theory, Electron phonon interaction, High temperature superconductors, Applications.

Quantum Mechanics:

The Wave Equation, Schrodinger's Equations, Linearity and super position, Expectation values, Operators, Particle in a box, Finite potential well, Tunnel effect, Harmonic oscillator, Schrodinger equation for the hydrogen atom, Separation of variable, Quantum numbers, Principal Quantum number, Orbital quantum number, Magnetic quantum number, Electron probability Density, Radiative Transitions, Selection rules, Zeeman effect.

Special Theory of Relativity:

Space, time and Motion, Frame of reference, Inertial and non-inertial frames of references, Galileo's principal of relativity, Galilean Transformations, The ether, Michelson- Morley Experiment, Failure of Galilean transformations, Einstein's principle of relativity, The Lorentz transformations, Consequences of special relativity, Length contraction, The time dilation, twin paradox, relativistic mass, relativistic momentum, Kinetic energy, Mass-Energy equivalence, Relation between momentum and energy.

Number Systems Used in Digital Electronics, Logic Gates and Boolean Algebra

The Decimal Number system, The binary System, Binary to decimal and decimal to binary conversion, Binary operations, The Octal Number System, Octal to decimal and Decimal to Octal conversion, Binary to octal and octal to binary Conversion, The Hexadecimal Number system, Binary to Hexadecimal and Hexadecimal to binary Conversion, Decimal to hexadecimal and Hexadecimal to decimal conversion, Logic Gates, Boolean Algebra, Equivalent Switching Circuits, De Morgan's Theorem.

Magnetic Materials:

Magnetic field, Magnetic dipole moment, Magnetization, Magnetic susceptibility, Magnetic permeability, Magnetic materials, Dia magnetic materials, paramagnetic materials, ferromagnetic materials, Origin of Magnetization, Classification of magnetic material, Magnetic moment of the atom, Diamagnetism, Para magnetism, ferromagnetism, Magnetostriction, Antiferromagenism, Ferrimagnetisms, Types of magnetic material, Soft and Hard magnetic material, Applications.