CMI PhD (Physics) Entrance Exam: Syllabus

I. Classical Mechanics: Newtonian Mechanics, Variational Principles & Lagrange's Equations, The Central Force Problem, Kinematics and Dynamics of Rigid Bodies, Small Oscillations, Hamilton's Equations, Canonical Transformations, Hamilton-Jacobi Theory, Special Relativity.

References:

1. Mechanics by C. Kittel, W. D. Knight, M. A. Ruderman, C. A. Helmholz, B. J. Moyer: Berkeley Physics Course Volume 1, Tata McGraw Hill.

2. Classical Mechanics by H. Goldstein, Addison-Wesley/Narosa.

II. Quantum Mechanics: Physical Basis of Quantum Mechanics, Schrodinger Equation, Operators, Eigenfunctions, Eigenvalues, Wavepackets, One Dimensional Bound State and Scattering Problems, Harmonic Oscillator, Angular Momentum, Hydrogen Atom, Collisions in Three Dimensions, Scattering from Spherically Symmetric Potentials, Matrix Formulation of Quantum Mechanics, Symmetry in Quantum Mechanics, Identical Particles and Spin, Stationary Perturbation Theory (Degenerate and Non-degenerate cases), Variational Method, WKB Approximation, Time-dependent Perturbation Theory, Green's functions, Scattering Matrix, Born Approximation and Partial Wave Analysis.

References:

1. Quantum Physics: by E. H. Wichman: Berkeley Physics Course Volume 4, Tata McGraw Hill.

2. Quantum Mechanics by L. I. Schiff, McGraw Hill.

III. Electrodynamics: Electrostatics, Electric Field in Matter, Conductors, Dielectrics, Magnetostatics, Magnetic Fields in Matter, Electrodynamics, Maxwell's Equations, Conservation Laws, Electromagnetic Waves, Potentials and Fields, Radiation, Special Relativity.

References:

1. Electricity and Magnetism: by E. M. Purcell: Berkeley Physics Course Volume 2, Tata McGraw Hill.

2. Introduction to Electrodynamics by D. J. Griffiths, Phi Learning.

IV. Statistical Mechanics: Thermodynamics and Kinetic Theory: Laws of Thermodynamics and Applications, Maxwell-Boltzmann Distribution, Transport Phenomena, Conservation Laws, Hydrodynamics; Classical and Quantum Statistical Mechanics: Microcanonical, Canonical, and Grand Canonical Ensembles, Density Matrix, Ideal Gases, Partition Function, Ideal Fermi Gas, Ideal Bose Gas, Phase Transitions.

References:

1. Statistical Physics: by F. Reif: Berkeley Physics Course Volume 5, Tata McGraw Hill.

2. Statistical Mechanics by K. Huang, Wiley Eastern.

5. Mathematical Physics: Matrices and Linear Algebra, Ordinary Differential Equations, Complex Analysis and Partial Differential Equations, Fourier series and transforms.

References:

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley.

2. Mathematical Methods for Physicists by G. B. Arfken and H. J. Weber, Academic Press.