RAFFLES UNIVERSITY

Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Physics

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Unit - I

Quantum Mechanics: Schrödinger Picture, Time independent perturbation theory: Theory and an example; Scattering theory: Quantum theory, Partial wave analysis (one example), Born Approximation and its validity (One example); Path integral formulation: propagator, Schrödinger wave equation from path integral, eg: free particles; Introduction to second quantization; Quantum field theory: quantization of scalar field and Dirac field.

Unit - II

Condensed Matter Physics: Electronic Structure Calculation: Hartree-Fock Theory, Introduction to Density Functional Theory; Correlated Electron States: Mott Transition, Hubbard Model, Magnetic impurities and Kondo Model; Quantum Hall effect: Integer and fractional Hall Effect, Laughlin wave function; Magnetism: Mean-field approximation for Heisenberg Hamiltonian model for Ferromagnetism.

Unit – III

Statistical Mechanics: Landau theory for phase transitions. Ising model: transfer matrix method; Onsager solution of 2-dimensional Ising model. Non-equilibrium Statistical Mechanics: Response function and susceptibility; fluctuation-dissipation theorem; irreversibility and the master equation; Fokker-Planck and diffusion equations.

Unit – IV

General Theory of Relativity: Equivalence principle and its applications: gravity as a curvature of space-time; geodesics as trajectories under the influence of gravitational field; generalisation to massless particles.

Unit – V

High Energy Physics: Introduction to relativistic kinematics, Review of Experimental methods: fixed target and collider experiments, Introduction of four forces and interactions, Feynman diagrams Basics of quantum electrodynamics: Glashow-SalamWeinberg model, Standard Model Physic.

Unit – VI

Nonlinear Optics: Nonlinear wave propagation in Anisotropic media; Second Harmonic Generation (SHG); Phase Matching Techniques; Three-Wave Interactions; Third Harmonic Generation (THG); Density Matrix and Perturbation approach to Nonlinear susceptibility

Text Books:

1. Introduction of Quantum Mechanics; David J. Griffiths; Pearson Education; 2010.
2. Principle of Quantum Mechanics; R. Shankar; Springer; 1994.
3. Introduction to Condensed Matter Physics; F. Duan, J. Guojun; World Scientific; 2007.
4. Statistical Mechanics: R. K. Pathria; Elsevier; 2002.
5. Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity, Steven Weinberg; Wiley; 2013.
6. Introduction to Elementary Particles; David J. Griffiths; Wiley; 2008.
7. Introduction to High Energy Physics, Donald Perkins; Cambridge University Press; 2000.
8. Nonlinear Optics, 3rd Ed; R. W. Boyd, Academic Press; 2008.

Reference Books:

1. Quantum Mechanics 2nd Ed; Bransden and Joachain; Pearson; 2000.
2. Quantum Mechanics and Path Integral; Feynmann and Hibbs, McGraw-Hill College; 1965.
3. Many-particle Physics; G. D. Mahan; Springer US; 2000; DOI: 10.1007/978-1-4757- 5714-9.
4. Advanced Condensed Matter; L. M. Sander; Cambridge University Press; 2009.
5. Introduction to Phase Transitions and Critical Phenomena; H. E. Stanley; Oxford University Press; 1987.
6. Gravity: Introduction to Einstein's General Relativity; J. B. Hartle; Pearson Education, 2003.
7. Quarks and Leptons: An Introductory Course in Modern Particle Physics, Francis Halzen and Alan Martin; Wiley; 1984.
8. Nonlinear Optics, 4th Ed; N. Bloembergen, World Scientific; 1996.
9. Fundamentals of Nonlinear Optics; P. E. Powers, CRC Press; 2011