RIMT UNIVERSITY MANDI GOBINDGARH
PUNJAB

Pattern of Course Work & Detailed Syllabus
For
Ph.D Programme in Physics

Syllabi Applicable For Admissions in 2018 Onwards

Pattern of Course Work for Ph.D Programme in Physics

Name of Course		Contact Hours/Week			Credit	Evaluation Scheme (% of Total Marks)					Exam Duration (Hours)
Code	Title	L	T	P		CWA	LWA	MTE	ETE	Total	
PHDRM 1101	Research Methodology & Statistical Technique	5	0	0	5	16	---	24	60	100	
PHDCA 1102	Computer Applications in Research	3	0	0	3	16	---	24	60	100	
PHDPHY 1103 A 1103 B 1103 C 1103 D 1103 E	*Core Subject of the Discipline in which Ph.D degree to be Awarded	5	0	0	5	16	---	24	60	100	
PHD 1104	Mini Project/Term Paper	-	-	-	2	---	---	---	100	100	
Total											

*This course is to be suggested by guide/supervisor in specific domain area of research undertaken by the research candidate. The candidate has to select any one from the following

PHDPHY 1103 A Wave Propagation in Continuous Media
PHDPHY 1103 B Materials Characterizations Techniques
PHDPHY 1103 C Advanced Nuclear Physics
PHDPHY 1103 D Advanced Quantum Mechanics
PHDPHY 1103 E Condensed Matter Physics

L	T	P	CWA	LWA	MTE	ETE
Lecture	Tutorial	Practical	Class Work Assessment	Lab Work Assessment	Mid Term Exam	End Term Exam

SUBJECT TITLE: Wave Propagation in Continuous Media

SUBJECT CODE: PHDPHY 1103 A

SEMESTER: I

CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
5	0	0	5

Internal Assessment: 40

End Term Exam: 60

Duration of Exam; 3 Hrs

UNIT-I

Transverse Vibrations of Strings, Axial Vibration of Bars, Waves in a Fluid-filled Elastic Tube, Torsional Vibration of Circular Bars, Transverse Vibration of Beams, Dynamics of Elastic Media, Acoustic Waves in Fluids, Surface Gravity Waves, Surface Waves on Shallow Water, Conservative Kinematic Models, First Order PDEs, General Solution of the Wave Equation, D'Alembert's Solution, Linear Waves in Diffusive Medium, Nonlinear Waves with Diffusion

UNIT-II

Harmonic Waves and Dispersion Relation, Phase Velocity, Superposition of Harmonic Waves, Dispersion, Group Velocity, Evolution of a Gaussian Wave Packet, Wave packets in dispersive media: Wave packets by superposition of sinusoidal wave

UNIT-III

Forced Motion, Energetics of Wave Motion, Wave Impedance, Harmonic Waves in Beams, Scattering of flexural waves, Motion of Material Points of a Beam, Waves in Cartesian Coordinates, Waves in Polar Coordinates, Energetics of Membrane Waves, Equations of motion, Plane Elastic Waves in Unbounded Continua, Incident P-wave, Incident SV-wave, Incident SH-wave, Rayleigh Surface Waves, Planar Acoustic Waves, Spherical Waves, Energetics of Acoustic Waves, Waves in Wave Guides of Rectangular Cross-section, and wave guides with a Circular Cross-section

Recommended Books

1. Wave motion in elastic solids, K.F. Graff, 1991.
2. Ultrasonic wave in solid media, J.L. Rose, Cambridge University Press, 1999.
3. Wave propagation in structures, J.F. Doyle, Springer, 1997.

SUBJECT TITLE: Materials Characterizations Techniques

SUBJECT CODE: PHDPHY 1103 B

SEMESTER: I

CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
5	0	0	5

Internal Assessment: 40

End Term Exam: 60

Duration of Exam; 3 Hrs

UNIT-I

Magnetic Measurements: Vibrating Sample Magnetometery, Thermomagnetic Analysis, SQUID X-RAY Techniques: XAFS and XANES Spectroscopy, X-Ray Magnetic Circular Dichroism, Single crystal and powder x-ray diffraction, X-Ray Diffraction Techniques for Liquid Surfaces and Monomolecular Layers, Small-angle X-ray scattering (SAXS). Inelastic X-ray scattering, Synchrotron radiation sources: advantages and special features of synchrotron radiation.

UNIT-II

Neutron Scattering Techniques: Neutron Powder Diffraction, Single-Crystal Neutron Diffraction, Magnetic Neutron Scattering, Small-angle neutron scattering (SANS), Phonon and dynamics studies by inelastic and quasielastic neutron scattering. Neutron reflectometery for thin films

UNIT-III

Microscopy: Optical, polarizing and confocal microscopy, Scanning Electron Microscopy (SEM) and Transmission electron microscopy (TEM), Elemental analysis by Enegry dispersive and wavelength dispesrive X-ray analysis: Sample preparation for TEM by ion milling and shadow techniques. AFM and STM: Basic principles and different modes of operation, Magnetic Force Microscopy (MFM).

Recommended Books

1. Solid State Magnetism, John Crangle, Edward Arnold – UK(1991).
2. X-ray and neutron Reflectivity, J. Daillant and A. Gilaud (Ed.) Springer (2009).
3. Physical Principles of Electron Microscopy: An Introduction to TEM, SEM and AEM, R. F. Egerton, Springer (2005).
4. Materials Characterization Techniques, S. Zhang, L. Li and A. Kumar CRC Press (2009).

SUBJECT TITLE: ADVANCED NUCLEAR PHYSICS
SUBJECT CODE: PHDPHY 1103 C
SEMESTER: I
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
5	0	0	5

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

UNIT-I

Nuclear Decays: Decay widths and lifetimes. Alpha Decay: General Properties and theory of alpha decay, Barrier penetration of alpha decay, alpha decay spectroscopy Spontaneous fission decay Beta Decay: General Properties, Neutrinos and Antineutrinos, the Fermi theory of beta decay, Angular momentum and selection rules of beta decay, electron capture, beta spectroscopy. Gamma decay, reduced transition probabilities for gamma decay, Weisskopf units for gamma decay.

UNIT-II

The Fermi gas model, the one body potential General properties, The harmonic oscillator potential separation of intrinsic and centre-of-mass motion, the kinetic energy and the harmonic oscillator. Conserved quantum numbers, angular momentum, parity and isospin, Quantum number for the two nucleon system, two proton or two neutron, and proton and neutron. 5 The Hartree Fock Approximation Properties of single Slater determinants, Derivation of the Hartree-Fock equations, examples of single particle energies, Results with Skyrme Hamiltonian: Binding energy, single particle energies, Rms charge radii and charge densities.

UNIT-III

The Shell Model: Ground state spin of nuclei, Static electromagnetic moments of nuclei, Electromagnetic transition probability on shell model, Exact treatment of two nucleons by shall model, two-nucleon wave function, matrix elements of one-body operator and two-body potential, Shell model digonalization, Configuration mixing, relationship between hole state and particle state, State of hole-particle excitation and core polarization, Seniority and fractional percentage by second-quantization technique.

Recommended Books

1. M.K. Pal Theory of Nuclear Structure, Affiliated East-West, Madras-1992.

2. Y. R. Waghmare, Introductory Nuclear Physics, Oxford-IBH, Bombay, 1981. . K. L. G. Heyde, The Nuclear Shell Model, (Springer-Verlag, 1994)

3. R. D. Lawson, Theory of the Nuclear Shell Model, (Clarendon Press, 1980).

SUBJECT TITLE: ADVANCED QUANTUM MECHANICS
SUBJECT CODE: PHDPHY 1103 D
SEMESTER: I
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
5	0	0	5

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

UNIT -I

Quantization of Wave Fields: Classical and quantum fields equations, complex fields, Hamiltonian formulation, quantization of non-relativistic Schrodinger equation for a system of bosons and fermions, commutation and anticommutation at unequal times, N-representations, Quantization of complex scalar (spin zero) fields, positive and negative frequency parts. Quantization of Dirac (spin ½) field) covariant anticommutation relations, interaction between charged particles and electromagnetic fields, quantization of electromagnetic field.

UNIT-II

Path Integral Formulation of Quantum Mechanics: The quantum mechanical law of motion classical action, quantum mechanical amplitudes, the sum over paths, Events occurring in succession, wave function, Application to free particle and harmonic and forced harmonic oscillator, Path integral as a functional and its evaluation, Schrodinger equation, time independent Hamiltonian, perturbation expansion, transition elements, Propagator and scattering matrix.

UNIT-III

Interacting Fields: Interaction Lagrangian for the fields, S-Matrix and its reduction, chronological product and wick's theorem, Covariant perturbation theory, Lagrangian for quantum electrodynamics, Feynman diagrams and rules for QED in configuration and momentum space, Radiation theory, absorption and emission, Furry's theorem, Coulomb scattering, election- positron annihilation, Bhabha scattering and Compton scattering.

Recommended Books

1. L.I. Schiff; Quantum Mechanics (McGraw Hill)
2. L.H. Ryder: Quantum Field theory (Cambridge Univ. Pr)
3. J.Bjorken and S.D. Drell: Ralativistic Quantum Mechanics Quantum Mechanics (McGraw Hill)
4. R.P. Feynmn and Hibbs: Path Integrals (McGraw Hill)

SUBJECT TITLE: CONDNESED MATTER PHYSICS
SUBJECT CODE: PHDPHY 1103 E
SEMESTER: I
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
5	0	0	5

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

UNIT I

Physical applications of Group theory in crystals: Theory of group representation, crystal symmetry operators; Crystallographic point groups. Representation of three dimensional rotation group, Crystal field splitting and other related problems.

UNIT II

Elastic Scattering of waves: Interference of Waves, Elastic scattering by Crystals, Experimental Techniques, Scattering from surfaces, Scattering from amorphous solids

UNIT III

Magnetic Properties: Background, Diamagnetism and Para magnetism, Ferromagnetism, Ferri and anti ferromagnetism, Spin waves, Magnetic resonance Phenomenon

Recommended Books

1. M. Tinkham, Group Theory and Quantum Mechanics, Dover Publications, 2003
2. N.W.Ashcroft and N.D. Mermin, Solid State Physics, Brooks Cole, 1976
3. J. Richard Christman, Solid State Physics, John Wiley, 1988