M. Phil Physics- Semester-I

S.No	Course Code	Title of the Course	Credit Hrs.		
			L	T	P
1	PHY-871	ADVANCED QUANTUM MECHANICS	4	1	0
2	PHY-873	ASTRO PHYSICS	4	1	0
3	MAS -874	ADVANCED MATHEMATICS	3	1	0
4	PHY-855	SEMINAR	4		

M. Phil Physics- Semester-II

S. No	Course Code	Title of the Course	Credit Hrs.		
			L	T	P
1	PHY-872	RESONANCE PHYSICS	3	1	0
2	PHY-875	ADVANCED SOLID STATE PHYSICS	4	1	0
3	PHY-890	PROJECT & THESIS	25		
4	PHY-855	SEMINAR	4		

ASTROPHYSICS

M. Phil Physics

1st Semester

Course Code: PHY- 873
Credit Hours: 4-1-0

Unit I: Physical Laws.

Adiabatic In closures, Diathermic Partitions, The Internal Energy, The First Law of Thermodynamics, The Second Law of Thermodynamics, The Specific Heats of a Perfect Gas. The adiabatic and Polytropic Changes. The Virial Theorem.

Unit II: Fundamentals of the Equilibrium of a Star.

Equations of Gravitational Equilibrium, and the Potential Energy, Some Theorems for Equilibrium Configurations.
Polytropic and Isothermal Gas Spheres: Polytropic Equation of State, The Equations of Equilibrium. The Lane-Enden Functions for n = 0, 1 and 5, and for general Polytropic Index n. Conversion of Lane-Emden Equation (LEE) to its Equivalent First Order Differential Equations, and Solutions. The Isothermal Gas Sphere, and the Possible Solutions.

Unit III: Stellar Models and Energy.

Brief Discussion of Models ε = const, and $\eta \propto S^{\alpha}T^{\upsilon}$ The Helmholtz- Kelvin Time Scale (Contraction Hypothesis), Transmutation of Elements. The Potential Barriers.

Unit IV: Stellar Envelopes, Central Condensation and White Dwarfs

Equilibrium of Stellar Envelops, and Solutions, Central Condensations of Some Typical Normal Stars. White Dwarf Stars, and the Gaseous Fringes Completely Degenerate Configurations, and Approximations with small Central Densities.

Unit V: Universe Around Us.

Solar System:- Planets, Stars and Galaxies, Stable and, Nonstable Stars Double Stars, Red Giant and Super Giant Stars. Star clusters.
Theory of Expanding Universe- Big Bang and Steady State Theories Implosion and Explosion phenomena - Novae, Supernovae, Pulsars, Quasars, and Black Holes, Chandrasekhar's Limit, and the critical Mass, Neutron Stars, Evolution of Stars, Production of Energy in Stars.

References Books:

1. An Introduction to the Study of Shelter Structure: S. Chandrasekhar (Chicago: University of Chicago Press, Chicago).
2. A. S. Eddington: The Internal Constitution of the Stars (Dover Publications, U. S. A).
3. Stellar Interiors: D Menzel et al. (Chapman and Hall, London)
4. Gravitational Theory and Gravitational Collapse: B. K. Harison, Kips S. Thorne et al. Chicago: University of Chicago Press, Chicago).
5. General Science (Introduction to Astronomy, Astrophysics, Physics, Climatology, Etc.): J.P. Sharma (Indiana Book House, Gita Press Road, Gorakhpur-273005).
6. The Universe Around Us: Sir James Jens (Cambridge, At the University Press).
7. High Energy Astrophysics: Trevor C. Weekes (Chapman And Hall Limited).
8. Planet Earth: Karl Stumpff (Ann Abbor, The University of Michigan Press).

Advanced Quantum Mechanics

Semester-I

Course Code: PHY- 871
Credit Hours:4-1-0

Unit I : Review & Introduction

Schrodinger Wave Equation & applications- Eigenfunction & Eigenvalues- SHO-

Angular momentum- 3-D Square well Potential H-atom.

Unit II: Matrix Formulation of Quantum Mechanics Matrix Algebra- Transformation

Theory Equations of Motion- SHO.

Unit III: Approximation Methods for Bound States

Stationary Perturbation Theory- The Variation Method- Methods for

Time - Department Problems

Identical Particles & Spin

Semi classical Treatment of Radiation

Unit IV: Relativistic Wave Equations

- Schrodinger's Relativistic Equation
- Dirac's Relativistic Equation
- Dirac's Equation for a Control Field

References Books:

1. Introduction to Quantum Mechanics: Pauling & Wilson
2. Quantum Theory of Matter: Slate
3. Feynman & Hibbs: Quantum Mechanics and Path Integrals
4. Bjorken & Drell: Relativistic Quantum Mechanics

Text Book: 1) Quantum Mechanics:
L.I. SCHIFF (III Edition)
MC Grah- Hill International Edition (2) Quantum Mechanics- Mathews & Venkates

Advanced Mathematics
Semester-I

Course Code: MAS-874
Credit Hours-4-1-0

Unit 1: Permutation groups, Group actions, Sylow theorem, Finite abelian groups, Solvable groups, Nilpotent groups, Free groups and presentation of groups.

(15)

Unit 2: Principal ideal domain, Euclidean domain, Unique factorization domain, Modules and Vector spaces, Invariant subspaces, Bilinear, quadratic, canonical forms, Free, projective & injective modules, Tensor product & Exterior power.

(15)

Unit 3: Normed linear spaces, Banach spaces, Hann-Banach Theorem, Open mapping theorem, Closed graph theorem, Hilbert spaces, Orthogonality, Unitary mapping, Pre Hilbert Spaces, Fourier series, Linear functionals & Riesz representation theorem, compact operators, Hardy space of the upper half plane, Harmonic functions and the boundary value problem.

(15)

Unit 4: Semi simple ring, Representation of finite groups, Schur's lemma, group algebra, Hilbert basis theorem, Real representations & representations over subfield of C, $GL_2(F_q)$ and $SL_2(F_q)$.

(15)

Unit 5: Quantum groups and their properties, Riemann surfaces and the geometry on Riemann surfaces, Application of linear algebra, Application of abstract algebra.

(15)

Reference books:

1.) Algebra (vol I & II), Ramji Lal, Shail publication
2.) Algebra, Artin M., PHI Publication
3.) Lecture in Abstract Algebra (GTM 30, 31, 32), Jacobson N., Springer
4.) Applied Abstract algebra, Lidl & Pilz, Springer
5.) Quantum Groups (GTM 155), Kassel, Springer
6.) Linear Algebra, Curtis, Springer
7.) Real Analysis, Elias M. Stein & Rami Shakarchi, Princeton University Press
8.) Linear Operator in Hilbert spaces (GTM 68), Weidmann, Springer
9.) Functional Analysis, Sundar S., Hindustan Publication (Trim series)
10.) Riemann surfaces (GTM 71), Farkas/ Kra, Springer
11.) Representation Theory A first course, William Fulton & Joe Harris, Springer

Resonance Physics

Semester-II

Course Code: PHY- 872
Credit Hours: 4-1-0

1) Introduction- Simple Resonance Theory- Absorption of Energy and Spin-Lattice Relaxation.

2) Basic Theory: Motion of Isolated Spins-Classical Treatment- Q.M. Description of Spin in a Static Field- Equations of Motion of the Expectation Value- Effect of A.C. Fields- Q.M. Treatment of a Rotating Magnetic Field- Bloch Equations Solution for Low H_1- Spin Echoes.

3) Magnetic Dipolar Broadening of Rigid Lattices- Basic Interaction- Method of Moments.

4) Magnetic Interaction of Nuclei with Electrons: Experimental Facts About Chemical Shifts- Quenching of orbital Motion- Theory of chemical shifts Electron Spin Interaction- Knight Shift.

5) Relation of Nuclei in a Metal- Spin Temperature- Adiabatic and Sudden changes- Double Resonance-
ENDOR.

6) Electron Spin Resonance- Example of Spin Orbit Coupling and Crystalline Fields- Hyperfine Structure. Summary.

Text Book : Principles of Magnetic Resonance – C.P. Slichter (Spriger-Verlag, 1978)

References Books:

1) Nuclear Magnetic Resonance: G. E. Pake Academic Press 1956.
2) A.K. Saha, T.P. Das: Theory and Application of Nuclear Induction; Saha Institute 1957.
3) William Low: Paramagnetic Resonance in Solids Academic Press, 1960.
4) A. Abragam, B. Bleany: EPR of Transition Ions Clarandon Press, 1970

Advanced Solid State Physics
Semester-II

Course Code-PHY-875
Credits Hours- 4-1-0

Unit I - Free electron theory and Energy bands, Nearly free electron Model, Block functions, Kroning- Penney Model, electron in periodic potential.

Unit II- Fermi Surfaces and Metals, Construction of Fermi Surfaces, electron orbits, hole orbits and open orbits, Calculation of energy bands, Dc Haas- Van Alphen Effect.

Unit III- Phonons, Plasmons, Polarons & Magnons, Plasmons, Mott Metal- insulator Transition, screening and phonons in metals, Fermi liquid, polarons, Exchange interaction and Magnons, Magnetic Resonance.

Unit IV- Superconductivity: Experimental Survey of Superconductivity, thermodynamics of the Super conducting Transition, London Equation, coherence length, BCS theory, flux Quantisation, type I & type II Superconductivity, Vortex State, HC_1 & HC_2, single particle tunneling, Joseph son effect.

References Books:

1. Introduction to Solid State Physics by Charles Kittle, 7^{th} Edition, 2003, Publisher John Wiley & Sons, Singapore, New York.
2. Solid State Physics by Adrianus J. Dekker, 1999, Publisher Macmillan India Limited, New Delhi.
3. Elementary Solid State Physics by M. Ali Omar, 2005, Publisher Pearson Education (Singapore) Pvt. Ltd;
4. Solid State Physics and Electronics by R. K. Puri and V. K. Sabbar, 2003, Publisher S. Chand and Company Ltd.
5. Fundamentals of Sold State by Saxena, Gupta, Saxena, 2003, Publisher Pragati Prakashan, Meerut.
6. Quantum Theory of Solids by C. Kittel, Second Revised edition, 1987, John Wiley & Sons**.**