MADHYANCHAL

PROFESSIONAL UNIVERSITY

Draft Rules & Syllabus
for the

Master of Science in Physics

(M.Sc. Phy.) Course

MADHYANCHAL PROFESSIONAL UNIVERSITY

DEPARTMENT OF PHYSICS

Scheme for M.Sc., CBCS Course

Semester I

S.N.o	Subject Code	Subject Name & Title	Maximum Marks Allotted							Hours per week.			Total Credits	Remarks
			Theory			Practical								
			End Sem	Mid Sem. MST	Quiz, Assignment	End Sem	Lab Work	Assignment/ Quiz/Term paper	Total Marks	L	T	P		One credit refers to one hour teaching in theory, Tutorial
1	MSc101 T	Methods of Mathematical Physics - I	60	20	10	100	-	-	-	3	1		4	
2	MSc 102 T	Quantum Mechanics I	60	20	10	100	-	-	-	3	1		4	
3	MSc 103 T	Classical Mechanics	60	20	10	100	-	-	-	3	1		4	
4	MSc 104 T	Electrodynamics	60	20	10	100	-	-	-	3	1		4	
5	MSc 101 P	Physics Practicals I (General)					80	20	100			4	4	
6	MSc 102 P	Physics Practicals II (Electronics)					80	20	100			4	4	
	Total		240	80	40	400	160	40	200	12	4	8	24	600

Semester II

S.N.o	Subject Code	Subject Name & Title	Maximum Marks Allotted							Hours per week.			Total Credits	Remarks
			Theory			Practical								
			End Sem	Mid Sem. MST	Quiz, Assignment	End Sem	Lab Work	Assignment /Quiz/Term paper	Total Marks	L	T	P		One credit refers to one hour teaching in theory, Tutorial
1	MSc101 T	Mathematical Physics II	60	20	10	100	-	-	-	3	1		4	
2	MSc 102 T	Quantum Mechanics II	60	20	10	100	-	-	-	3	1		4	
3	MSc 103 T	Nuclear and Radiation Physics	60	20	10	100	-	-	-	3	1		4	
4	MSc 104 T	Condensed Matter Physics and Electronics	60	20	10	100	-	-	-	3	1		4	
5	MSc 101 P	Physics Practicals II (General)					80	20	100			4	4	
6	MSc 102 P	Physics Practicals III (General)					80	20	100			4	4	
	Total		240	80	40	400	160	40	200	12	4	8	24	600

Chapter II Syllabus

Semester I

PHY 101: METHODS OF MATHEMATICAL PHYSICS I

Unit I

- Vector analysis and curvilinear coordinates: Integration of vector functions - line integrals, surface integrals and volume integrals - vector theorems without proof (Gauss, Green"s and Stokes") and their applications in physics.

- Generalized coordinates - elements of curvilinear coordinates - transformation of coordinates - orthogonal curvilinear coordinates - unit vectors - expression for arc length, volume element. The gradient, divergence and curl in orthogonal curvilinear coordinates. Laplacian in orthogonal curvilinear coordinates, spherical polar coordinates, cylindrical coordinates.

Unit II

- Matrices and complex variables: Matrix representation of linear operators, Hermitian and unitary operators, Hilbert space. Diagonalisation of matrices – simultaneous diagonalisation.

- Complex variables and integral transforms: Review of functions of a complex variable – Cauchy Riemann conditions. Contour integrals. Cauchy integral theorem, Cauchy integral formula. Taylor and Laurentz series. Zero isolated singular points, simple pole, m^{th} order pole. Evaluation of residues. The Cauchy's residue theorem. The Cauchy principle value. Evaluation of different forms of definite integrals. A digression on Jordan‟s lemma.

Unit III

- Partial differential equations: Review of system of surfaces and characteristics.
- First order partial differential equations for a function of two variables.
- Linear second order partial differential equations. Classification into elliptic, parabolic and hyperbolic types.
- Boundary value problems-solutions by method of separation of variables - solution of 1-, 2- and 3- dimensional wave equation and diffusion equation in Cartesian, plane, cylindrical and spherical polar coordinates.

Unit IV

- Special functions: Review of power series method for ordinary differential equations – description of beta and gamma functions.
- Bessel functions – solution of Bessel"s equation - generating function and recurrence relations – orthogonality of Bessel functions.
- Legendre polynomials – solution of Legendre equation – generating function and recurrence relations – orthogonality property of Legendre polynomials.
- Solution of Hermite equation – Hermite polynomials – generating functions and recurrence relations.

Reference Books:

1. Bose A K and Joshi M C, „Methods of Mathematical Physics" (Tata McGraw Hill, 1984)
2. Sokolnikoff and Redheffer, „Mathematics of Physics and Modern Engineering, (McGraw Hill, 1958)
3. Irving J and Mullneu N, „Mathematics in Physics and Engineering" (Academic Press, 1959)
4. Kreysig E, „Advanced Engineering Mathematics" (Wiley Eastern, 1969)
5. Mathews J and Walker R L, „Mathematical Methods of Physics" (W A Benjamin, Inc, 1979).
6. Arfken G, „Mathematical Methods for Physicists" (Academic Press)
7. Harper C, „Introduction to Mathematical Physics" (PHI, 1978)
8. Chattopadhyaya P K, „Mathematical Physics" (Wiley Eastern, 1990)
9. Harry Lass, „Vector and Tensor Analysis" (McGraw Hill, 1950).
10. Mary L Boas, „Mathematical Methods in the Physical sciences" (John Wiley, 1983)
11. Joshi A W, „Matrices and Tensors in Physics" (Wiley Eastern, 1995)
12. Ayres F, „Differential Equations" (Schaum series, McGraw Hill)
13. Spiegel M R, „Vector Analysis" (Schaum series, McGraw Hill, 1997)
14. Ayres F, „Differential Equations" (Schaum series, McGraw Hill)
15. Sneddon I A, „Elementary Partial Differential Equations" (McGraw Hill, 1957)

PHY 102: QUANTUM MECHANICS I

Unit I

- General formulation of quantum mechanics
- Schrodinger wave equation - review of concepts of wave particle duality, matter waves, wave packet and uncertainty principle. Schrodinger"s equation for free particle in one and three dimensions - equation subject to forces. Probability interpretation of the wave function, probability current density - normalisation of the wave function, box normalisation, expectation values and Ehrenfest"s theorem.

Unit II

- Fundamental postulates of QM
- Representation of states, dynamical variables - Adjoint of an operator. Eigen value problem - degeneracy. Eigenvalues and eigenfunctions. The Dirac-delta function. Completeness and normalisation of eigen functions. Closure. Physical interpretation of eigen values, eigen functions and expansion coefficients. Momentum eigen functions.

Unit III

- Stationary states and eigen value problems
- The time independent Schrodinger equation - particle in square well -bound states normalised states. Potential step and rectangular potential barrier - reflection and transmission coefficients - tunnelling of particles.
- Simple harmonic oscillator - Schrodinger equation and energy eigen values - Energy eigen functions. Properties of stationary states.

Unit IV

- Angular momentum, parity and scattering
- Angular momentum operators, eigen value equation for L^2 and L_z - Separation of variables. Admissibility conditions on solutions - eigen values, eigen functions. Physical interpretation. Concept of parity. Rigid rotator. Particle in a central potential - radial equation.
- Three-dimensional square well. The hydrogen atom - solution of the radial equation - energy levels. Stationary state wave functions - bound states.

Theory of scattering - the scattering experiment, differential and total cross-section, scattering amplitude, method of partial waves, scattering by a square well potential.

Reference Books:

1. Cohen Tannoudji C, Diu B and Laloe, „Quantum Mechanics", Vol. I (John Wiley, 1977)
2. Schiff L I, „Quantum Mechanics", III Edn. (McGraw Hill, 1968)
3. Shankar R, „Principles of Quantum Mechanics" (Plenum, 1980)
4. French A P and Taylor E F, `An introduction to Quantum Physics" (W W Norton, 1978)
5. Gasirowicz, „Quantum Physics" (Wiley, 1974)
6. Wichmann E H, „Quantum Physics" (McGraw Hill, 1971).
7. Powell and Crassman, „Quantum Mechanics"(Addison Wesley, 1961).
8. Mathews P M and Venkatesan K, „A Text Book of Quantum Mechanics" (Tata McGraw Hill, 1977).
9. Ghatak A K and Lokanathan S, „Quantum Mechanics", III Edn. (McMillan India, 1985.
10. Sakurai J J, „Modern Quantum Mechanics", Revised Edn. (Addison Wesley, 1994)

PHY 103: CLASSICAL MECHANICS

Unit I

- System of Particles: Centre of mass, total momentum, angular momentum and kinetic energy of a system of particles, Newton's laws, conservation of linear momentum, angular momentum and energy.
- Lagrangian Formulation: Constraints and their classification, degree of freedom, generalized co-ordinates, virtual displacement, D'Alembert's principle, Symmetry of space and time: Conservation of linear momentum, angular momentum and energy.

Unit II

- Hamiltonian formalism: Generalized momenta, Hamiltonian function, Physical significance and the Hamilton's equations of motion, Examples of (a) The Hamiltonian of a particle in a central force field, (b) the simple harmonic oscillator. Principle of least action: derivation of equation of motion, variation and end points.
- Canonical transformations: Generating functions (four basic types), examples of canonical transformations, the Harmonic oscillator in one dimension, Poisson brackets, equations of

motion in terms of Poisson brackets, properties of Poisson brackets (anti-symmetry, linearity and Jacobi Identity).

- The Hamilton-Jacobi equation, Solution of linear harmonic oscillator using Hamilton-Jacobi method.

Unit III

- Central Forces**:** Definition and characteristics. Reduction of two particle equations of motion to the equivalent one-body problem, reduced mass of the system, conservation theorems (First integrals of the motion), equations of motion for the orbit, classification of the orbits, conditions for closed orbits, Kepler‟s laws of planetary motion. Newton‟s law of gravitation.
- Scattering in Central Force Field: general description of scattering, cross-section, impact parameter, Rutherford scattering, centre of mass and laboratory co-ordinate systems.

- Motion in a Non-inertial reference frames: Motion of a particle in a general non- inertial frame of reference, motion of pseudo forces, equation of motion in a rotating frame of reference, the Coriolis force, deviation due east of a falling body, the Foucault pendulum.

Unit IV

- Rigid body dynamics: Degrees of freedom of a rigid body, angular momentum and kinetic energies of a rigid body, moment of Inertia tensor, principal moment ofinertia, Euler angles, Euler's equations of motion for a rigid body, Torque free motion of a rigid body, precession of earth's axis of rotation.
- Small oscillations**:** types of equilibriums, Quadratics forms for kinetic and Potential energies of a system in equilibrium, Lagrange's equations of motion, Normal modes and normal frequencies, examples of (i) longitudinal vibrations of two coupled harmonic oscillators, (ii) Normal modes and normal frequencies of a linear, symmetric, tri-atomic molecule.

References

1 Classical mechanics, L. D. Landau and E. M. Lifshitz, (4^{th} edition, Pergamon press 1985).

2 Lagrangian and Hamiltonian Mechanics, M.G. Calkin, (World Scientific, 1996)

3 Analytical Mechanics, G R Fowles, Holt, Rinehart (1977).

4 Classical Mechanics, Walter Greiner, Springer India (2006).

5 Analytical Mechanics, K A Gamalnath, Narosa, (2011).

6 Classical Mechanics, A K Saxena, CBS Publishers

7 Classical Mechanics, H Goldstein , (Addison Wesley, 1980)

8 Classical mechanics, H. Goldstein, C. Poole, J. Safko, (3rd edition, Pearson Educations Inc. 2002).
9 Classical mechanics, K. N. Srinivasa Rao, (University press,2003).
10 Classical mechanics, N. C. Rana and P. S. Joag, (Tata McGraw-Hill,1991).
11 Classical dynamics of particles and systems, J. B. Marion, (Academic press,1970).
12 Introduction to Classical mechanics, R.G.Takwale and P.S.Puranik, (Tata McGraw-Hill 1983).
13 Classical Mechanics, J C Upadhyaya, (Himalaya Publishing House,2005)
14 Classical Mechanics,G. Aruldhas, (Prentice Hall of India,2008)

PHY 105: ELECTRODYNAMICS

Unit I Electrostatics and Magneto statics:

- Gauss"s law and applications, Electric Potential, Poisson"s equations, Work, energy in electrostatics. Laplace"s equations and its solution in one, two and three dimensional problems (Cartesian co ordination). Boundary conditions and uniqueness theorem. Method of images and applications. Multipole expansion. Electric dipole field, redo pot, Field inside a dielectric- special problems involving linear dielectric, Biot –Savart law and applications, Ampere"s law and applications,

- Magnetic vector potential, Boundary conditions. Multipole expansion of vector potential. Review of magnetisation. Magnetic field inside matter, The field of a magnatized object.

Unit II Electromagnetic waves:

- Review of Maxwell"s equations, formulating electrodynamics using scalar and vector potentials, Gauge transformations. Coulomb gauge and Lorentz gauge. Energy and momentum of electromagnetic waves.
- Propagation through linear media, reflection and transmission of electromagnetic waves: plane waves in conducting media, skin depth, dispersion of electromagnetic waves in non conductors, wave guides, transmission of electromagnetic waves in rectangular wave guide.

Unit III Electromagnetic Radiation:

- Retarded potentials. Electric and magnetic dipole radiation. Lienard-Wiechert potentials. Fields of a point charge in motion, slowly moving, Power radiated by a point charge oscillation, Larmour formula,

- Review of Lorentz transformations, Four vectors, Magnetism as a relativistic phenomenon, Lorentz transformation of electric and magnetic fields, The electromagnetic field tensor notation, potential formulation of electrodynamics.

Unit IV Plasma Physics:

- Plasma - definition, Debye shielding distance, hydromagnetic equations. Motion of charged particle in (a) uniform magnetic field (b) electric and magnetic fields at not angled (c) space dependent magnetic field.
- Adiabatic invariants, the equation of motion of a plasma fluid, magnetic pressure, plasma confinement, Pinch effect, Plasma as a conducting fluid, Drift velocities, Plasma oscillations, Plasma waves, Propagation of electromagnetic waves in plasma. Magnetic mirrors.

Reference Books:

1 Sommerfeld A, „Mechanics‟ (Academic Press, 1964)

2 Krauss John D, „Electromagnetics‟, II Edn. (Tata McGraw Hill, 1973)

3 Singh R N, „Electromagnetic Waves and Fields‟ (Tata McGraw Hill, 1991)

4 D.J. Griffiths, „Introduction to Electrodynamics‟, III Edn. (PHI, 2003).

5 B.B. Laud „Electromagnetics‟ (New age International PVT. LTD)

6 P. Lorrain and D. Corson, „Electromagnetic field and waves‟(CBS)

7 I.S Grant and W.R. Phillips „Electromagnetism‟ (John Wiley and sons Ltd.)

8 Pramanik, „Electromagnetism‟ (PHI,2010)

9 J.D. Jackson, „Classical Electrodynamics‟ (Wiley eastern,2003)

10 Reitz J R, Milord F J, Christy R W, „Foundations of Electromagnetic Theory‟, III Edn. (Narosa Publishing House, 1990)

11 Purcell E M, `Electricity and Magnetism‟, II Edn. (McGraw Hill, 1985)

12 A.R. Choudhari, „The Physics of fluids and plasmas" (Cambridge UP 1998)
13 Chen Francis, „Plasma Physics", II Edn. (Plenum Press, 1984)
14 Bitten Court J A, „Fundamentals of Plasma Physics" (Pergamon Press, 1988)
15 Paul Bellan, „Fundamentals of Plasma Physics" (CUP 2006)

PHY 101: PHYSICS PRACTICALS I (General)

1 Characteristics and efficiency of a GM counter.
2 Study the beta ray attenuation in matter.
3 Determination of energy gap of a semiconductor.
4 Susceptibility by Quinke`s method.
5 Modes of vibration of a fixed free bar
6 Temperature dependence of Hall coefficient.
7 Magnetic susceptibility of hydrated copper sulfate.
8 To study the variation of magnetoresistance of a sample with the applied magnetic field.
9 To determine the strength of an α-source using SSNTD.
10 Transition temperature of a ferroelectric material
11 Dielectric constant of a given material.

PHY 102: PHYSICS PRACTICALS II (Electronics)

1 Clipping and clamping circuits
2 Differentiator & integrator circuits
3 Logic gates.
4 UJT characteristics - relaxation oscillator.
5 Opamp circuits - voltage to current converter, current to voltage converter, active limiter and active clamper.
6 Active filters – high pass, low pass, band pass and band stop
7 MOSFET common source amplifier.
8 BJT differential amplifier.
9 Voltage regulator (with series pass transistor) / 3 pin regulator.
10 Wein bridge Oscillator.

Semester II

PHY 201 MATHEMATICAL PHYSICS II

Unit I Tensor analysis: Introduction - rank of a tensor. Transformation of coordinates in linear spaces - transformation law for the components of a second rank tensor. Contra-variant and covariant and mixed tensors - First rank tensor, higher rank tensors, symmetric and antisymmetric tensors. Tensor algebra - outer product - contraction - inner product - quotient law. The fundamental metric tensor - associate tensors. Line element and Metric Tensor, Christoffel‟s Symbols of first and second kind, Length of a vector, Angle between vectors, Geodesics, Covariant derivative, Tensor form of Gradient, Divergence and Curl

Unit II Fourier series: Fourier integral and Fourier transform - definition - special form of Fourier integral and properties. Convolution theorem involving Fourier transform. Applications of Fourier transforms. Laplace transform - Convolution theorem involving Laplace transforms. Applications of Laplace transforms.

Unit III Green‟s Functions and Integral Equations: Green‟s function for one, two and three dimensional equations, Eigen function expansion of Green‟s functions, Fredholm and Volterra type integral equations, solution with separable kernels, Neumann series method. Non-homogeneous integral equations.

Unit IV Groups - subgroups - classes. Invariant subgroups - factor groups. Homomorphism and Isomorphism. Group representation - reducible and irreducible representation. Schur‟s lemmas, orthogonality theorem. Decomposing reducible representation into irreducible ones. Character of a representation, character table, Construction of representations. Representation of groups and quantum mechanics. Lie groups and Lie algebra. Generators of Unitary Groups, Three dimensional rotation group SO(3), SU(2) and SU(3) groups. The homomorphism between SU(2) and SO(3) groups.

Text Books:

1. Chattopadhyaya P K, „Mathematical Physics‟ (Wiley Eastern, 1990)
2. Joshi A W, „Introduction to Group Theory‟ (Wiley Eastern, 1995)
3. Spiegel M R, „Vector Analysis‟ (Schaum series, Tata McGraw Hill, 2009)

4. Joshi A W, „Matrices and Tensors in Physics" (Wiley Eastern, 199
5. Arfken G, „Methods of Mathematica Physics, (Academic Press 2005)
6. Kreyszig, Advanced Engineering Mathematics, (New Age International, 2004)

Reference Books:

1. Sokolnikoff and Redheffer, „Mathematics of Physics and Modern Engineering, (McGraw Hill, 1958)
2. Irving J and Mullneu N, „Mathematics in Physics and Engineering" (Academic Press, 1959)
3. Mary L Boas, „Mathematical Methods in the Physical Sciences" (John Wiley, 1983)
4. Mathews J and Walker R L, „Mathematical Methods of Physics" (W A Benjamin, Inc, 1979)
5. Sreenivasa Rao K N, „The Rotation and Lorentz Groups and Their Representations for Physicists" (John Wiley & sons, 1988)
6. N.Hammermesh,"Group Theory", (Addison-Wesley,1964)
7. M.Tinkham,"Group Theory and Quantum Mechanics", (McGraw-Hill,1964)
8. E.Butkov, "Mathematical Physics", (Addison-Wesley,1968)
9. P.M.Morse and H.Feshbach,"Methods of Theoretical Physics", (Interscience,1953)

PHY 202 QUANTUM MECHANICS II

Unit I Matrix formalism of quantum mechanics

Linear vector spaces - orthogonality and linear independence, bases and dimensions, completeness, Hilbert"s spaces. Hermitian operators. Bra and Ket notations for vectors. Representation theory. Schwartz"s inequality theorem - proof of Heisenberg uncertainty relation.

Unit II Quantum dynamics

Equations of motion - Schrodinger and Heisenberg picture - quantum Poisson bracket. Harmonic oscillator problem solved by matrix method.

Angular momentum - angular momentum operator, commutation relations - raising and lowering operators - eigen values and eigen functions of L^2 and L_z - addition of two angular momentum - Clebech-Gordan coefficients - the 3-j symbol - Pauli spin matrices.

Unit III Approximation methods

Perturbation theory for discrete levels - equations in various orders of perturbation theory - non-degenerate and degenerate cases, simple examples. Time dependent perturbation theory.

The variation method - the hydrogen molecule - exchange interaction. The WKB method.

Unit IV Relativistic quantum mechanics and elements of second quantisation

Klein-Gordan equation for a free particle - Dirac equation - Dirac matrices. - spin and magnetic moment of the electron.

Transition from particle to field theory. Second quantisation of the Schrodinger, Klein, Dirac and Electromagnetic equations (qualitative). Creation and annihilation operators - commutation and anti-commutation relation and their physical implications.

Text Books:

1. Thankappan V K, „Quantum Mechanics" (Wiley Eastern Ltd., 1985)
2. Ghatak A K and Lokanathan S, „Quantum Mechanics" (Macmillan, India, 1984)
3. Mathews P M and Venkatesan K, „Text Book of Quantum Mechanics" (Tata McGraw Hill, 1976)
4. Powell J L and Crasemann B, „Quantum Mechanics" (Addison Wesley, 1961)

Reference Books:

1. Schiff L I, „Quantum Mechanics", III Edn. (McGraw Hill, 1969)
2. Merzbecher E, „Quantum Mechanics", III Edn. (John Wiley & Sons, 1998)
3. Shankar R, „Principles of Quantum Mechanics" (Plenum, 1980)
4. Sakurai J J, „Modern Quantum Mechanics" Revised Edn. (Addison-Wesley, 1994)
5. Edmonds, „Angular Momentum in Quantum Mechanics" (Princeton University Press, 1960)

PHY 203 NUCLEAR AND RADIATION PHYSICS

Unit I General properties of the nucleus and nuclear decay

Constituents of nucleus and their properties. Mass of the nucleus-binding energy. Charge and charge distribution. Estimation of nuclear radii by different methods. Spin statistics and parity. Magnetic moment of the nucleus. Quadrupole moment.

Nuclear decay - Alpha decay - quantum mechanical tunnelling - wave mechanical theory. Beta decay - continuous beta ray spectrum - neutrino hypothesis. Fermi"s theory of beta decay - Kurie plots and ft-values - selection rules. Detection of neutrino - non-conservation of parity in beta decay. Gamma decay - selection rules - multipolarity - Internal conversion (qualitative only).

Unit II Interaction of radiations and radiation detectors: Interactions of electrons with matter - Specific energy loss, Coulombic mode of interactions, radiative mode of energy loss, electron range and transmission curves.

Interaction of gamma rays with matter - Elastic scattering, photoelectric effect, Compton scattering, Klein-Nishina formula (qualitative) and pair production processes, cross section, gamma ray attenuation, linear and mass absorption coefficients.

Radiation detectors - Gas filled counters - general features - ionization chamber, proportional counter and GM counter.

Radiation quantities and units - radiation exposure, absorbed dose, equivalent dose and effective dose

Unit III Ionising radiations and applications: Sources of ionising radiations in the environment – terrestrial radiation sources and radionuclides, cosmic radiations and cosmogenic radionuclides. Technologically enhanced radiation sources. Artificial radiation sources artificial radionuclides. Production of radioisotopes using reactors. Application of radioisotopes in medicine, agriculture and industry. Radiation shielding (qualitative treatment).

Nuclear Models: Liquid drop model - semi empirical mass formula, stability of the nuclei against beta decay, mass parabola. Shell model (qualitative)

Unit IV Nuclear reactions - Cross section for a nuclear reaction. „Q" equation of a reaction in laboratory system - threshold energy for a reaction. Centre of mass system for nucleus-nucleus collision. Non-relativistic kinematics. Relation between angles and cross sections in lab and CM systems.

Reactor physics: fission chain reaction. Slowing down of neutrons - moderators. Conditions for controlled chain reactions in bare homogeneous thermal reactor. Critical size. Effect of reflectors. Brief introduction of nuclear fuel cycle. Breeder Reactors.

Text Books:

1. Segre E, „Nuclei and Particles", II Edn. (Benjamin, 1977)
2. Knoll G F, Radiation Detection and Measurement", II Edn. (John Wiley, 1989)
3. Eisenbud M, „Environmental Radioactivity" (Academic Press, 1987)
4. Ghoshal S N, „Atomic and Nuclear Physics", Vol. I & II (S Chand & Company, 1994)

Reference Books

1. Patel S B, „Nuclear Physics - An Introduction‟ (Wiley Eastern, 1991)
2. Krane K S, „Introductory Nuclear Physics‟ (John Wiley, 1988)
3. Roy R K and Nigam P P, „Nuclear Physics - Theory and Experiment‟ (Wiley Eastern Ltd., 1993)
4. Singru R M, „Experimental Nuclear Physics‟ (Wiley Eastern, 1972)
5. Zweifel P F, „Reactor Physics‟, International Student Edn. (McGraw Hill, 1973)
6. Kapoor S S and Ramamurthy V S, „Radiation Detectors‟ (Wiley Eastern, 1986)
7. Henry Semat & John R AlBright, „Introduction to Atomic and Nuclear Physics‟ V Edn. (Chapman & Hall, 1972)
8. Burcham W E, „Nuclear Physics‟, II Edn. (Longman, 1963)
9. Mann W B, Ayres R L and Garfinkel, „Radioactivity and its Measurements‟ (Pergamon Oxford, 1980)
10. Little field T A and Thorley N „Atomic and Nuclear Physics‟, II Edn. (Nostrand Co., 1988)

PHY 204 : CONDENSED MATTER PHYSICS and ELECTRONICS]

Unit I Elementary Crystallography and X-ray diffraction Elementary Crystallography**:** Concept of Crystallography, unit cell, primitive and non-primitive, base, Bravais lattice in two and three dimension, crystal structure, coordination numbers, Miller indices, Crystal structures of NaCl, CsCl, diamond, zinc blende and copper. Close packing system.

X ray diffraction**:** Scattering of X rays by an electron, by an atom and by a crystal. Atomic scattering factor, Bragg law. Geometric structure factor. Systematic absences. Reciprocal lattice - its properties, Ewald‟s sphere - its construction. Laue and powder experimental methods.

Lattice Vibration**:** Properties of lattice waves, chain of identical atoms and a diatomic linear chain, quantisation of lattice vibrations, phonon, phonon momentum, elastic scattering by phonon, phonon-phonon interaction, anharmonicity and thermal expansion, problems.

Unit II Free Electron Theory and Band Theory of Solids: Free electron in one dimensional potential well, three dimensional potential well, quantum state and degeneracy, density of states, Fermi Dirac Statistics and distribution with temperature, free electron theory of metals, Fermi energy above 0 K, Electronic specific heat.

Electrical conductivity of metal,. Relaxation time and mean free path, Wiedemann-Franz law. Failures of free electron model. Kronig-Penney mode and Effective mass. Classification of solids - metal, semiconductors, insulators. intrinsic and extrinsic semiconductors. Carrier concentration in intrinsic semiconductors, impurity states-donor states, acdeptor states, thermal ionisation of donors and acceptors, temperature effects of mobility, Electrical conductivity of semiconductor.

Unit III Phasors and devices

Phasors - Phasor relations for R, L and C - Sinusoidal steady state response of a series RLC circuit. Fourier series - trigonometric form of Fourier series - complex form of Fourier series. Application of Fourier and Laplace transforms in circuit analysis. BJT, JFET and MOSFET devices. Voltage divider bias. Small signal analysis of BJT and FET amplifiers in CE/CS configuration. UJT characteristics and its use in a relaxation oscillator. SCR characteristics and its use in ac power control

Unit IV Operational amplifiers and Digital electronics

BJT differential amplifier. Operational amplifier - voltage/current feedback concepts (series & parallel). Inverting and noninverting configurations. Basic applications of opamps - comparator and Schmitt trigger. IC555 timer - monostable and astable multivibrators. Crystal oscillator using opamp. Voltage regulators – three terminal and SIMPS Tristate devices. Decoders and encoders. Multiplexers and demultiplexers with applications. Digital to analog conversion with R/2R network. Analog to digital conversion using flash technique.

Text Books:

1. Hayt W H, Kemmerly J E & Durbin S M, „Engineering Circuit Analysis‟, VI Edn. (McGraw-Hill, 2002).
2. Boylestad R L, „Introductory Circuit Analysis‟, VIII Edn. (Prentice Hall, 1997)
3. Boylestad R L & Nashelsky L, „Electronic Devices & Circuit Theory‟, VIII Edn. (Prentice Hall, 2002).
4. Floyd T L, „Electronic Devices‟, V Edn. (Pearson Education Asia, 2001).
5. Gayakwad R A, „Opamps and Linear Integrated Circuits‟, III Edn. (PHI, 1993).
6. Floyd T L, „Digital Fundamentals‟, VII Edn. (Pearson Education Asia, 2002).
7. Cullity B D and Stock S R, „Elements of X-ray diffraction‟, III Edn. (PH, 2001)
8. Ashcroft F W & Mermin N D, „Solid State Physics‟ (Harcourt, 1976)

9. Verma A R and Srivastava O N, „Crystallography Applied to Solid State Physics‟, II Edn. (New Age, 1991)
10. Kittel C, „Introduction to Solid State Physics‟, IV Edn. (Wiley Eastern, 1974)
11. Cullity B D and Stock S R, „Elements of X-ray diffraction‟, III Edn. (Prentice-Hall, 2001)
12. Ashcroft F W & Mermin N D, „Solid State Physics‟ (Harcourt, 1976)
13. Verma A R and Srivastava O N, „Crystallography Applied to Solid State Physics‟, II Edn. (New Age, 1991)
14. McKelvey J P „Solid State and Semiconductor Physics‟ (Robert E. Kreiger, 1982)
15. Kittel C, „Introduction to Solid State Physics‟, IV Edn. (Wiley Eastern, 1974)
16. Omar M A, „Elementary Solid State Physics‟ (Addison Wesley, 1975)
17. Dekker A J, „Solid State Physics‟ (Macmillan, 1971).
18. Singh J, „Semiconductor Devices‟ (John Wiley, 2001)
19. M A Wahab " Solid State Physics" Narosa Publication, second edition 2005

Reference Books:

1. Alexander C K and Sadiku M N O, „Fundamentals of Electric Circuits‟ (McGraw Hill International Edition, 2000)
2. Donald Neamen, „Electronic Circuit Analysis and Design‟ II Edn. (Tata McGraw Hill, 2002)
3. Sedra A & Smith K C, „Microelectronics‟, IV Edn. (Oxford University Press, India, 1998)
4. Horenstein M N, „Microelectronic Circuits and Devices‟, II Edn. (PHI, 1996).

PHYSICS PRACTICALS II (General)

1. Half life of K-40
2. Thermoelectric constant
3. Gamma ray Spectrum of Cs-137
4. Ferroelectric Curie temperature
5. Estimation of effect of white light (sun tracking) on energy generation by solar PV module.
6. To measure the variation of dielectric constant with temperature and verification of Curie Weiss law.
7. Verification of Inverse square law (G.M.tube)
8. Transition temperature of ferrites.
9. Temperature dependence of Hall coefficient.

10. To study the I-V characteristics of solar panel.
11. Study of Hall effect
12. To measure the variation of dielectric constant with temperature and verification of Curie Weiss law.

PHYSICS GENERAL PRACTICALS III

1. Study of interference and diffraction using He-Ne Laser
2. Ultrasonic Interferometer
3. Michelson`s Interferometer
4. Constant deviation Spectrometer
5. Quarter wave plate
6. Diffraction Haloes
7. Fresnel‟s laws of reflection
8. To determine the ionization potential of given source.
9. To determine the value of Planck‟s constant using photocell/LED.
10. Babinet Compensator
11. Demonstration of energy quantization using the Frank-Hertz Experiment.
12. Study of Zeeman effect: determination of e/m for an electron