DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY
MURTHAL (SONEPAT) HARYANA-131039
DEPARTMENT OF PHYSICS
M.Sc. in Physics (Four –Semester Course)
(Effective from Session 2012-2013)
Semester-I

Paper No.	Paper Title	Teaching Scheme		Examination Scheme			Duration of Exam(Hours)	Credit
		L	P	Sessional Marks	External Marks	Total		
PHY-501 B	Mathematical Physics	4	0	50	100	150	3	4
PHY-503 B	Classical Mechanics	4	0	50	100	150	3	4
PHY-505 B	Computational Physics	4	0	50	100	150	3	4
PHY-507 B	Fundamental of Electronics	4	0	50	100	150	3	4
PHY-509 B	Physics Lab-I (General)	0	8	50	100	150	3	4
PHY-511 B	Computational Physics & Programming Lab	0	4	25	50	75	3	2
Total		16	12	275	550	825		22

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Semester-II

Paper No.	Paper Title	Teaching Scheme		Examination Scheme			Duration of Exam(Hours)	Credit
		L	P	Sessional Marks	External Marks	Total		
PHY-502 B	Elements of solid State Physics	4	0	50	100	150	3	4
PHY-504 B	Atomic & Molecular Physics	4	0	50	100	150	3	4
PHY-506 B	Quantum Mechanics-I	4	0	50	100	150	3	4
PHY-508 B	Elements of Nuclear Physics	4	0	50	100	150	3	4
PHY-510 B	Physics Lab-II (General)	0	8	50	100	150	3	4
PHY-512 B	Computational Physics & Simulation Lab	0	4	25	50	75	3	2
Total		16	12	275	550	825		22

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Semester-III

Paper No.	Paper Title	Teaching Scheme		Examination Scheme			Duration of Exam(Hours)	Credit
		L	P	Sessional Marks	External Marks	Total		
PHY-601 B	Electrodynamics & Plasma Physics	4	0	50	100	150	3	4
PHY-603 B	Quantum Mechanics-II	4	0	50	100	150	3	4
Any one of the following options								
OPTION-1 (Condensed Matter Physics)								
PHY-605B	Crystallography and imperfections in crystals	4	0	50	100	150	3	4
PHY-607B	Characterization of materials	4	0	50	100	150	3	4
OPTION-2 (Electronics)								
PHY-609B	Analog Communication	4	0	50	100	150	3	4
PHY-611B	Digital Communication	4	0	50	100	150	3	4
OPTION-3 (Nuclear Physics)								
PHY-613B	Nuclear Reactions	4	0	50	100	150	3	4
PHY-615B	Nuclear Detectors	4	0	50	100	150	3	4
OPTION-4 (Spectroscopy)								
PHY-617B	Laser Physics & Quantum Optics	4	0	50	100	150	3	4
PHY-619B	Integrated optics	4	0	50	100	150	3	4
Any one of the following practical paper corresponding to the theory paper will be assigned.								
PHY-621B	CMP-Lab-I	0	12	75	150	225	4	6
PHY-623B	Electonics Lab –I	0	12	75	150	225	4	6
PHY-625B	Nuclear Phy Lab-1	0	12	75	150	225	4	6
PHY-625B	Laser Lab-1	0	12	75	150	225	4	6
Total		16	12	275	550	825		22

Note: The student will opt any one option which will be continued in IV Semester as well.

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Semester-IV

Paper No.	Paper Title	Teaching Scheme		Examination Scheme			Duration of Exam(Hours)	Credit
		L	P	Sessional Marks	External Marks	Total		
PHY-602 B	Statistical Mechanics	4	0	50	100	150	3	4
PHY-604 B	Advance Quantum Mechanics & Elements of Particle Physics	4	0	50	100	150	3	4
Any one of the following options								
OPTION-1 (CMP)								
PHY-606B	Renewable Energy Sources	4	0	50	100	150	3	4
PHY-608B	Nano Science & Technology	4	0	50	100	150	3	4
OPTION-2 (Electronics)								
PHY-610B	Electronic Device & Smart Materials	4	0	50	100	150	3	4
PHY-612B	Microprocessor & Interfacing	4	0	50	100	150	3	4
OPTION-3 (Nuclear Physics)								
PHY-614B	Nuclear Models	4	0	50	100	150	3	4
PHY-616B	Nuclear Technique	4	0	50	100	150	3	4
OPTION-4 (Spectroscopy)								
PHY-618B	Fibre Optics and communication	4	0	50	100	150	3	4
PHY-620B	Optical Electronics	4	0	50	100	150	3	4
Any one of the following practical paper corresponding to the theory paper will be assigned.								
PHY-622B	CMP-Lab-II	0	8	50	100	150	4	4
PHY-624B	Electonics Lab –II	0	8	50	100	150	4	4
PHY-626B	Nuclear Phy Lab-1I	0	8	50	100	150	4	4
PHY-628B	Laser Lab-1I	0	8	50	100	150	4	4
PHY-D-630B	Dissertation	4	0	25	50	75	1	2
Total		16	12	275	550	825		22

M.Sc. Physics
Semester-I

MATHMATICAL PHYSICS

Paper No.-PHY-501B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT- I

MATRICES AND TENSORS

Matrices: Orthogonal, Unitary and Hermition Matrices with examples, Inverse of a matrix, Independent element of orthogonal and unitary matrices of order 2, Eigen values & Eigen vectors, Matrix diagonalization, complete orthonormal sets of functions.

Tensors: Introduction, definition, Covariant and Contravariant tensors, symmetric and skew-symmetric tensor, Contraction theorem, product of tensors, Quotient rule, Levi-Civita symbol, Non-cartesian tensors, Metric tensors, Covariant differentiation.

UNIT-II

SOLUTION OF LINEAR ODE’S OF SECOND ORDER & SPECIAL FUNCTIONS

Frobenius method for the series solution of second order linear ordinary differential equations, The Wronskian and Second solution.

Bessel function of first and second kind, Generating function and recurrence relations, integral representation.

Legendre Polynomial: $P_n(x)$ as solution of Legendre differential equation, Generating function, recurrence relations and special properties, Orthogonality of $P_n(x)$, Rodrigue’s formula.

Hermite and Laguerre Polynomial; solution of Hermite & Lageurre differential equation, Generating function and recurrence relation only

UNIT-III

COMPLEX VARIABLE

Function of complex variable, limit, continuity and differentiability of function of complex variables ,Analytic function, Cauchy-Riemann conditions, Cauchy’s integral theorem, Cauchy’s Integral formula, Taylor’s and Laurent’s series, singular points, residues, evaluation of residues, Cauchy’s residue theorem, Jordan’s lemma, evaluation of real definite integrals.

UNIT-IV

INTEGRAL TRANSFORM

Fourier series, Dirichlet's conditions, Fourier series of arbitrary period, Half-wave expansions, development of the Fourier integral , Fourier integral theorem, Fourier transforms, Properties of Fourier transform, Convolution theorem , Fourier transform of Dirac Delta function

Laplace transform, first and second shifting theorem, Laplace transforms of derivatives and integral of a function, convolution theorem ,Inverse Laplace transform by partial fraction and by using convolution theorem, application of Laplace transform in solving differential equations.

TEXT AND REFERENCE BOOKS:

1. Mathematical Methods for Physicists: G. Arfken and H.J. Weber, (Academic Press, San Diego)
2. Matrices and Tensors in Physics: A.W. Joshi (Wiley Eastern, New Delhi).
3. Mathematical Physics: P.K. Chatopadhyay (Wiley Eastern, New Delhi).
4. Introduction to Mathematical Physics: C. Harper (Prentice Hall of India, New Delhi).
5. Mathematical Methods in the Physical Sciences: M.L. Boas (Wiley, New York).
6. Applied Mathematics for Engineers and Physicists: L .Pipes & L.R. Horwell
7. Mathematics for Physicist: Mary L. Boas
8. Mathematical Physics: B.S. Rajput.
9. Mathematical Methods for Physicists: A. K. Ghatak, I. C. Goyal

M.Sc. Physics
Semester-I

CLASSICAL MECHANICS

Paper No.-PHY-503B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

LAGRANGIAN FORMULATION &HAMILTON'S PRINCIPLES

Mechanics of a system of particles, constraints of motion, generalized coordinates, D' Alembert's Principle and Lagrange's velocity –dependent forces (gyroscopic) and the dissipation function, Application of Lagrangian formulation. Hamilton principle, Lagrange's equation from Hamilton principle, extension to non-holonomic systems,

UNIT-II

RIGID BODY MOTION

Reduction to equivalent one body problem, the equation of motion and first integrals, the equivalent one – dimensional problem and the classification of orbits, the differential equation for orbits, the Kepler's problem(inverse square law), scattering(Rutherford) in central force field. The Euler's angles, rate of change of a vector, the Coriolis force and its applications,

UNIT-III

SMALL OSCILLATIONS & HAMILTON EQUATION

Euler equation of motion, Torque free motion of rigid body, motion of a symmetrical top, Eigen value equation, Free vibrations, Normal coordinates, vibration of Tri-atomic Molecule. Legendre Transformation, Hamilton's equations of motion, Hamilton's equations from variation principle, Principle of least action.

UNIT-IV

CANONICAL TRANSFORMATION AND HAMILTON-JACOBI THEORY

Canonical transformation and its examples, Poisson's brackets, Equation of motion, Angular momentum, Poisson's Brackets relations, infinitesimal canonical transformation, Conservation Theorems., Hamilton-Jacobi equation for Hamilton's principal function, Harmonic Oscillator problem

TEXT AND REFERENCE BOOKS:

1. H.Goldstein, C.Poole & J. Safko, Classical Mechanics (Pearson Education Asia, New Delhi)
2. N.C. Rana and P.S. Joag, Classical Mechanics (Tata McGraw-Hill, 1991)
3. Kiran C. Gupta, Classical Mechanics of Particles & Rigid Bodies (Wiley Eastern)

M.Sc. Physics
Semester-I

COMPUTATIONAL PHYSICS

Paper No.-PHY-505B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**

Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

Basic Computer organization: Input and output units, Storage unit, Arithmetic Logic unit, Control unit, Central processing unit.
Fortran Programming: Data types, Arithmetic & logical expression, Input-output statements, If statement, Do loop, Arrays and subscripted variables, functions and subroutines, Handling input and output files.

UNIT-II

Errors: Round off errors, truncation error, machine error, random error.
Solution of algebraic equation: Bisection method, iteration method, Newton Raphson method, Muller method.
Interpolation and extrapolation: Finite difference, forward difference, backward difference, central differences, Lagrange method.
Curve Fitting: Least-square curve fitting, straight line and polynomial fits.

UNIT-III

Differentiation: Taylor series method, numerical differention using Newton's forward difference formula, strilling formula.
Integration: Trapezoidal rule, Simpson 1/3 rule, Gaussian Quadrature, Legendre-Gauss Quadrature, Numerical double integration

UNIT-IV

Numerical solution of ordinary differential equation: Taylor series method, Eulers methods, forth order Runga Kutta method.
Second order differential equation: Initial and boundary value problem, Numerical solution of radial Schorindger for hydrogen atom using forth order Runga Kutta method (when eigen value is given).

REFERENCES:

1. Numerical Mathematical Analysis, J.B. Scarborough (Oxford Book Co.)
2. Computational: Physics an introduction by RC Verma, PK Ahulawalia and K C Sharma (New Age International Publisher)
3. Introduction to Numerical Analysis by F b Hilderbrand(Tata McGraw Hill, New Delhi)

4. Programming with Fortran 77, Schaum's outline seriios by William E. Mayo and Martin Cwiakala (McGraw Hill,Inc).
5. Fortran Programming and Numerical methods by R C Desai (Tata McGraw Hill, New Delhi).
6. Computer Applications in Physics Suresh Chandra (Narosa Publishing House).
7. Introductory methods of numerical methods of numerical Analysis by S S Sastry (Prentice Hall of India).
8. Computer orented Numerical Method by V Rajaraman (Prentice Hall of India).
9. An introduction to numerical analysis, John Wiley and Sons.

M.Sc. Physics
Semester-I

ELECTRONICS - I

Paper No.-PHY-507B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

SEMICONDUCTOR DEVICES & DATA INTERPRETATION
Drift and diffusion current , Generation and recombination of charges, p-n junction, Capacitance of p-n junctions, Varactors, switching diodes, Clippers & Clampers, photoconductors, photodiode, light emitting diodes and liquid crystal display.
Junction Field Effect Transistor(JFET) : Basic structure & Operation, pinch off voltage, single ended geometry of JFET, Volt–Ampere characteristic, Transfer Characteristics. JFET as Switch and Amplifier.

MOSFET: Enhancement MOSFET, Threshold Voltage, Depletion MOSFET, comparison of p & n Channel FET, SCR, 4 layer pnpn devices, Tunnel diode

UNIT-II

OPERATION AMPLIFIER
Differential Amplifier: Circuit configuration, dual input balanced output different amplifier, Inverting and Non-inverting inputs, CMRR.
Operational Amplifiers: Block diagram, open and close loop configuration, inverting & non-inverting amplifier, Op-amp with negative feedback – Voltage series feedback, Effect of feedback on closed loop voltage gain, Input resistance, output resistance, band width, output offset voltage, Measurements of Opamp parameters.

Op-amp Application: d.c. and a.c. amplifier, summing, scaling and Averaging amplifier, Integrator, Differentiator, Electronic analog computation comparator

UNIT-III

DIGITAL CIRCUITS
Boolean algebra, de Morgans theorem, truth table to Karnaugh map and simplification.
Data processing circuits : Multiplexers, Demultiplexers, Adders, Encoders, Decoders, Parity generators. Sequential Circuits : RS, JK, D, clocked, preset and clear operation, race a round condition in JK flipflops, master-slave JK flip-flops as building block of sequential circuits. Shift registers, Asynchronous and synchronous counter, counter Design and applications.

UNIT-IV

MEMORIES AND CONVERTERS

Semiconductor Memories : ROM, PROM, and EPROM, Ram, Static and Dynamic Random Access Memories (SRAM and DRAM), Content addressable memory, other advanced memories. D/A and A/D Converters : Parallel comparator A/D converter, A/D converter using voltage to frequency and using voltage to time conversion, accuracy and resolution. D/A converter resistive network, accuracy and resolution.

Text and References Books:

J. Millman, CC. Halkias	Integrated Electronics (Tata McGraw Hill}
R.P.Jain	Modern Digital Electronics (Tata McGraw Hill)
Malvino & Leach	Digital Electronics
S.M. Sze	Semiconductor Devices : Physics and Technology
Ramakanth A. Gayakwad	OP-Amps & Linear integrated Circuits (Second Edition, 1991)
A.P. Malvino and Donald P. Laach	Principals and Applications in Electronics (Tata McGraw-Hill, N.Delhi,1993)
Thomas L. Floyd	Digital Electronics (Pearson Pub.)
A.D. Helfrick & W.D. Cooper	Modern Electronic Instrumentation and measurement techniques (PHI)
J.D. Ryder	Fundamental of electronics

M.Sc. Physics
Semester-I
PHYSICS LAB - I

Paper No.-PHY-509B | **Credits: 04**
08Hrs /week | **Max. Marks: 100+50**
Total: 120 Hrs. | **Duration of Exam: 03 Hrs.**

Note: : Students are expected to perform at least eight experiments out of following list.
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1. To study the characteristics of Junction Field Effect Transistor.
2. To study the characteristic of Metal Oxide Semiconductor Field Effect Transistor.
3. To study the characteristics of optoelectronics Devices (LED, Photodetector).
4 To measure the band gap of Germanium using Four Probe Method.
5 To determine Hall Voltage, concentration of charge carrier and the type of semiconductor in the Hall effect experiment.
6 To study the Magnetostriction effect in a metallic rod.
7 (i) To measure input offset voltage, input bias current, input offset current and CMRR of opamp.
(ii) To study the frequency response of an operational amplifier.
8. To study the use of operational amplifier for different mathematical operation.
9. To study the use of operational amplifier for voltage to current & current to voltage conversion conversion.
10 To study the characteristic of SCR and its application as a switching device.
11 To determine plank's constant using photovoltaic cell.
12 To determine the variation of refractive index of the material of prism with wavelength and to verify Cauchy's dispersion formula.
13 To study SR & JK flipflop circuits using logic gates.
14 To study the use of digital comparator.
15. To study use of multiplexer, demultiplexer, decoder & phase shifter.

M.Sc. Physics
Semester-1st
Computational Physics & Programming Laboratory

Paper No.-PHY-511B | **Credits: 02**
04Hrs /week | **Max. Marks: 50+25**
Total: 120 Hrs. | **Duration of Exam: 03 Hrs.**

Note: Students are expected to perform at least five experiments out of following list.

1 To perform Matrix summation, subtraction and multiplication.
2 To find the root of algebraic equation using bisection method.
3 To find the root of algebraic equation Newton Raphson method.
4 To find the root of algebraic equation using Muller method
5 To fit a straight line through given data using Least square method.
6 To fit the given data using polynomial fitting.
7 Interpolation and extrapolation using Lagrange method.
8 To perform Numerical differentiation using Newton’s method.

M.Sc. Physics
Semester-II

ELEMENTS OF SOLID STATE PHYSICS

Paper No.-PHY-502 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT – I

CRYSTAL STRUCTURE

Crystalline solids, Direct lattice, translational vectors, two and three – dimensional Bravais lattices, Miller Indices, Closed packed structures.

Interaction of X- Rays with matter, absorption of X-Rays, Elastic scattering from a perfect lattice. Reciprocal lattice, Bragg's Law, Ewald construction, Brillouin zones and applications of reciprocal lattice to diffraction techniques. Experimental method in X-ray Diffraction - Laue method, powder method and rotating crystal method, structure factor, bonding in solids.

UNIT – II

LATTICE VIBRATION, PHONONS AND FREE ELECTON THEORY OF METALS

Lattice Modes of Vibration, Elastic Vibrations of continuous media, Vibrations of 1-D monatomic and diatomic linear lattice. Phonon Modes, Lattice vibration Spectrum, phonon momentum, Inelastic scattering by phonons.

Classical theory of Free electron, Fermi gas, energy levels and density of orbitals, Fermi-Dirac distribution function, Quantum theory of free electrons in a 3 –D box, electronic specific heat of a metal.

UNIT – III

BAND THEORY OF SOLIDS AND SUPERCONDUCTIVITY

Electrons in a periodic lattice: Bloch theorem, band theory and classification of solids, effective mass. Tight binding approximations. Fermi surface, Conduction in Semiconductors (both Intrinsic and Extrinsic), quantum Hall effect.

Basic Properties of Superconductors, Meissner Effect, Transport Behavior, Types of Superconductors, London's equations, penetration depth, coherence length, energy gap parameter, Josephson Effects, BCS theory of Superconductivity, Introduction to high temperature superconductors.

UNIT – IV

MAGNETISM

Langevin's theory of Dia- and Para-magnetism, Weiss Theory of paramagnetism and Ferromagnetism, Quantum theory of Ferro-magnetism, Hesignberg's theory of magnetism. Ferromagnetic domains, Anti-ferromagnetism, Ferrimagnetism and Bloch-wall.Structure of Ferrites.

TEXT AND REFERENCE BOOKS:

C. Kittel	Introduction to Solid State Physics (Wiley, New York)
C. Kittel	Quantum Theory of Solids (Wiley, New York)
Verma and Srivastava	Crystallography for Solid-State Physics
J. Ziman	Principles Of the Theory of Solids (Cambridge University Press, Cambridge)
Azaroff	Introduction to Solids
Omar	Elementary Solid-State Physics
Aschroft & Mermin	Solid State Physics (Reinhert & Winston, Berlin)
Chaikil & Lubensk	Principles of Condensed Matter Physics
M. Tinkham	Introduction to Superconductivity
S. O. Pillai	Solid State Physics (new Age International Publishers)
M. A. Wohab	Soild State Physics (Narosa).

M.Sc. Physics
Semester-II

ATOMIC AND MOLECULAR PHYSICS

Paper No.-PHY-504 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT – I

ATOMIC PHYSICS

Two electron system: Interaction energy in L-S and J-J coupling, atomic states arriving due to different electronic configuration (L-S coupling only), Briet's scheme, Spectrum of He-atom and Heisenberg resonance.
Hyperfine structure of spectral line: Isotope effect, nuclear spin and hyperfine multiplet, Determination of nuclear spin using hyperfine structure

UNIT –II

MOLECULAR PHYSICS

Microwave spectroscopy: Diatomic molecule as rigid rotator; its energy level and spectra, Intensity of rotational lines, Diatomic molecule as non rigid rotator. Isotope effect in rotational spectra

Infrared spectroscopy: Diatomic molecules as harmonic and anharmonic oscillator, Diatomic molecule as vibrating rotator, Energy levels and spectrum, thermal distribution of quantum states, Isotope effect in vibration spectra.

Raman spectroscopy: Introduction, Pure rotational Raman spectra, Pure Vibrational Raman spectra, Raman rotational vibrational spectra,

UNIT –III

ELECTRONIC BAND SPECTRA

Salient features of electronic band spectra, Born Oppenheimer approximation, Vibrational coarse structure of electronic bands, progression and sequences, Rotational fine structure of electronic bands, The Fortrat parabola.
Intensity of electronic bands: Franck Condon principle (absorption and emission), quantum mechanical treatment of Franck Condon principle.

UNIT –IV

LASER PHYSICS & FLUORESCENCE SPECTROSCOPY

Laser: Spontaneous and stimulated emission, Einstein A & B coefficient, optical pumping, population inversion, rate equation, modes of resonator and coherence length.

Fluorescence and Phosphorescence, Kasha's rule, quantum yield, nonradioactive transition, Jablonski diagram, Time resolved fluorescence and determination of excited state life time.

REFERENCES BOOKS:

1. Introduction to Atomic spectra: H.E. White
2. Fundamental of Molecular spectroscopy: C.N. Banwell
3. Atomic spectra & Structure: G. Herzberg
4. Physics of Atoms and Molecule: Bransden and Joachain
5. Molecular spectroscopy: J. M. Brown
6. Introduction to Molecular spectroscopy : G. M. Barrow
7. Spectra of Atoms and Molecule: P.F. Bemath
8. Laser- Theory and Application: K. Thyagrajan and A. K. Ghatak
9. Principle of Fluorescence spectroscopy : Lacowicz
10. Theory & Interpretation of Fluorescence and Phosphorescence: Ralph S Beck

M.Sc. Physics
Semester-II

QUANTUM MECHANICS-I

Paper No.-PHY-506 B | **Credits: 04**
04 Hrs /week | **Max. Marks: 100+50**
Total: 60 Hrs. | **Duration of Exam: 03 Hrs.**

Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT – I

SCHROEDINGER EQUATIONS AND APPLICATIONS:

The Schroedinger equations: Time dependent and time independent forms, Probability current density, expectation values, Ehrenfest's theorem, Gaussian wave packet and its spreading. Exact statement and proof of the uncertainty principle, eigenvalues and Eigen functions, wave unction in coordinate and momentum representations, Degeneracy and orthogonality. Application of Schrodinger equation for a particle in one dimensional Box, Tunneling problem and Linear Harmonic Oscillator.

UNIT – II

OPERATORS

Operator in quantum mechanics, Hermitian operator and Unitary operator change of basis, Eigenvalues and eigenvectors of operators, Dirac's Bra and Ket algebra, Linear harmonic oscillator, coherent states, Time development of states and operators, Heisenberg, Schroedinger and interactive pictures, annihilation & creation operators, Matrix representation of an operator, Unitary transformations.

UNIT – III

ANGULAR MOMENTUM

The angular momentum operators and their representation in spherical polar coordinates, solution of Schrodinger equation for spherically symmetric (central) potentials, spherical harmonics, Hydrogen atom. Commutators and various commutation relations. Eigen values and eigenvectors of L^2 and L_z. Spin angular momentum, Eigenvalues and eigenvectors of J^2 and J_z. Representation of general angular momentum operator, Addition of angular momentum, C.G. coefficients, Stern-Gerlach experiment.

UNIT – IV

TIME INDEPENDENT PERTURBATION THEORY

Time independent perturbation theory: Nondegenerate case, first and second order perturbation, Degenerate case, First order Stark effect in hydrogen.

The Variational Method: expectation value of the energy, application to the ground state of Harmonic oscillator, Hydrogen and Helium atoms, Vander-Waal interactions.

TEXT AND REFERENCE BOOKS:

L.I. Schiff	Quantum Mechanics(Tata McGraw-Hill, Delhi)
B. Craseman and J.L. Powell	Quantum Mechanics (Narosa, New Delhi)
S. Gasiorowicz	Quantum Mechanics (Wiley, New York)
J.J. Sakurai	Modern Quantum Mechanics (Addison Wesley)
P.M. Mathews & K.Venkatesan	Quantum Mechanics (Tata McGraw-Hill, Delhi)
Ghatak & Loknathan	Quantum Mechanics
M.P. Khanna	Quantum Mechanics (Har Anand, N. Delhi)
V.K. Thankappan	Quantum Mechanics (New Age, N. Delhi)
N. Zettili	Quantum Mechanics: Concepts and applications
Bransden and Jochain	Quantum Mechanics
Satya prakash	Quantum Mechanics
B. S. Rajput	Advanced Quantum Mechanics

M.Sc. Physics
Semester-II

ELEMENTS OF NUCLEAR PHYSICS

Paper No.-PHY-508 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT -I

Constituents of the nucleus, isotopes, isotones and isobars. Measurement of nuclear mass by mass spectrometry and nuclear size by electron scattering method. Binding energy and its variation with mass number. Nuclear charge distribution, Nuclear matter distribution, magnetic dipole moment, electric quadrupole moments.

UNIT -II

Qualitative description of various modes of energy loss of charged particles in matter. Stopping power and Bethe-Bloch formula. Dependence of stopping power on energy of projectile, nature of projectile and stopping medium. Concept of energy and range straggling, Bragg curve.

Interaction of gamma radiation with matter: Qualitative idea of Photoelectric effect, Compton scattering and pair production. Linear and mass attenuation coefficients of gamma rays in matter. Positron annihilation in matter.

Radiation Detectors: Gas detectors; Direct-Current mode Ionization chamber, Proportional counter. G.M Counter.

UNIT -III

Alpha decay, Tunnel theory of alpha decay, Beta decay, Fermi theory of beta decay, shape of beta spectrum, Fermi- Kurie plot and its importance. Gamma decay, Multipole transitions in nuclei, Angular momentum and parity selection rule. Internal conversion and Nuclear isomerism.

UNIT -IV

Overview of deuteron problem. Introduction to liquid drop model with its validity and limitations. Evidence of shell structure, Magic numbers, single particle shell model.

Nuclear energy: The fission process-Neutrons released in the fission process, cross section, the fission reactors, nuclear Fusion and thermonuclear reactions, Energy production in stars.

REFERENCES:

1. Nuclear Physics: Principle and Application by John Lilley (Wiley Pub.).
2. Concepts of Nuclear Physics by Bernard L Cohen (TMH).

3. Nuclear Physics Experimental and Theoretical by H S Hans (New Age Int.).
4. Nuclear Radiation Detector by S S Kapoor and V S Ramamurthy(New Age Int.).
5. Introduction to Nuclear Physics by H.A. Enge(Addison-Wesley).
6. Atomic Nucleus by R D Evans(Tata Mc Graw Hill).
7. Nuclear Physics 2nd edition by I Kaplan(Narosa) .
8. Concepts of Modern Physics by Arthur Beiser (TMH).

M.Sc. Physics
Semester-I

PHYSICS LAB - II

Paper No.-PHY-510B | **Credits: 04**
08Hrs /week | **Max. Marks: 100+50**
Total: 120 Hrs. | **Duration of Exam: 03 Hrs.**

Note: Students are expected to perform at least ten experiment in each semester.

1. To study the characteristics of G.M. Counter.
2. To find the end point energy of given source using G.M. Counter.
3. To find the absorption coefficient of given material using G.M. counter.
4. To measure the Curie Temperature of a given ferroelectric material.
5. To measure the Curie Temperature of a given magnetic material.
6. To measure the thickness of hair and width of slit using He-Ne/Diode Lasers.
7. To measure the wavelength of He-Ne Laser using Transmission Grating.
8. To determine the wavelength of laser using Michelson Interferometer.
9. To study the hystersis loss of the given sample by tracing B-H curve.
10. To study the working of DAC and measure resolution and setting time of DAC.
11. To study working of ADC and measure resolution and conversion time of ADC.
12. To measure (i) the frequency of an a.c. signal and (ii) the phase difference between the two voltages using CRO.
13. To design an (i) inverting amplifier and (ii) non-inverting amplifier, of a given gain using operational amplifier.
14. To study the characteristic of voltage doubler and voltage tripler..

M.Sc. Physics
Semester-1st
Computational Physics & Simulation Laboratory

Paper No.-PHY-512B **Credits: 02**
04Hrs /week **Max. Marks: 50+25**
Total: 120 Hrs. **Duration of Exam: 03 Hrs.**

Note: Students are expected to perform at least five experiments out of following list.

1 To perform Numerical differentiation using Taylor series method.
2 To perform numerical differentiation using strilling formula.
3 To perform Numerical integration using the Simpson's method.
4 To perform Numerical integration using the Trapezoidal method.
5 To perform numerical integration using Legendre-Gauss Quadrature
6 To evaluate double integration numerically.
7 To find Solution of first order differential equations using the Runge-Kutta method.
8 To find the radial part of wave function of deuteron in its ground state using Runge-Kutta Method.

M.Sc. Physics
Semester-III

ELECTRO-DYNAMICS AND PLASMA PHYSICS

Paper No.-PHY-601 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

TIME VARYING FIELDS & MAXWELL'S EQUATION

Energy stored in an electric and magnetic fields; Power flow in an electromagnetic field and Poynting's theorem; Maxwell's equations; The wave equation; Sinusoidal Waves; Electromagnetic waves, wave equations and their propagation in vacuum, linear dielectric medium and conductors, skin depth; Maxwell's equations using phasor notation.

UNIT-II

ELECTROMAGNETIC WAVES

Reflection and refraction of place waves: Boundary Conditions; Reflection by a perfect dielectric – normal and oblique incidence, Fresnel's equations, Brewster's angel; Reflection by a perfect conductor – normal incidence; Power loss in a plane conductor.

Polarization: Linear, elliptical and circular, Direction cosines.

Dispersion and Scattering: Coherent and Incoherent Scattered Light, Polarisation of scattered light. Dispersion in solids, liquids and gases.

UNIT -III

FIELDS AND RADIATIONS FROM MOVING CHARGE

Vector and Scalar Potential, Gauge transformation, Coulomb Gauge and Lorentz Gauge; Retarded Potential and Lienard-Wiechert Potential; Electric and Magnetic fields due to a uniformly moving point charge and an accelerated charge.

Power radiated by a point charge, Bremsstrahlung, Synchrotron radiation and Cerenkov radiation; Radiation reaction, Reaction Force of Radiation.

UNIT -IV

PLASMA PHYSICS AND WAVEGUIDES

Elementary Concepts: Plasma as fourth state of matter, Various kinds of Plasma, Debye Shielding, Plasma Parameters, Plasma Oscillations and plasma frequency expression, Fluid equations, electron plasma wave, ion acoustic wave, Magnetoplasma and Plasma Confinement, applications of Plasma.

EM Waves Guides: Rectangular, Cylindrical, Parallel plane, Optical fiber & Dielectric slab wave guides; Lippman Fringes; TE, TM & TEM waves, TE waves in rectangular wave guide and concept of cut off frequency, Coaxial transmission line.

TEXT AND REFERENCES BOOKS:

1. Introduction to Electrodynamics: David J. Griffiths, (Prentice Hall India, New Delhi).
2. Keith W. Whites, EE 382.
3. Classical Electrodynamics: J.D. Jackson, (Wiley Eastern, New Delhi).
4. Classical Electromagnetic Radiation: J.B. Marion and M.A. Heald, (Academic Press, San Diego).
5. Plasma Physics by Bittencourt
6. Introduction to Plasma Physics by F. F. Chen
7. Electromagnetic Waves by Jordan & Balme
8. Classical Electrodynamics : S.P. Puri, (Tata McGraw Hill, New Delhi).

M.Sc. Physics
Semester-III

QUANTUM MECHANICS - II

Paper No.-PHY-603 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

WKB-APPROXMATION AND TIME DEPENDENT PERTURBATION THEORY
WKB Approximation: WKB method for one-dimensional problems, Application to barrier penetration, WKB method for three dimensional problems.
Time-dependent perturbation theory: General expression for the probability of transition from one state to another, harmonic perturbation, Fermi's golden rule, selection rule, adiabatic and sudden approximations.

UNIT-II

COLLISION IN 3-D AND SCATTERING THEORY
Basic concept of scattering, Scattering cros-section, Scattering amplitude, scattering by spherically symmetric potentials, partial wave analysis and phase shifts, scattering by a perfectly rigid sphere and by square well potential. Born approximation and its applications toYukawa potential and other simple potentials. Electron scattering by an atom. Neumann equation and its solution, Neumann series and Bessel function.

UNIT-III

IDENTICAL PARTICLES
Identical particles: Symmetric and antisymmetric wave functions, distinguishability of identical particles, Pauli's exclusion principle, connection with statistical mechanics, collisions of identical particles. Spin angular momentum: connection between spin and statistics, spin matrices and eigenfunctions. Spin functions for many electron system. Atomic levels of Helium atoms as an example of two electron system.

UNIT-IV

RADIATION AND RELATIVISTIC QUANTUM MECHANICS
Semiclassical theory of radiation: Transition probability for absorption and induced emission, electric dipole and forbidden transitions, selection rules.
Relativistic quantum mechanics: Klein – Gordon equation, Dirac equation and its plane wave solutions.

TEXT AND REFERENCES BOOKS:

L.I. Schiff	Quantum Mechanics (Tata McGraw-Hill)
S. Gasiorowicz	Quantum Physics (Wiley, New York)
B. Craseman and J.D. Powell	Quantum Mechanics(Narosa, New Delhi)
A.P. Messiah	Quantum Mechanics
J.J. Sakurai	Modern Quantum Mechanics (Addison Wesley)
P. M. Mathews & K. Venkatesan	A Text book of Quantum Mechanics (Tata McGraw Hill, New Delhi)
Ghatak & Loknathan	Quantum Mechanics
Chhen Tannoudji	Quantum Mechanics
M. P. Khanna	Quantum Mechanics (Har Anand, New Delhi)

M.Sc. Physics
Semester-III
CRYSTALLOGRAPHY AND IMPERFACTIONS IN CRYSTALS

Paper No.-PHY-605 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT - I

CRYSTAL STRUCTURE:
Elementary concepts of space group and its relevance to crystalline structure. Principle powder Diffractometer. Interpretation of powder photograph, Analysis indexing: Ito's method. Accurate determination of lattice parameters-least-square method. Rietveld analysis. Application of powder method. Liquid crystals and quasi crystals.

UNIT - II

DIFFRACTION ANALYSIS:
Interpretation of oscillation photograph, X-ray method of orienting crystals about a crystallographic direction, Bernal chart, Indexing of reflections, Burger's precession method. Determination of relative structure amplitude from measured intensity (Lorentz and Polarization factors).

UNIT - III

IMPERFECTION OF CRYSTALS:
Point Defects (Schottkay and Frankel) and their thermodynamics, Color Centres F, M, R, V and H, Ploarons and Excitons, Edge dislocation and screw dislocation, Mechanism of plastic deformation, Stress and strain fields of screw and edge dislocation, Elastic energy of dislocations, Forces between dislocations, Stress needed to operate Frenkel-Read source, Dislocations in fcc, hcp and bcc lattices.

UNIT - IV

DEFECT ANALYSIS:
Partial dislocations and stacking faults in closed-packed structures. Experimental method of detecting dislocations and stacking faults in closed packed structures, Electron Microscopy: Kinematic theory of diffraction contrast and line imaging. Optical techniques for the observation of defects: Photoluminience (PL), Fourier Transform Infra Red (FTIR) and Raman spectroscopy
.

REFERENCE BOOKS:

1. Crystallographiy for Solid State Physics: Verma and Srivastava.
2. X-ray Crystallography: Azraf.
3. Elementary Dislocation Theory: Weertman and Weerdtman.
4. Crystal Structure Analysis: Burger
5. Electron Microscopy of Thin Cryslals: Hirsh.

M.Sc. Physics
Semester-III
CHARACTERIZATION OF MATERIALS

Paper No.-PHY-607 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

STRUCTURAL ANALYSIS:

X-ray characterization of imperfections in crystals, Basic concepts of small angle X-ray scattering and its application in evaluation of shape and size of surface particles. Neutron scattering and diffraction with reference to light elements and magnetic structures.

UNIT-II

ELECTRON SPECTROSCOPY TECHNIQUES:

LEED (Low Energy Electron Diffraction) for surface structures, Surface Topography, Elementary Concepts of Scanning and Scanning Tunnelling Microscopic Techniques for chemical analysis. Methods. RBS (Rutherford Back Scattering) and SIMS (Secondary Ion Mass Spectroscopy).

UNIT-III

OPTICAL SPECTROSCOPIC TECHNIQUES:

Double Beam IR Spectrometers, Basic Concepts of Raman Spectrography in Solids, Sensitive Detectors such as CCD Camera, Concept of Space Group and Point Group, Identification and Analysis of Optic and Acoustic Modes in Solids. Electronic Absorption Study for Band Gap Determination.

UNIT-IV

ANALYSIS OF TRACE ELEMENTS:

Basic of nuclear magnetic resonance (NMR) and electronic spin resonance (ESR) spectroscopy, Mossbauer spectroscopy, Microwave spectroscopy, Photoacoustic spectroscopy and their applications. Laser as a source of radiation and its characteristics Laser fluorescence and absorption spectroscopy, Multiphoton ionization and separation of isotopes.

REFERENCE BOOKS:

1.Analytical Techniques for Thin Films-Treatise on Material Science and Technology, Vol. 27: K.N. Tu and R. Rosenberg (ed).
2. Electron Microprobe Analysis: S.J.B. Reed.
3. Topics in Applied Physics, Vol. 4: R. Gomer (ed.).
4. Analysis of high Temperature Materials: Van Der Biest (ed.)

M.Sc. Physics
Semester-III
ANALOG COMMUNICATION

Paper No.-PHY-609 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT -I

MICROWAVE ELECTRONICS
Microwave characteristic features & applications, Wave guide and cavity resonators, Two cavities Klystron, Reflex Klystron, Gunn diode characteristics, microwave antenna, Detection of microwave, Dielectric constant measurement, Isolator and circulator, PIN diode modulator, Directional coupler, Avalanche Transist Time Devices: IMPATT Diode-Physical structure, Principle of operation, breakdown voltage, Avalanche and Drift region, Transferred Electron devices.

UNIT -II

RADAR COMMUNICATION
Basic Radar systems, Radar range equation and performance factor, Radar Cross-section, Pulsed Radar system, Duplexer, Radar display, Doppler Radar, CWIF Radar, FMCW Radar, Moving Target Indicator (MTI), Blind Speeds.

UNIT -III

ANALOG SIGNAL TRANSMISSION
Introduction, Amplitude, Frequency & phase modulation; AM, FM modulating and demodulating circuits; AM, FM Receivers functioning (Block Diagram) and characteristic features; Pulse modulation; Sampling Processes, PAM, PWM and PPM modulation and demodulation, Quantization noise, PCM, Differential PCM and Delta modulation systems, Comparison of PCM and PDM, Time division multiplexing.

Data interpretation and analysis: Precesion and accuracy, Error analysis, Propogation of errors, Least square fitting, Linear and non-linear curve fitting, Chi-Square test.

UNIT -IV

SATELLITE COMMUNICATION
Principle of Satellite communication, Satellite frequency allocation and band spectrum, Satellite orbit, trajectory and its stability, Satellite link Design, Elements of Digital Satellite Communication, Multiple Access Technique, Antenna system, Transponder, Satellite Applications.

TEXT & REFERENCE BOOKS:

1. Communication System : Simon Haykin.
2. Electronic Communication : Roddy and Coolen.
3. Microwave and Radar Engineeering : M.Kulkarni.
4. Digital and Analog Communication systems : K. San Shanmugam.
5. Satellite Communication : Pratt and Bosterin.
6. Microwave : K.C. Gupta.

M.Sc. Physics
III Semester

DIGITAL COMMUNICATION

Paper No.-PHY-611 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks

UNIT -I

SIGNALS, SYSTEMS AND NOISE
Elements of communication systems, Fourier representation of periodic and non-periodic signals, Power spectral density, Impulse and step response of systems, Time and frequency domain analysis of systems, Ideal and Real filters, Noise in communication systems, Representation of narrow band noise, Signal to noise ratio, Noise equivalent band width and Noise figure.

UNIT -II

INFORMATION THEORY AND CODING
Introduction, Amount of information, Average information, Shannon's encoding algorithm, Communication channels, Rate of information and capacity of discrete memory less channels, Shanon-Hartley theorem. Linear block cyclic codes and Convolutions codes.

UNIT -III

DIGITAL SIGNAL (DATA) TRANSMISSION
Introduction, Base band and pass band data transmission; Base band binary PAM system, Optimum receiver for binary digital modulation Schemes, Binary ASK, FSK, PSK and differential PSK signalling Schemes, Brief idea M-array signalling Schemes, Serial data Communication in Computers, USART 8251, MODEM.

UNIT -IV

FIBRE OPTIC COMMUNICATION

Basic optical communication system, wave propagation in optical fibre media, step and graded index fiber, Material dispersion and mode propagation, losses in fibre, optical fibre source and detector, optical joints and coupler, Digital optical fibre communication system, First/Second generation system, Data communication network.

TEXT & REFERENCE BOOKS:

1. Digital and Analog Communication Systems : K. San Shanmugam.
2. Communication Systems : Simon Haykin.
3. Optical Fibre Communication : Kaiser.

M.Sc. Physics
Semester-III

NUCLEAR REACTIONS

Paper No.-PHY-613 B — **Credits: 04**
04 Hrs /week — **Max. Marks: 100+50**
Total: 60 Hrs. — **Duration of Exam: 03 Hrs.**

Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

Qualitative features and phenomenological potentials, Charge symmetry and charge independence of nuclear forces. Exchange forces, Generalized Pauli exclusion principle, Meson theory of nuclear forces, Relationship between the range of the force and mass of the mediating particle.

Type of nuclear reactions, Q-value of nuclear reactions and its determination. Invariance in nuclear reactions. Basic concepts of cross section: Total cross section, Partial cross section, differential cross section. Cross section in terms of partial wave analysis.

UNIT-II

Physical properties of deuteron: Mass, binding energy, spin or total angular momentum, parity, magnetic moment and electric quadrupole moment. Ground state of deuteron (square well potential), Range depth relationship for square well potential. Neutron-proton scattering at low energy, Concept of scattering length and significance of its sign. Spin dependence of neutron-proton scattering, Effective range theory of neutron-proton scattering.

UNIT-III

Nuclear reactions and cross sections, Breit-Wigner dispersion formula for s-wave neutrons of low energy, The compound nucleus, Continuum theory of cross section for the formation of compound nucleus, Statistical theory of nuclear reactions.

Form of the optical potential: Square well, Woods-Saxon and spin dependent optical potential. Elastic scattering and reaction cross section with optical model.

UNIT-IV

Kapur-Peierls dispersion formula for potential scattering, Limitations of the optical model. Stripping and pick-up reactions. General theory of striping and pick-up reactions, Born approximation or Butler theory of direct reactions.

REFERENCES:

1. Nuclear Physics: Principle and Application by John Lilley (Wiley Pub.).
2. Concepts of Nuclear Physics by Bernard L Cohen (TMH).
3. Nuclear Physics: Theory and Experiment by R R Roy and B P Nigam (New Age Int.)
4. Nuclear Physics Experimental and Theoretical by H S Hans (New Age Int.).
5. Concepts of Modern Physics by Arthur Beiser (TMH).

M.Sc. Physics
Semester-III

NUCLEAR DETECTORS

Paper No.-PHY-615 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

Interaction of heavy charged particles with matter in low, medium and high velocity region. Range-Energy relationship for heavy charged particles, Energy and range straggling. Interaction of fast electrons in matter. Basic idea of photon Interaction in Matter, linear and mass absorption coefficients of gamma rays in matter. Distribution of energy deposition by photon in a finite medium. Mechanism of charge production in detector media.

UNIT-II

Features of Gas Ionization Detectors: Mobility of charge(ions and electrons) carriers, Electron attachment and recombination, Gas multiplication and modes of operation of gas detectors.

Pulse-mode operated ionization chambers: Pulse formation in a parallel plate ionization chamber, Gridded ionization chambers and measurements of energy of heavily ionizing particles.

Geiger-Muller Counters: The Geiger discharge, Development of pulse and quenching, Dead time, Geiger plateau, Counting efficiency.

UNIT-III

Interaction of heavy charged particles, electrons and photons with silicon and germanium. Production of electron-hole pairs. Semiconductor properties, Detector medium requirement and role of p-n junction, Working of p-n junction detector, Partially and totally depleted detectors, Charge collection and pulse shape. Diffused junction silicon detectors, Surface barrier detectors, Lithium-Drifted silicon detectors, Si(Li),. Lithium-Drifted Germanium detectors, Ge(Li),.

UNIT-IV

Scintillation mechanism and classification of scintillation materials: Mechanism of scintillations in inorganic crystal scintillators, Mechanism of scintillations in organic crystal scintillators, Scintillation response, Time characteristics of scintillator output, Nobel gas scintillators, Detection efficiency of scintillation detectors, Energy resolution of scintillation detectors.

Inorganic scintillators: Thallium activated sodium iodide-NaI(Tl) scientillator. Photo and electron multipliers: Photomultiplier tubes, Channel electron multipliers and micro channel plates.

REFERENCES:

1. Nuclear Radiation Detector by S S Kapoor and V S Ramamurthy(New Age Int.).
2. Techniques for Nuclear and Particle Physics Experiments by W R Leo (Springer-Verlag)
3. Nuclear Radiation Detection, Measurements and Analysis by K Muraleedhara Varier (Narosa)

M.Sc. Physics
Semester-IV
Condensed Matter Physics Lab-II

Paper No.-621 B	**Credits: 06**
12 Hrs /week	**Max. Marks: 100+50**
Total: 180 Hrs.	**Duration of Exam: 03 Hrs.**

Note: Students will be required to perform at least eight experiments in a semester.

1. Measurement of lattice parameter and indexing of powder photograph.
2. Identification of unknown sample using powder diffraction method.
3. To study the ferroelectric transitions in TGS crystal and measurement of Curie temperature.
4. To measure the superconductivity transition temperature and transition width of a high temperature superconductor.
5. Rotation/oscillation photograph and their interpretation.
6. To study the modulus of rigidity and internal friction in a metal as a functioning temperature.
7. To measure the cleavage step height of a crystal by multiple Fizaeu Fringes.
8. To determine magneto resistance of a Bismuth crystal as a function of magnetic field.
9. To find the 'g' factor of DPPH using electron spin resonance .
10. Determination of carrier concentration by optical method
11. To study electric properties of thin films of metals & oxides.
12. Band gap measurement of oxide film using UV spectroscopy.
13. To measure the superconductivity transition temperature and transition width of a high temperature superconductor.

M.Sc. Physics
Semester-III
Electronics Laboratory-I

Paper No.-PHY- 623B | **Credits: 06**
12 Hrs /week | **Max. Marks: 100+50**
Total: 180 Hrs. | **Duration of Exam: 03 Hrs.**

LIST OF EXPERIMENTS

Note: Students are expected to perform at least ten experiments out of following list.

1. To study a 650nm fiber optic link for both analog signal and digital signal and also to observe the relationship between the input and received signal.
2. To obtain the intensity modulation of given sinusoidal optical fiber signal.
3. To obtain the intensity modulation of given digital optical fiber signal.
4. To measure numerical aperature, propogation loss, bending loss and connector loss in optical fibre.
5. Study of the low pass, high pass and band pass filters using the passive elements and active elements.
6. (i) To study the power dissipation in the SSB and DSB side bands of AM wave. To Study the demodulation of AM wave. (ii) To study various aspects of frequency modulation and demodulation.
7. Design of Regulated power supply and study of its characteristics.
8. To study various displays and drivers on a bread-board – Assembling circuits on breadboard.
9. To study the effect of noise on various analog system, calculate signal to noise ratio, noise figure, noise power and noise power spectral density.
10. Microwave characteristics and measurements.
11. Nonlinear applications of Op amplifier.
12. To study the characteristic, propogation modes, wavelength and phase velocity in a wave guide.
13. PLL characteristics and its applications.
14. PAM, PWM and PPM Modulation and demodulation.

M.Sc. Physics
Semester-III
NUCLEAR PHYSICS LAB-I

Paper No.-PHY- 625 B — **Credits: 06**
12Hrs /week — **Max. Marks: 100+50**
Total: 180 Hrs. — **Duration of Exam: 03 Hrs.**

Note: Note: Students are expected to perform all these experiments.

1. To verify the inverse square law using gamma rays.
2. To estimate the efficiency of GM detector for (a) gamma source (b) beta source
3. To find the Linear & mass attenuation coefficient using gamma source.
4. To study the Solid State Nuclear Track Detector.
5. To determine the mass absorption coefficient for beta rays.
6. To study the counting statistics for radioactive decay using SSNTD.
7. To determine the operating voltage of a photomultiplier tube.
8. To find the photopeak efficiency of a Nal(Tl) crystal of a given dimensions for gamma rays of different energies.

M.Sc. Physics
Semester-IV
Electronics Laboratory-II

Paper No.-626B **Credits: 06**
06 Hrs /week **Max. Marks: 100+50**
Total: 90 Hrs. **Duration of Exam: 03 Hrs.**

Note: Students are expected to perform at least ten experiments out of following list.

1. To study the magnetostriction property of the magnetic material.
2. To study the Electrical properties of the developed materials as a function of doping material.
3. To Study the variation of electrical/dielectric properties of different materials as a function of temperature.
4. To study the piezo-electric effect in materials.
5. To determine Hall Voltage, concentration of charge carrier and the type of semiconductor in the Hall effect experiment.
6. Design of a waveform generator using Comparator IC and study its characteristics.
7. D/A converter interfacing and frequency/temperature measurement with microprocessor 8085 / 8086
8. A/D converter interfacing and AC/DC voltage/current measurement using microprocessor 8085/8086.
9. PPI 8251 interfacing with microprocessor for serial communication.
10. To setup logic conditions for the input and the output at the data bus port of BBC microcomputer.
11. To calibrate ADC of the BBC microcomputer.
12. Microprocessor kit: (a) hardware familiarization (b) programming for (i) addition and subtraction of numbers using direct and indirect addressing modes (ii) Handling of 16 bit numbers (iii) use of CALL and RETURN instructions and block data handling.
13. (a) Selection of port for I & O and generation of different waveforms (b) control of stepper motor.
14. Microcontroller kit: hardware familiarization of C and universal programmer and programming for four digit seven segment multiplexed upcounter upto 9999.
15. (a) EEPROM based 8 to 3 encoder using microcontroller (b) interfacing with ADC (temperature sensor) and DAC (variable voltage source).

M.Sc. Physics
Semester-IV

STATISTICAL MECHANICS

Paper No.-PHY-602 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT - I

STATISTICAL BASIS OF THERMODYNAMICS

The microscopic and macroscopic states, Concept of equal a priori probability, contact between statistics and thermodynamics, classical ideal gas, Entropy of Mixing, Gibbs paradox and its solution, Phase space and Liouville's theorem, Ensemble and Ensemble average.

UNIT - II

ENSEMBLE THEORY

The microcanonical ensemble theory and its application to ideal gas of monatomic particles; canonical ensemble and its thermodynamics, partition function; classical ideal gas in canonical ensemble theory, energy fluctuations; equipartition and Virial theorems, a system of quantum harmonic oscillators as canonical ensemble; Statistics of paramagnetism; The grand canonical ensemble and significance of statistical quantities, classical ideal gas in grand canonical ensemble theory; density and energy fluctuations.

UNIT - III

QUANTUM STATISTICS OF IDEAL SYSTEMS

Quantum states and phase space; an ideal gas in quantum mechanical ensembles, Ideal Bose system, basic concepts and thermodynamic behaviour of an ideal Bose gas; Bose-Einstein condensation; gas of photons (the radiation fields) and gas of phonons (the Debye field); Ideal Fermi systems: thermodynamic behaviour of an ideal Fermi gas, discussion of heat capacity of a free-electron gas at low temperatures; Pauli parameters, Boltzmann H-Theorem.

UNIT - IV

ELEMENTS OF PHASE TRANSITIONS & FLUCATIONS

Introduction, a dynamical model of phase transitions, Critical indices, Ising model, Thermodynamic fluctuations, random walk and Brownian motion, introduction to non-equilibrium processes, diffusion equation.

REFERENCES:

1. Statistical Mechanics (2nd edition): R.K. Patharia (Butterworth-Heinemann, Oxford).
2. Statistical Mechanics: K. Huang (Wiley Eastern, New Delhi).
3. Statistical Mechanics: B.K. Agarwal and M. Eisner (Wiley Eastern, New Delhi).
4. Elementary Statistical Physics: C. Kittel (Wiley, New York).
5. Statistical Mechanics: S.K. Sinha (Tata McGraw Hill, New Delhi).
6. A textbook of Statistical Mechanics by Suresh Chandra, CBS Publishers, New Delhi.

M.Sc. Physics
Semester-IV

ADVANCE QUANTUM MECHANICS & ELEMENTS OF PARTICLE PHYSICS

Paper No.-PHY-604 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT -I

Dirac matrices, Dirac equation, Charge and current densities of Dirac equation. Significance of negative energy solutions, Spin angular momentum of the Dirac particle. Non-relativistic limit of Dirac equation, Electron in electromagnetic field. Spin magnetic moment, Spin orbit interaction.

UNIT -II

Lagrangian field theory, Canonical Quantization, Classical field equation in terms of Lagrangian density and Hamiltonian formalism of a classical field, Quantization of field, Concept of second quantization and illustration with schrodinger field(Non-Relativistic field).

UNIT -III

Relativistic fields: Klein-Gorden field(Scalar field), Dirac(spinor) field and electromagnetic field. S-matrix, Feynman rules, Feynman diagrams for scattering of an electron by a potential, scattering of a photon by an electron, , electron-electron scattering, electron-proton scattering, positron-positron scattering, pair creation, pair annihilation, Compton scattering by electrons.

UNIT -IV

Units in high energy physics. Classification of elementary particles, Leptons, Hadrons and their antiparticles. Quarks model of the proton, antiproton, neutron and antineutron. Elementary particles quantum numbers. Types of fundamental interaction between elementary particles: electromagnetic, weak, strong and gravitational. Parity, Pion parity, Charge conjugation, positronium decay. C,P and T invariance and CPT theorem(statement only).

REFERENCES:

1. Quantum Mechanics by V.K. Thankappan (New Age Int.)

2. Advanced quantum mechanics by J. J. Sakurai (Pearson).

4. A text Book of Quantum Mechanics by P.M. Mathews and K Venkatesan (TMH).

5. Introduction to High energy Physics by D H Perkins (Cambridge university press).

6. Introduction to particle physics by M.P. Khanna (PHI).

M.Sc. Physics

Semester-IV

RENEWABLE ENERGY SOURCES

Paper No.-PHY-606 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

SOLAR ENERGY: FUNDAMENTAL AND MATERIAL ASPECTS

Fundamentals of photovoltaic Energy Conversion Physics and Material Properties, Basic to Photovoltaic Energy Conversion: Optical properties of Solids. Direct and indirect transition semiconductors, interrelationship between absorption coefficients and band gap recombination of carriers.

UNIT-II

SOLAR ENERGY: DIFFERENT TYPES OF SOLAR CELLS

Types of Solar Cells, p-n junction solar cell, Transport Equation, Current Density, Open circuit voltage and short circuit current, Brief description of single crystal silicon and organic and Polymer Solar Cells, Elementary Ideas of Advanced Solar Cells e.g. Tandem Solar cells, Solid Liquid Junction Solar Cells, Nature of Semiconductor, Principles of Photo-electrochemical Solar Cells.

UNIT-III

HYDROGEN ENERGY: FUNDAMENTALS, PRODUCTION AND STORAGE

Relevance in relation to depletion of fossil fuels and environmental considerations. Solar Hydrogen through Photo electrolysis, Physics of material characteristics for production of Solar Hydrogen. Brief discussion of various storage processes, special features of solid hydrogen storage materials, Structural and electronic characteristics of storage materials. New Storage Modes.

UNIT-IV

HYDROGEN ENERGY: SAFETY AND UTILIZATION

Various factors relevant to safety, use of Hydrogen as Fuel, Use in Vehicular transport, Hydrogen for Electricity Generation, Fuel Cells, Various types of Fuel Cells, Applications of Fuel Cell, Elementary concepts of other Hydrogen- Based devices such as Hydride Batteries.

REFERENCE BOOKS:

1. Solar Cell Devices- Physics: Fonash
2. Fundamentals of Solar Cells Photovoltaic Solar Energy: Fahrenbruch & Bube
3. Phoptoelectrochemical Solar Cells: S.Chandra
4. Hydrogen as an Energy Carrier Technologies Systems Economy: Winter & Nitch (Eds.)
5. Hydrogen as a Future Energy Carrier: Andreas Zuttel, Andreas Borgschulte and Louis Schlapbach

M.Sc. Physics

Semester-IV

NANO SCIENCE & TECHNOLOGY

Paper No.-PHY-608 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**

Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

Unit-I

Physics of Nanomaterials

Definition of nanotechnology, Nanomaterials, Novel combination of properties of materials of nanoscale, Device miniaturization, Functional enhancement.

Nanoparticles as superatoms, Size dependence of melting point, vapour pressure, Nucleation, Chemical reactivity, Intermolecular interactions, Surface tension of solid surfaces, Wetting dewetting of rough and chemically inhomogeneous surfaces.

Quantum confinement & energy levels,Band structure, Density of states in 0D, 1D, 2D & 3D materials, Quantum dots, wires, & wells, Parabolic, triangular, cylindrical & spherical wells, Quantum corral, Band gap engineering, Heterostructures & superlattices, 2D electron gas, Effective mass in heterostructures.

Unit-II

Nanofabrication Techniques

Nanoparticles- comminution & dispersion, Nucleation & growth, Ultrathin coatings, Molecular beam epitaxy Atomic layer deposition, Self assembly of monolayers, Langmuir Blodgett films, Thermodynamics of self organization, Crystallization and supermolecular interactions.

Top down and bottom up approaches to nanofabrication, Optical & electron beam lithography, Dip pen lithography, Focussed ion beam technique, Thin films deposition, Evaporation, Sputtering, Electrodeposition and sol Gel Tech, Plasma assisted chemical vapour deposition.

Unit-III

Characterization of Nanomaterials

Contact & Non contact methods of surface characterization, AFM, STM and Near field microscopy, Ellipsometry, Surface plasma resonance techniques, Electron spectroscopy techniques – AES, XPS, SIMS

Unit-IV

Nanomatetials & Devices

Carbon based nanomaterials, carbon nanotubes, Fullerens, Graphene, Metal matrix composites, Polymers- electroactive material blends, Semiconductor Nanoparticles, Nanowires, Nanoribbon and nanospring..

Issues of miniaturization, Digital information processing, Quantum computing, Ballistic transport, Coulomb blockade, Single electron devices, Molecular electronic devices, Coupled quantum dots, Spintronics, Ultra-sensitive magnetic sensors, Spin dependent transistors, Photonic devices, Mechanical and Fluidic devices, Chemical and bio-chemical sensors, energy conversion devices.

List of Books on Nanotechnology

1. The Physics of Low Dimensional Semiconductors—John H. Davies – Cambridge University Press

2. Nanotechnology- An Introduction – J.J. Ramsden – William Andrew Elsevier

3. Nano-optoelectronics Sensors & Devices – Ning Xi & King w. Chiu Lai - William Andrew Elsevier

4. Quantum Heterostructures- Microelectronics & Optoelectronics – V.V. Mitin, V.A. Kochetp & M.A. Stroscio – Cambridge University Press

5. Nanostructures & Nanomaterials – Synthesis, Properties & Applications – G. Cao – Imperial College Press

6. Introduction to Nanotechnology – C.P.Poole Jr. & F.J. Owens - John Wiley & Sons

7. Nanotechnology – M. Wilson, K. Kannangara, G. Smith, M. Simmons & B. Raguse – Overseas Press

M.Sc. Physics
Semester-IV

NOVEL AND SMART MATERIALS

Paper No.-PHY-610 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT -I
PHYSICAL MECHANISM IN ELECTRONIC MATERIALS

Crystal Structures of Electronic materials (Elemental, III-IV and VI semiconductors), Energy band consideration in solids in relation to semiconductors, Direct and Indirect bands in Semiconductor, Electron/Hole concentration and Fermi energy in Intrinsic/Extrinsic semiconductor, continuity equation, Carrier mobility in Semiconductors, Carrier Trapping and recombination/generation in semiconductors, Shockley theory of recombination, Switching in electronic devices, Defect related electronics states characterization by C-V characteristics of electronic junction devices, temperature stimulated current and capacitance (TSC/TSCAP), Deep level transient spectroscopy (DTLS), Electron Beam Induced Current (EBIC) and Light Beam Induced Current (LBIC).

UNIT -II
INTEGRATED CIRCUIT FABRICATION

Introduction to IC technology, Basic monolithic integrated circuit epitaxial growth, diffusion of impurities, masking and etching, Fabrication of monolithic IC's, Active and Passive components, advantages of IC's, MSI, LSI , Application of IC, Optical & Photon Lithography and Clean Room Specification.

UNIT -III

SUPERIONIC CONDUCTORS

Introduction, Types of ionic solids, Superionic materials, Classification of superionic materials, Alkali metal ion conductors, silver ion conductors,. Copper ion conductors, proton conductors, B-alumina composite electrolytes, ion conducting glasses and polymers. Basic concepts: jump mechanisms, ionic conductivity and diffusion coefficient. Defect concentration in pure crystals and doped crystals, impurity – vacancy association, Application of superionic conductors on solid state batteries, fuel cells, electrochromic display devices and gas sensors.

UNIT -IV

ENGINEERING MAGNETIC MATERIALS

Hard and soft Magnetic materials, ferrites, Rare earth compounds and bonded magnets. Materials for antenna, inductor and transformer cores. Magnetic recording fundamentals. Particulate and thin film recording media. Recording heads: ferrite heads, metal – in gap heads, thin film heads and magnetoresistive heads. Fundamentals opto magneto – opto recording. Magneto – optic recording media and heads. Introduction to magnetic bubbles.

TEXT AND REFERENCES BOOKS:

1. Physics of Semiconductor Devices : S.M. Sze
2. Semiconductor Devices Basic Principles : Jaspreet Singh
3. Metal/Semiconductor Schottky Barrier Junction and their Applications : B.L. Sharma.
4. Metal/Semiconductor Contact : Rhoderick
5. Superionic Solids, Principles and Application – S. Chandra, North Holland, 1981.
6. Encyclopaedia of Applied Physics G.L. Trig Vol. 9, G.L. Trigg, V.CH Publishers, 1994.
7. Materials science and technology – A comprehensive treatment – Vol. 3A & 3B, R.W. Cahn, P. Hassen and E.J. Kraurer, VCH Publishers, Germany, 1992.
8. Linear Integrated Circuits : D. Roy Choudhury and Shail B. Jain, New Age Int. Pub..

M.Sc. Physics
Semester-IV
MICROPROCESSOR AND INTERFACING

Paper No.-PHY-612 B — **Credits: 04**
04 Hrs /week — **Max. Marks: 100+50**
Total: 60 Hrs. — **Duration of Exam: 03 Hrs.**

Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT -I

MICROPROCESSOR 8085

Introduction, Buffer registers, Bus oraganised computers, SAP-I, Microprocessor (µP) 8085 Architecture, memory interfacing, interfacing I/O devices. Assembly language programming : Instruction classification, addressing modes, op code and operand, fetch and excute cycle, timing diagram, machine cycle, instruction cycle and T states, Data transfer, Logic and Branch operations- Programming examples.

UNIT -II

MICROPROCESSOR 8086

Architecture, Pin description for minimum and maximium modes, Internal operation, Instruction execution timing diagram, Addressing modes, Instruction format for constructing machine, language codes for different instructions. Introductionn to assembly language, Instruction set and directives, Stacks, Procedures, Macros and interrupts. Flow chart of standard programming structures, I/O interfacing and data transfer scheme.

UNIT -III

ADVANCED MICROPROCESSOR

Multitasking, Architecture and memory management of microprocessor 80286, Brief idea about architecture of microprocessor 80386, 80486 and Pentium, Introduction to microcontroller.

UNIT -IV

MICROPROCESSOR BASED MEASUREMENT/CONTROL CIRCUITS

Transducer, D/A and A/D Converters, PPI 8255 Data Acquisition and storage, Microprocessor based traffic light controller, Temperature and water level indicator/controller. DC and steper motor speed measurements, Waveform generation and frequency measurement.

TEXT & REFERENCE BOOKS:

1. Fundamentals of Microprocessor and Microcomputer : B. Ram.
2. Microprocessor System the 8086/8088 Family : Liu and Gibson.
3. Microprocessor Architecture Programming and Application : R.S. Goanker.
4. Introduction to microprocessor : A.P. Mathur.
5. Microprocessor and Interfacing : D.V. Hall.

M.Sc. Physics
Semester-IV

NUCLEAR MODELS

Paper No.-PHY-614 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

Semi-empirical mass formula, Potential energy, Kinetic energy, Coulomb energy, Pairing energy, Shell effect. Nuclear fission, Spontaneous nuclear fission, Bohr and Wheeler theory of nuclear fission. Quantum treatment of nuclear fission or Barrier Penetration for fission. Statistical model of nuclear fission. Concept of photofission.

UNIT-II

Evidence for nuclear shell structure, Concept of magic numbers, Properties of magic nucleus, Three-dimensional central Schrodinger equation, The square-well potential: the energy eigen value problem for bound sates, The harmonic oscillator potential.

UNIT-III

Need of introducing spin-orbit coupling to reproduce the magic numbers, Extreme single particle shell model and its predictions regarding ground state spin parity, magnetic moment and electric quadrupole moments, Schmidt lines, Nordheim's rule for total angular momenta, Single particle model, Configuration mixing. Individual (independent) particle model.

UNIT-IV

Qualitative feature of collective model, Rotational mode, Rotaional energy spectra and the nuclear wave function for even-even and odd-A nuclei. Vibrational mode, Potential energy and total Hamiltonian in vibration mode.

REFERENCES:

1. Theory of Nuclear Structure by M. K. Pal
2. Nuclear Physics: Theory and Experiment by R R Roy and B P Nigam (New Age Int.)
3. Nuclear Physics Experimental and Theoretical by H S Hans (New Age Int.).
4. Basic ideas and concepts in Nuclear Physics by K Heyde (Second Edition Overseas Press)
5. Nuclear Structure Vol. 1& 2 by Aage Bohr and Ben R Mottelson (world Scientific)
6. Concepts of Modern Physics by Arthur Beiser (TMH).

M.Sc. Physics
Semester-IV

NUCLEAR TECHNIQUES

Paper No.-PHY-616 B **Credits: 04**
04 Hrs /week **Max. Marks: 100+50**
Total: 60 Hrs. **Duration of Exam: 03 Hrs.**
Note: The Question Paper for end semester examination will consists of two questions from each unit. The candidates will attempt five questions selecting at least one question from each unit. All questions will carry equal marks.

UNIT-I

Radiofrequency Accelerators : Linear accelerators - Resonance acceleration and phase stability, electron and proton Linacs. Circular accelerators- Cyclotron, Frequency Modulated Synchrocyclotron, AVF Cyclotron, Alternating-gradient accelerators.

UNIT-II

Electrostatic and Heavy Ion Accelerators : Van de Graaff voltage generator, Cockcroft-Walton voltage generator, insulating column, voltage measurement, Acceleration of heavy ions, Tandem electrostatic accelerator, Production of heavy negative ions, Pelletron and Tandetron, Cluster beams, Superconducting Heavy Ion Linear Accelerators.

UNIT-III

Time of flight technique (TOF), Recoil distance measurement and concept of pulse shape discrimination. Data acquisition system(DAS),

Importance of coincidence techniques, Bothe type (series type) coincidence circuit, Rossi type (parallel type) coincidence circuit, Application of coincidence circuits: Slow-fast coincidence set up, Sum coincidence unit, Anti Compton gamma ray spectroscopy, Time to pulse height convertors(TPHC) or time to amplitude convertors(TAC), Concept of time delays in timing channel. Basic idea of determination of half lives of nuclei.

UNIT-IV

Radiation applications and Protection: Dosimetric Units: The Roentgen, Absorbed dose, Relative Biological effectiveness (RBE), Equivalent dose, Effective Dose, Typical doses from sources (Natural, Environmental & Medical exposures), Radiation shielding and its safety (Gamma-rays, electrons, positrons, charged particles, Neutrons)
Radioistopes, Practical uses of radioisotopes, Radioactive waste disposal applications of radioisotopes dating of archeological and other ancient object, Medical uses of radioisotopes and electron beams, radiotherapy, Carbon-14 and potassium-argon dating 39,40 method trace element studies.

REFERENCES:

1. Nuclear Radiation Detector by S S Kapoor and V S Ramamurthy (New Age Int.).
2. Techniques for Nuclear and Particle Physics Experiments by W R Leo (Springer-Verlag)
3. Nuclear Radiation Detection, Measurements and Analysis by K Muraleedhara Varier (Narosa)
4. Particle Accelerator Physics, Vol I and II, H.J. Wiedman, Springer Verlag (1998)
5. Particle Accelerators, M.S. Livingston and J.P. Blewel, McGraw-Hill Book Press.
6. Nuclear Spectroscopy and Reactions Part-A, Ed. J. Cerny, Academic Press, 1974.
7. Theory of Resonance Linear Accelerators by I.M. Kapchenkey, Harwood, Academic Publishers.

M.Sc. Physics
Semester-IV
Condensed Matter Physics Lab-II

Paper No.-622 B | **Credits: 04**
8 Hrs /week | **Max. Marks: 100+50**
Total: 180 Hrs. | **Duration of Exam: 03 Hrs.**

Note: Students will be required to perform at least seven experiments in a semester.

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1. Study of hysteresis loop of ferroelectric ceramics at different temperature & determination of phase transition.
2. Synthesis of nano-ferrites by chemical co-precipitation method.
3. Synthesis of oxide nano-particles and band gap determination.
4. Study of crystalline properties of materials using XRD
5. Thermo luminescence
6. Study of a sample using FTIR technique
7. Intensity measurement using UV Spectrum study
8. To determine the lattice constant of LIF crystal using X ray diffraction
9. Study of magneto resistance effect in metallic , semiconductor and amorphous sample
10. Study of Dielectric constant & curie temperature of ferroelectric ceramics.
11. Study of Thermo luminescence of F centres in all alkali Halides crystals/glasses.

M.Sc. Physics
Semester-IV
Electronics Laboratory-II

Paper No.-624 B **Credits: 04**
08 Hrs /week **Max. Marks: 100+50**
Total: 90 Hrs. **Duration of Exam: 03 Hrs.**

LIST OF EXPERIMENTS

Note: Students will be required to perform at least eight experiments in a semester.

1.To study the magnetostriction property of the magnetic material.
2.To study the Electrical properties of the developed materials as a function of doping material.
3. To Study the variation of electrical/dielectric properties of different materials as a function of temperature.
5. To study the piezo-electric effect in materials.
5.To determine Hall Voltage, concentration of charge carrier and the type of semiconductor in the Hall effect experiment.
6. Design of a waveform generator using Comparator IC and study its characteristics.
7. D/A converter interfacing and frequency/temperature measurement with microprocessor 8085 / 8086
8. A/D converter interfacing and AC/DC voltage/current measurement using microprocessor 8085/8086.
9. PPI 8251 interfacing with microprocessor for serial communication.
10. To setup logic conditions for the input and the output at the data bus port of BBC microcomputer.
11. To calibrate ADC of the BBC microcomputer.

12. Microprocessor kit: (a) hardware familiarization (b) programming for (i) addition and subtraction of numbers using direct and indirect addressing modes (ii) Handling of 16 bit numbers (iii) use of CALL and RETURN instructions and block data handling.
13. (a) Selection of port for I & O and generation of different waveforms (b) control of stepper motor.
14. Microcontroller kit: hardware familiarization of C and universal programmer and programming for four digit seven segment multiplexed upcounter upto 9999.
15. (a) EEPROM based 8 to 3 encoder using microcontroller (b) interfacing with ADC (temperature sensor) and DAC (variable voltage source).

M.Sc. Physics
Semester-IV
NUCLEAR Physics Lab-II

Paper No.-PHY-626 B **Credits: 04**
08Hrs /week **Max. Marks: 100+50**
Total: 120 Hrs. **Duration of Exam: 03 Hrs.**

Note: Students are expected to perform all these experiments.

1. To determine the range and energy of alpha particles using spark counter
2. To study Compton Scattering.
3. To study the Rutherford scattering.
4. To study Poisson and Gaussian distributions using a GM Counter.
5. To calibrate a gamma ray spectrometer and to determine the energy of a given gamma ray source.
6. To determine the beta ray spectrum of beta source (like Cs-137) and to calculate the binding energy of K-shell electron of given source.
7. To study the various modes in a multichannel analyser and to calculate the energy resolution, energy of gamma ray.

Item No. :2 To consider and approve changes in the topic of Ph. D. candidates admitted in the Department of Physics during the session 2009-10.

Note :

During the comprehensive evaluation, the DRC in Physics considered and approved the minor changes in the topic of research of the candidates listed below. The PGBOS & Research in Physics in its meeting held on 28.4.12 approved the decision of DRC.

Sr.No.	Name	Existing Topic	Revised Topic	Name of supervisor/Co-supervisor
1.	Neetu Singh	A Study of physical technique, lithography used for fabrication and detection of nanostructure.	Modeling & simulation of Bio-Nanomaterials using non-equilibirium green function approach	Prof. B.P. Malik/ Dr.V.K.Lamba
2.	Dinesh Kumar	Energy storage in PV system and PV design	Electric and thermal study of metal/CNT nanocomposites	Prof. S.K. Singh/ Dr. Vimal Kumar

The matter is placed before the Academic Council for consideration and approval.

Item No. :3 During the comprehensive evaluation based on the clearance of course work, the report of the PGBOS & Research in Physics is hereby put up before the Academic council for consideration and approval of the candidates for registration in Ph.D. course 2010-11(photocopy of recommendation PGBOS & Research in Physics is attached). The list of successful students for Ph.D registration is as follows:

Name	Roll No.
1. Amarjeet	11001951001
2. Heena Dhanopia	11001951003
3. Naveen Kumari	11001951005
4. Preeti	11001951006

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