FACULTY OF SCIENCES

SYLLABUS

FOR

M. Sc. Physics (For Colleges)

(Semester: I - IV)

Examinations: 2019-20

GURU NANAK DEV UNIVERSITY
AMRITSAR

**(ii) Subject to change in the syllabi at any time.
Please visit the University website time to time.**

M.Sc. (Physics) (For Colleges) (Semester-I)

COURSE-SCHEME

Semester-I

Course No.	***Course Title***	***Teaching Hours /Week***	***Max. Marks***
Phy.401	Electronics	4	100
Phy.402	Mathematical Physics	4	100
Phy.403	Classical Mechanics	4	100
Phy.404	Computational Techniques	4	100
Phy.421	Electronics Lab.	6	100
Phy.422	Computer Lab	6	100
			600

Semester-II

Course No.	***Course Title***	***Teaching Hours /Week***	***Max. Marks***
Phy.451	Quantum Mechanics-I	4	100
Phy.452	Electrodynamics-I	4	100
Phy.454	Atomic And Molecular Spectroscopy	4	100
Phy.455	Condensed Matter Physics-I	4	100
Phy.471	Condensed Matter Physics Lab-I	6	100
Phy.472	Spectroscopy Lab	6	100
			600

M.Sc. (Physics) (For Colleges) (Semester-I)

Semester-III

Course No.	*Course Title*	*Teaching Hours /Week*	*Max. Marks*
Phy.501	Quantum Mechanics-II	4	100
Phy.502	Electrodynamics-II	4	100
Phy.503	Condensed Matter Physics-I	4	100
Phy.504	Nuclear Physics	4	100
Phy.521	Condensed Matter Physics Lab	6	100
Phy.522	Nuclear Physics Lab	6	100
			600

Semester-IV

Course No.	*Course Title*	*Teaching Hours /Week*	*Max. Marks*
Phy.551	Particle Physics	4	100
Phy.552	Condensed Matter Physics-II	4	100
Phy.553	Assignment/Project	4	50

And any **TWO** of the following papers subject to the availability of teacher:

Phy.554	Physics of Materials	4	100
Phy.562	Radiation Physics	4	100
Phy.563	Reactor Physics	4	100
Phy.564	Plasma Physics	4	100
Phy.565	Geophysics	4	100
Phy.566	Nano Technology	4	100
Phy.568	Advanced Electronics	4	100
			450

*The student will have to prepare an assignment/Project and will deliver a Seminar on an advanced research topic of current scientific interest.

M.Sc. (Physics) (For Colleges) (Semester-I)

ELECTRONICS

Course No. PHY-401 **Course Hrs 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section A

Electronic Devices: MOSFETs, construction and working of U.J.T. and SCR and their application in wave generation and power control, **Multivibrators (astable, monostable and bistable)**

Lectures 15

Section B

Electronic Circuits: Differential amplifier, Operational amplifier (OP-AMP), OP-AMP as inverting and non-inverting, scalar, summer, integrator, differentiator. Schmitt trigger and logarithmic amplifier, Electronic analog computation circuits.

Lectures 15

Section C

Digital Principles: Binary and Hexadecimal number system, Binary arithmetic, Logic gates, Boolean equation of logic circuits, Karnaugh map simplifications for digital circuit analysis, and design, Encoders & Decoders, Multiplexers and Demultiplexers, Parity generators and checkers, Adder-Subractor circuits.

Lectures 15

Section D

Sequential Circuits: Flip Flops, Registers, Up/Down counters, D/A conversion using binary weighted resistor network, Ladder, D/A converter, A/D converter using counter, Successive approximation A/D converter.

Lectures 15

Books:

1. Electronic Devices and Circuits- Millman and Halkias-Tata Mc Graw Hill, 1983.
2. Digital Principles and Applications- A.P.Malvino and D.P.Leach-Tata Mc Graw Hill, New Delhi, 1986.
3. Digital Computer Electronics- A P Malvino-Tata Mc Graw Hill, New Delhi, 1986
4. Electronic Devices and Circuit Theory 10e- Robert L. Boylestad; Louis Nashelsky 2009.

M.Sc. (Physics) (For Colleges) (Semester-I)

MATHEMATICAL PHYSICS

Course No. PHY-402 **Course Hrs: 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section A

Fourier Transformation: Fourier decomposition, Fourier series and convolution theorem. Fourier transformations and its applications to wave theory.

Lectures 8

Coordinate Systems: Curvilinear coordinates, differential vector operators in curvilinear coordinates. Spherical and cylindrical coordinate systems. General coordinate transformation, Tensors: covariant, contravariant and mixed, Algebraic operations on tensors, Illustrative applications.

Lectures 7

Section B

Differential Equations: Second order differential equations. Frobenius method. Wronskian and a second solution, the Sturm Lioville problem. One dimensional Greens function.

Lectures 7

Special functions: Gamma function. The exponential integral and related functions. Bessel functions of the first and second kind. Legendre polynomials, associated Legendre polynomials and spherical harmonics. Generating functions for Bessel, Legendre and associated Legendre polynomials.

Lectures 8

Section C

Complex Analysis: The Cauchy-Reimann conditions, Cauchy integral theorem, Cauchy integral formula. Taylor, and Lorent series, singularities and residues. Cauchy residue theorem. Calculation of real integrals.

Lectures 15

Section D

Group Theory: Definition of a group, multiplication table, conjugate elements and classes of groups, direct product. Isomorphism, homomorphism, permutation group. Definitons of the three dimensional rotation group and SU(2).

Lectures 15

Books:

1. Mathematical Methods for Physicists: George Arfken-New York Academy, 1970.
2. Advanced Mathematical Methods for Engg. and Science Students: George Stephenson and P.M. Radmore-Cambridge Uni Press, 1990.
3. Applied Mathematics for Engineers & Physicists: Pipes and Harvil

M.Sc. (Physics) (For Colleges) (Semester-I)

CLASSICAL MECHANICS

Course No. PHY-403 **Course Hrs: 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section A

Lagrangian Mechanics: Newton's laws of motion, mechanics of a system of particles, constraints, D' Alembert's principle and Lagrange equations of motion. Velocity dependent potentials and dissipation function. Some applications of Lagrangian formulation, Hamiltons principle, derivation of Lagrange equations from Hamilton's principle. Conservation theorems and symmetry properties.

Lectures 15

Section B

Central Force Problem: Two body central force problem, reduction to equivalent one body problem, the equation of motion and first integrals, the equivalent one dimensional problem, and classification of orbits. The differential equation for the orbit and integrable power-law potential. The Kepler problem. Scattering in a central force.

Lectures 15

Section C

Rigid Body Dynamics: The independent coordinates of a rigid body, orthogonal transformation, the Euler's angles. Eulers 's theorem on the motion of rigid body, finite and infinitesimal rotations, rate of change of a vector, angular momentum and kinetic energy about a point for a rigid body, the inertia tensor and moment of inertia, the eigen values of the inertia tensor and the principal axis transformation. Euler's equations of motion, torque free motion of a rigid body.

Lectures 15

Section D

Canonical Transformations: Legendre transformation and Hamilton equations of motion, cyclic coordinates and conservation theorems, derivation of Hamiltons equations from a variational principle, the principle of least action. The equations of canonical transformation, examples of canonical transformations, Poisson brackets. Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation

Lectures 15

Books:

1. Classical Mechanics: Herbert Goldstein-Narosa Pub. House, New Delhi, 1970.
2. Mechanics : L.D. Landau-Pergamon Press, Oxford, 1982.
3. Classical Mechanics Rana and Joag-Tata Mc Graw Hill, New Delhi, 1995.

M.Sc. (Physics) (For Colleges) (Semester-I)

COMPUTATIONAL TECHNIQUES

Course No.: PHY-404 **Course Hrs.: 60**
Time : 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section A

Introduction of MATLAB
Introduction: Basics of MATLAB, working with arrays, creating and printing plots, Interacting Computations: Matrices and Vectors, Matrices and Array Operations, built in functions, saving and loading data, plotting simple graphs Programming in MATLAB: Script files, function files, Compiled files, p-code, variables, loops, branches, and control flow, Input/Output, Advanced data objects, structures, cells

Lectures 15

Section B

Interpolation
Interpolation, Newton's formula for forward and backward interpolation, Divided differences, Symmetry of divided differences, Newton's general interpolation formula, Lagranges interpolation formula

Lectures 15

Section C

Numerical Differentiation and integration
Numerical integration, A general quadrature formula for equidistant ordinates, Simpson, Weddle and Trapezoidal rules, Monte- Carlo Method, Euler's method, Modified Euler's method, Runge-Kutta Method.

Lectures 15

Section D

Roots of Equation
Approximate values of roots, Bisection Method, Regula-Falsi Method, Newton-Raphson method, Bairstow method. Simultaneous Linear Algebraic Equations: Solution of Simultaneous Linear equations, Gauss elimination method, Gauss-Jordon method, Matrix inversion

Lectures 15

Books:
1. Getting started with MATLAB- Rudra Pratap-Oxford University Press-2005.
2. A concise introduction to MATLAB- William J Palm III- McGraw Hill-2008.
3. James Scarborough- Numerical Mathematical Analysis (Oxford and IBH), 1966.
4. S.D.Conte- Elementary Numerical Analysis (McGraw Hill), 1965.
5. John. H. Methews, Numerical Methods for Mathematics, Science and Engineering (Prentice Hall of India).

M.Sc. (Physics) (For Colleges) (Semester-I)

ELECTRONICS LAB.

Course No. PHY-421 **Max. Marks: 100**

1. To Study the D C characteristics and applications of DIAC.
2. To study the D C characteristics and applications of SCR.
3. To study the D C characteristics and applications of TRIAC.
4. Investigation of the D C characteristics and applications of UJT.
5. Investigation of the D C characteristics of MOSFET.
6. Study of bi-stable, mono-stable and astable, multivibrators.
7. Study of Op-Amps and their applications such as an amplifier (inverting, non-inverting), scalar, summer, differentiator and integrator.
8. Study of logic gates using discrete elements and universal gates.
9. Study of encoder, decoder circuit.
10. Study of arithmetic logic unit (ALU) circuit.
11. Study of shift registers.
12. Study of half and full adder circuits.
13. Study of A/D and D/A circuits.

M.Sc. (Physics) (For Colleges) (Semester-I)

COMPUTER LAB

Course No. PHY- 422 **Max. Marks: 100**

Perform the following problems using any of two softwares : Fortran/Matlab/Python

1. Determination of Roots

a) Bisection Method

b) Newton Raphson Method

c) Secant Method

2. Integration

a) Trapezoidal rule

b) Simpson 1/3 and Simpson 3/8 rules

c) Gaussian Quadrature

3. Differential Equations

a) Euler's Method

b) Runge Kutta Method

4. Interpolation

a) Forward interpolation, Backward interpolation.

b) Lagrange's interpolation.

5. Applications

a) Chaotic Dynamics, logistic map

b) One dimensional Schrondinger Equation

c) Time period calculation for a potential

d) Luminous intensity of a perfectly black body vs. temperature

M.Sc. (Physics) (For Colleges) (Semester-II)

QUANTUM MECHANICS - I

Course No. PHY-451 **Course Hrs. 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section A

Basic Formulation and quantum Kinematics: Stern Gerlach experiment as a tool to introduce quantum ideas, analogy of two level quantum system with polarisation states of light. Complex linear vector spaces, ket space, bra space and inner product, operators and properties of operators. Eigenkets of an observable, eigenkets as base kets, matrix representations. Measurement of observable, compatible vs. incompatible observable, commutators and uncertainty relations. Change of basis and unitary transformations. Diagonalisation of operators. Position, momentum and translation, momentum as a generator of translations, canonical commutation relations.

Lectures 15

Section B

Quantum Dynamics: Wave functions as position representation of ket vectors. Momentum operator in position representation, momentum space wave function.Time evolution operator and Schorodinger equation, special role of the Hamiltonian operator, energy eigen kets, time dependence of expectation values, spin precession. Schrodinger vs. Heisenberg picture, unitary operators, state kets and observable in Schrodinger and Heisenberg pictures, Heisenberg equations of motion, Ehrenfest's theorem.

Lectures 15

Section C

One Dimenstional Systems: Potential Step, potential barrier, potential well. Scattering vs. Bounds states. Simple harmonic oscillator, energy eigen states, wave functions and coherent states.

Lectures 12

Section D

Spherical Symmetric Systems and Angular momentum: Schrodinger equation for a spherically symmetric potential. Orbital angular momentum commutation relations. Eigen value problem for L^2, spherical harmonics. Three dim harmonic oscillator, three dim potential well and the hydrogen atom. Angular momentum algebra, commutation relations. Introduction to the concept of representation of the commutation relations in different dimensions. Eigen vectors and eigen functions of J^2 and J_z. Addition of angular momentum and C.G. coefficients.

Lectures 18

Books:

1. Modern Quantum Mechnics: J.J. Sakurai-Pearson Educaton Pvt. Ltd., New Delhi, 2002.
2. Quantum Mechanics :L I Schiff-Tokyo Mc Graw Hill, 1968.
3. Feynmann lectures in Physics Vol. III-Addison Wesly, 1975.
4. Quantum Mechanics :Powel and Craseman-Narosa Pub. New Delhi, 1961.
5. Quantum Mechanics : Merzbacher-John Wiley & Sons, New York, 1970.

M.Sc. (Physics) (For Colleges) (Semester-II)

ELECTRODYNAMICS-I

Course No: PHY-452 **Course Hrs: 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section A

Electrostatics: Coulomb's law, Guass's law, Poisson's equation, Laplace equation. Solution of boundary value problem: Green's function, method of images and calculation of Green's function for the image charge problem in the case of a sphere, Laplace equation, uniqueness theorem. Electrostatics of dielectric media, multipole expansion. Boundary value problems in dielectrics; molecular polarisability, electrostatic energy in dielectric media.

Lectures 15

Section B

Magnetostatics: Biot and Savart's law. The differential equation of Magnetostatics and Ampere's law, vector potential and magnetic fields of a localised current distribution. Magnetic moment, force and torque on a magnetic dipole in an external field. Megnetic materials, Magnetisation and microscopic equations.

Lectures 15

Section C

Time-varying fields: Time varying fields, Maxwell's equations, conservation laws: Faraday's law of induction, Energy in a magnetic field. Maxwell's displacement current, vector and scalar potential, Gauge transformations; Lorentz gauge and Coulomb gauge. Poynting theorem, conservation laws for a system of charged particles and electromagnetic field, continuity equation.

Lectures 15

Section D

Electromagnetic Waves: Plane wave like solutions of the Maxwell equations. Polarisation, linear and circular polarisation. Superposition of waves in one dimension. Group velocity. Illustration of propagation of a pulse in dispersive medium. Reflection and refraction of electromagnetic waves at a plane surface between dielectrics. Polarisation by reflection and total internal reflection. Waves in conductive medium, Simple model for conductivity.

Lectures 15

Books:

1. Classical Electrodynamics - J.D. Jackson-John & Wiley Sons Pvt. Ltd. New York, 2004.
2. Introduction to Electrodynamics - D.J. Griffiths-Pearson Education Ltd., New Delhi, 1991.
3. Classical Electromagnetic Radiation - J.B. Marion-Academic Press, New Delhi, 1995.

M.Sc. (Physics) (For Colleges) (Semester-II)

ATOMIC AND MOLECULAR SPECTROSCOPY

Course No. PHY-454 **Course Hrs.60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section A

Spectra of one and two valance electron systems: Magnetic dipole moments; Larmor's theorem; Space quantization of orbital, spin and total angular momenta; Vector model for one and two valance electron atoms; Spin-orbit interaction and fine structure of hydrogen, Lamb shift, Spectroscopic terminology; Spectroscopic notations for L-S and J-J couplings; Spectra of alkali and alkaline earth metals; Interaction energy in L-S and J-J coupling for two electron systems; Selection and Intensity rules for doublets and triplets

Lectures 15

Section B

Breadth of spectral line and effects of external fields: The Doppler effect; Natural breadth from classical theory; natural breadth and quantum mechanics; External effects like collision damping, asymmetry and pressure shift and stark broadening; The Zeeman Effect for two electron systems; Intensity rules for the Zeeman effect; The calculations of Zeeman patterns; Paschen-Back effect; LS coupling and Paschen –Back effect; Lande's factor in LS coupling; Stark effect

Lectures 15

Section C

Microwave and Infra-Red Spectroscopy: Types of molecules, Rotational spectra of diatomic molecules as a rigid and non-rigid rotator, Intensity of rotational lines, Effect of isotopic substitution, Microwave spectrum of polyatomic molecules, The vibrating diatomic molecule as a simple harmonic and anharmonic osci llator, Diatomic vibrating rotator, The vibration-rotation spectrum of carbon monoxide, The interaction of rotation and vibrations, Outline of technique and instrumentation, Fourier transform spectroscopy.

Lectures 15

Section D

Raman and Electronic Spectroscopy: Quantum and classical theories of Raman Effect, Pure rotational Raman spectra for linear and polyatomic molecules, Vibrational Raman spectra, Structure determination from Raman and infra-red spectroscopy, Electronic structure of diatomic molecule, Electronic spectra of diatomic molecules, Born Oppenheimer approximation-The Franck-Condon principle, Dissociation and pre-dissociation energy, The Fortrat diagram, example of spectrum of molecular hydrogen.

Lectures 15

Books:

1. Introduction to Atomic Spectra: H.E. White-Auckland Mc Graw Hill, 1934
2. Fundamentals of Molecular spectroscopy: C.B. Banwell-Tata Mc Graw Hill, 1986.
3. Spectroscopy Vol. I, II & III: Walker & Straughen
4. Introduction to Molecular Spectroscopy: G.M.Barrow-Tokyo Mc Graw Hill, 1962.
5. Spectra of Diatomic Molecules: Herzberg-New York, 1944.
6. Molecular Spectroscopy: Jeanne L McHale-NewJersy Prentice Hall, 1999.
7. Molecular Spectroscopy: J.M. Brown-Oxford University Press, 1998.
8. Spectra of Atoms and Molecules: P.F. Bermath-New York, Oxford University Press, 1995.

Modern Spectroscopy: J.M. Holias

M.Sc. (Physics) (For Colleges) (Semester-II)

CONDENSED MATTER PHYSICS-I

Course No. PHY-455 **Course Hrs. 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Lattice Specific Heat and Elastic Constants:
Different theories of lattice specific heat of solids, Einstein model of the Lattice Specific heat, Density of modes of vibration, Debye model of Lattice specific heat, Born cut-off procedure, Specific heat of metals. Elastic strain and stress components, Elastic compliance and stiffness constants, Elastic constants of cubic crystals, Elastic waves in cubic crystals.

Lectures 15

SECTION-B

Defects and Diffusion in Solids:
Point defects: Impurities, Vacancies-Schottky and Frankel vacancies, Diffusion, Fick's law, Self diffusion in metals, Color centers and coloration of crystals, F-centres, V-centres, Line defects, Edge and screw dislocations, Burgers vectors, Stress field of dislocations, Grain boundaries, Low angle grain boundaries, dislocation densities, Dislocation multiplication and slips, dislocation and crystal growth. **Lectures 15**

SECTION-C

Conductivity of metals and ionic crystals
Electrical conductivity of metals, Drift velocity and relaxation time, The Boltzmann transport equation, The Sommerfield theory of conductivity, Mean free path in metals, Qualitative discussion of the features of the resistivity, Mathiesson's rule.Thermal conductivity of metals, Wiedemann-Franz law. Hydration energy of ions, Activation energy for formation of defects in ionic crystals, Ionic conductivity in pure alkali halides. **Lectures 15**

SECTION-D

Dielectrics and Ferro Electrics:
Macroscopic field, The local field, Lorentz field, The Claussius-Mossotti relations, Different contribution to polarization: dipolar, electronic and ionic polarizabilities, Ferroelectric crystals: Classifications and their general properties, Structure and properties of BaTiO3, The dipole theory of ferroelectricity, objection against dipole theory, Thermodynamics of ferroelectric transitions.

Books:

1. Solid State Physics: A.J. Dekker-Prentice Hall, 1965.
2. An Introduction to Solid State Physics: C. Kittle-Wiley, 1958
3. Elementary Solid State Physics-Omar, Addison Welly, 1975.
4. Principles of Solid State Physics: R.A. Levey-Academic Press, 1968
5. Introduction of Solid State Physics: Ashroft-Cengage Learning, 1999

Condensed Matter Physics Lab-I

Course No. PHY-471 **Max. Marks: 100**

1. To determine Hall coefficient by Hall Effect.
2. To determine the band gap of a semiconductor using p-n junction diode..
3. To determine the magnetic susceptibility of a material using Quink's method.
4. To determine the g-factor using ESR spectrometer.
5. To determine the energy gap and resistivity of the semiconductor using four probe method.
6. To trace hysteresis loop and calculate retentivity, coercivity and saturation magnetization.
7. To determine dielectric constant.
8. To study the series and parallel characteristics of a photovoltaic cell.
9. To study the spectral characteristics of a photovoltaic cell.

M.Sc. (Physics) (For Colleges) (Semester-II)

SPECTROSCOPY LAB.

Course No. PHY-472 **Max. Marks: 100**

1. To find the wavelength of monochromatic light using Febry Perot interferometer.
2. To find the wavelength of sodium light using Michelson interferometer.
3. To calibrate the constant deviation spectrometer with white light and to find the wavelength of unknown monochromatic light.
4. To find the grating element of the given grating using He-Ne laser light.
5. To find the wavelength of He-Ne laser using Vernier calipers.
6. To verify the existance of Bohr's energy levels with Frank-Hertz experiment.
7. To determine the charge to mass ratio (e/m) of an electron with normal Zeeman Effect
8. To determine the velocity of ultrasonic waves in a liquid using ultrasonic interferometer

M.Sc. (Physics) (For Colleges) (Semester-III)

QUANTUM MECHANICS-II

Course No. PHY-501 **Course Hrs: 60**
Time : 3 Hrs **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Perturbation Theory: First and second order perturbation theory for nondegenerate and degenerate systems. Perturbation of an oscillator and anharmonic oscillator, the variation method. First order time dependent perturbation theory, constant perturbation, Calculation of transition probability per unit time for harmonic perturbation. The Helium atom problem. Stark effect.

Lectures 18

SECTION-B

Scattering Theory: Born approximation, extend to higher orders. Validity of Born approximation for a square well potential. Optical theorem. Partial wave analysis, unitarity and phase shifts. Determination of phase shift, applications to hard sphere scattering. Low energy scattering in case of bound states. Resonance scattering.

Lectures 18

SECTION-C

Relativistic Quantum Mechanics: Klein Gordon equation. Dirac Equation, Lorentz covariance of Dirac equation. Positive and negative energy solutions of Dirac equation, positrons. Properties of gamma matrices. Parity operator and its action on states. Magnetic moments and spin orbit energy.

Lectures 12

SECTION-D

Identical Particles : Brief introduction to identical particles in quantum mechanics (based on Feynmann Vol.III) symmetrisation postulates. Application to 2-electron systems. Pauli exclusion principle. Bose Einstein and Fermi Dirac Statistics.

Lectures 12

Books :

1. Modern Quantum Mechnics: J.J. Sakurai-Pearson Educaton Pvt. Ltd., New Delhi, 2002.
2. Quantum Mechanics: L I Schiff-Tokyo Mc Graw Hill, 1968.
3. Feynmann lectures in Physics Vol. III-Addison Wesly, 1975.
4. Quantum Mechanics: Powel and Craseman-Narosa Pub. New Delhi, 1961.
5. Quantum Mechanics: Merzbacher-John Wiley & Sons, New York, 1970.

M.Sc. (Physics) (For Colleges) (Semester-III)

ELECTRODYNAMICS – II

Course No. PHY-502 **Course Hrs. : 60**
Time: 3 Hrs **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Wave Guides: Field at the surface of and within a conductor. Cylindrical cavities and wave-guides, modes in a rectangular wave guide, energy flow and attenuation in wave guides. Perturbation of boundary conditions, resonant cavities, power loss in cavity and quality factor.

Lectures 18

SECTION-B

Relativistic formulation of electrodynamics: Special theory or relativity, simultaneity, length, contraction, time dilation and Lorenz's transformations. Structure of space-time, four scalars, four vectors and tensors, relativistic mechanics. Relativistic electrodynamics. Magnetism as a relativistic phenomena and field transformations. Recasting Maxwell equations in the language of special relativity, covariance and manifest covariance, field tensor.

Lectures 18

SECTION-C

Radiation Systems: Fields of radiation of localized oscillating sources, electric dipole fields and radiation, magnetic dipole and electric quadrupole fields, central fed antenna, brief introduction to radiation damping and radiation reaction.

Lectures 12

SECTION-D

Fields of moving charges: Lienard Wiechert potential, field of a moving charge. Radiated power from an accelerated charge at low velocities, Larmour's power formula and its relativistic generalisation ; Angular distribution of radiation emitted by an accelerated charge.

Lectures 12

BOOKS :

1. Classical Electrodynamics: J.D. Jackson-Wiley, 1967
2. Electricity and Magnetics: D.J. Griffiths-Prentice hall, 1996
3. Classical Electromagnetic Radiation: J.B. Marian-Academic Press, 1965

M.Sc. (Physics) (For Colleges) (Semester-III)

CONDENSED MATTER PHYSICS-I

Course No. PHY-503 **Course Hrs. 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Lattice Specific Heat and Elastic Constants:
Different theories of lattice specific heat of solids, Einstein model of the Lattice Specific heat, Density of modes of vibration, Debye model of Lattice specific heat, Born cut-off procedure, Specific heat of metals. Elastic strain and stress components, Elastic compliance and stiffness constants, Elastic constants of cubic crystals, Elastic waves in cubic crystals.

Lectures 15

SECTION-B

Defects and Diffusion in Solids:
Point defects: Impurities, Vacancies-Schottky and Frankel vacancies, Diffusion, Fick's law, Self diffusion in metals, Color centers and coloration of crystals, F-centres, V-centres, Line defects, Edge and screw dislocations, Burgers vectors, Stress field of dislocations, Grain boundaries, Low angle grain boundaries, dislocation densities, Dislocation multiplication and slips, dislocation and crystal growth.

Lectures 15

SECTION-C

Conductivity of metals and ionic crystals
Electrical conductivity of metals, Drift velocity and relaxation time, The Boltzmann transport equation, The Sommerfield theory of conductivity, Mean free path in metals, Qualitative discussion of the features of the resistivity, Mathiesson's rule.Thermal conductivity of metals, Wiedemann-Franz law. Hydration energy of ions, Activation energy for formation of defects in ionic crystals, Ionic conductivity in pure alkali halides. **Lectures 15**

SECTION-D

Dielectrics and Ferro Electrics:
Macroscopic field, The local field, Lorentz field, The Claussius-Mossotti relations, Different contribution to polarization: dipolar, electronic and ionic polarizabilities, Ferroelectric crystals: Classifications and their general properties, Structure and properties of BaTiO3, The dipole theory of ferroelectricity, objection against dipole theory, Thermodynamics of ferroelectric transitions.

Books:

1. Solid State Physics: A.J. Dekker-Prentice Hall, 1965.
2. An Introduction to Solid State Physics: C. Kittle-Wiley, 1958
3. Elementary Solid State Physics-Omar, Addison Welly, 1975.
4. Principles of Solid State Physics: R.A. Levey-Academic Press, 1968
5. Introduction of Solid State Physics: Ashroft-Cengage Learning, 1999.

M.Sc. (Physics) (For Colleges) (Semester-III)

NUCLEAR PHYSICS

Course No. PHY-504 **Course Hrs. 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Nuclear Interactions and Nuclear Reactions
Nuclear Forces: Two nuclear system, deutron problem, binding energy, nuclear potential well, pp and pn scattering experiments at low energy, meson theory of nuclear forces, e.g. Bartlett, Heisenberg, Majorans forces and potentials, exchanges forces and tensor forces, effective range theory-spin dependence of nuclear forces-Charge independence and charge symmetry of nuclear forces-Isospin formalisim- Yukawa interaction.

Lectures 15

SECTION-B

Nuclear Models
Liquid drop model, Bohr-Wheeler theory of fission, Experimental evidence for shell effects, Shell Model, Spin-Orbit coupling, Magic-Applications of Shell model like Angular momenta and parities of nuclear ground states, Quantitative discussion and estimates of transition rates-magnetic moments and Schmidt lines, Collective model, Nuclear vibrations spectra and rotational spectra, applications, Nilsson model.

Lectures 15

SECTION-C

Nuclear Decay
Beta decay, Fermi theory of beta decay, shape of the beta spectrum, Total decay rate, Angular momentum and parity selection rules, Comparative half-lives, Allowed and forbidden transitions, selection rules, parity violation, Two component theory of neutrino decay, Detection and properties of neutrino, Gamma decay, Multipole transitions in nuclei, Angular momentum and parity selection rules, Internal conversion, Nuclear isomerism.

Lectures 15

SECTION-D

Nuclear Reactions
Direct and compound nuclear reaction mechanisms, cross sections in terms of partial wave amplitudes, Compound nucleus, scattering matrix, Reciprocity theorem, Breit Winger one level formula, Resonance scattering.

Lectures 15

Books:

1. A. Bohr and B.R. Mottelson: Nuclear Structure, Vol.1(1969) and Vol.2 Benjamin, Reading, A.1975.
2. Kenneth S. Krane: Introductory Nuclear Physics, Wiley, New York, 1988
3. G.N. Ghoshal: Atomic and Nuclear Physics Vol.2, S. Chand and Co., 1997
4. P. H. Perkins, introduction to High Energy Physics, Addison-Wiley, London, 1982.
5. Introduction to Elementary particle physics by D. Grifiths.

M.Sc. (Physics) (For Colleges) (Semester-III)

CONDENSED MATTER PHYSICS LAB

Course No. PHY-521 **Max. Marks: 100**

1. To determine the energy loss in transformer and ferrite cores using B-H curve.
2. To determine Stefan's constant using Boltzmann's Law.
3. To determine temperature coefficient of junction voltage and energy band gap in a p-n junction diode.
4. To study the depletion capacitance and its variation with reverse bias in a p-n junction.
5. Experiments with Microwaves set up.
6. To determine the lattice dynamics and dispersion relation for the monatomic and diatomic lattices.
7. To determine Curie temperature of ferrites.
8. To determine the energy loss in the ferrites at room temperature.
9. Study of Thermoluminescence of f-centres in Alkali Halide Crystals.
10. Study of optical Band gap using UV-Visible spectrophotometer.

M.Sc. (Physics) (For Colleges) (Semester-III)

NUCLEAR PHYSICS LAB

Course No. PHY-522 **Max. Marks: 100**

1. Pulse-Height Analysis of Gamma Ray Spectra.
2. Calibration of Scintillation Spectrometer.
3. Least square fitting of a straight line.
4. Study of absorption of gamma rays in matter.
5. Study of Compton Scattering Effect.
6. To study the characteristics of a G.M. Counter.
7. To determine the Dead time of a G.M. Counter.
8. Absorptions of Beta Particles in Matter.
9. Source strength of a Beta Source.
10. Window thickness of a G.M. Tube.
11. To investigate the statistics of radioactive measurements.
12. Study of Poisson Distribution.
13. Study of Gaussian Distribution.

M.Sc. (Physics) (For Colleges) (Semester-IV)

PARTICLE PHYSICS

Course No. PHY-551 **Course Hrs: 60**
Time: 3 Hrs **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Elementary Particles and Their Properties: Historical survey of elementary particles and their classification, determination of mass, life time, decay mode, spin and parity of muons, pions, kaons and hyperons. Experimental evidence for two types of neutrinos, production and detection of some important resonances and antiparticles.

Lectures 15

SECTION-B

Symmetries and Conservation Laws: Conserved quantities and symmetries, the electric charge, baryon number, leptons and muon number, particles and antiparticles, hypercharge (strangeness), the nucleon isospin, isospin invariance, isospin of particles, parity operation, charge conservation, time reversal invariance, CP violation and CPT theorem, the K^O - K^O doublet unitary symmetry SU(2), SU (3) and the quark model.

Lectures 15

SECTION-C

Week Interaction: Classification of weak interactions, Fermi theory of beta decay, matrix element, classical experimental tests of Fermi theory, Parity non conservation in beta decay, lepton polarization in beta decay, the V-A interaction, parity violation in P-decay. Weak decays of strange-particles and Cabibbo's theory.

Lectures 15

SECTION-D

Gauge theory and GUT: Gauge symmetry, field equations for scalar (spin 0), spinor (spin ½), vector (spin-1) and fields, global gauge invariance, local gauge invariance, Feynmann rules, introduction of neutral currents. Spontaneously broken symmetries in the field theory, standard model.

Lectures 15

Books:

1 Subatomic Physics: H. Fraunfelder and E.M. Henley- N.J. Prentice Hall
2 Introduction to Elementary Particles: D. Griffiths-Wiley-VCH-2008
3 Introduction to High Energy Physics: D.H Perkins-Cambridge University Press, 2000.

M.Sc. (Physics) (For Colleges) (Semester-IV)

CONDENSED MATTER PHYSICS-II

Course No. PHY-552 **Course Hrs. 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Diamagnetism and Paramagnetism

Classification of magnetic materials, Origin of permanent magnetic dipoles, Diamagnetic susceptibility, Langevin diamagnetic equation, Classical theory of paramagnetism, Quantum theory of paramagnetism, Quenching of orbital angular momentum, Cooling by adiabatic demagnetization, Paramagnetic susceptibility of conduction electrons, Determination of susceptibilities of para and diamagnetic materials: Theory, Gouy method and Quincke's method

Lectures 15

SECTION-B

Ferromagnetism, Antiferromagnetism and Ferrimagnetism

Ferromagnetism, Curie point and the exchange integral, Weiss molecular field, the interpretation of the Weiss field, Temperature dependence of spontaneous magnetization, Saturation magnetization at absolute zero, Ferromagnetic domains, Anisotropy energy, Transition region between domains: Bloch wall, Origin of domains, Coercivity and hysteresis, Spin waves, Quantization of spin waves, Thermal excitations of magnons, Neutron Magnetic Scattering, Ferrimagnetic Order, Curie temperature and susceptibility of ferrimagnets, Antiferromagnetism, Two sublattice model, Superexchange interaction, Susceptibility below the Neel temperature, Antiferromagnetic magnons. **Lectures 15**

SECTION-C

Superconductivity:

Superconductivity, zero resistivity, critical temperature, Meissner effect, Type I and Type II superconductors, specific heat and thermal conductivity, Thermodynamics of superconducting transition, London's equation, Coherence length, BCS theory of conventional superconductors, BCS ground states, Flux quantization on a superconducting ring, Duration of persistent current, Josephson effect: dc Josephson effect, ac Josephson effect, macroscopic quantum interference, Superconducting magnet and SQUID, High temperature superconductors: Structure and properties.

Lectures 15

SECTION-D

Optical properties

Interaction of light with solids, Atomic and electronic interactions, Optical properties of metals and non-metals: Reflection, Refraction, Absorption, Transmission, Fundamentals of direct and indirect band gap, Exciton absorption, Free carrier absorption, Absorption process involving impurities, Photoconductivity, Luminescence, excitation and emission, Decay mechanisms, Thallium activated alkali halides, Sulphide phosphors. **Lectures 15**

Books :

1. An Introduction to Solid State Physics: C. Kittel-Wiely Estem Ltd., New Delhi, 1979.
2. Solid State Physics-A.J. Dekkar-Maemillan India Ltd., New Delhi, 2004.
3. Material Science and Engineering William D. Callister JR, Wiley
4. Elementary Solid State Physics-Omar, Addison Wesly, 1975.
5. Principles of Solid State Physics-R.A. Levy-New York Academy, 1968.
6. Solid State Physics-Aschroft and Mermin-New York Holt, 1976

M.Sc. (Physics) (For Colleges) (Semester-IV)

ASSIGNMENT/PROJECT

Course No. PHY-553 **Course Hrs: 60**
Time: 3 Hrs **Max. Marks: 50**

Assignment and Project should be based on following techniques in:

1. Material Science
2. Computational Physics
3. Nuclear Physics
4. Advanced Theoretical Physics
5. Radiation Physics
6. Electronics

Note:

Evaluation committee will consist of following members:

1. External examiner (from university)
2. HOD, College/ Internal Examiner

M.Sc. (Physics) (For Colleges) (Semester-IV)

PHYSICS OF MATERIALS
(ELECTIVE PAPER)

Course No. PHY-554 **Course Hrs.: 60**
Time: 3 Hrs **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Vacuum Technology:
Basic ideas about vacuum, Throughput, Conductance, Vacuum pumps : rotary pump, diffusion pump, ion pump, molecular pump, cryopump, Vacuum gauges : pirani gauge, penning gauge, ionization gauge (hot cathode ionization gauge, cold cathode ionization gauge).

Lectures 15

SECTION-B

Thin Film
Thin Film and growth process, Influence of nature of substrate and growth parameters (substrate temperature, thickness, deposition rate). Thin film deposition, techniques: thermal evaporation, chemical vapor deposition, spray pyrolysis, sputtering. Epitaxial growth, Thin film thickness measurement techniques: film resistance method, optical method, microbalance method.

Lectures 15

SECTION-C

Polymers, Ceramics, Liquid Crystals and Nanophase Materials: Characteristics, Application and Processing of polymers : Polymerization, Polymer types, Stress- Strain behaviour, melting and glass transition, thermosets and thermoplasts. Characteristics, Application and Processing of Ceramics, glasses and refrectories, Liquid Crystals : classification and applications, Nanophase materials: synthesis and applications.

Lectures 15

SECTION-D

Characterization of Materials
Powder and single crystal X-ray diffraction, Transmission electron microscopy, Scanning electron microscopy, Low Energy Electron Diffraction (LEED), Auger electron microscopy, Atomic force microscopy.

Lectures 15

Books:

1. Vacuum Technology: A. Roth-North Holland Pub. Co., 1976
2. Thin Film Phernomeon: K.L. Chopra-R E Kriegn Pub. Co., 1979.
3. High Temperature Superconductors: E.S.R. Gopal & SV. Subramanyam-Wiley, 1989
4. Material Scienceand Engg: W.D. Callister-.Wiley, 1994
5. Nanostructured Materials: J.C. Ying-Wiley-. Academic Press, 2001
6. Methods of Surface Analysis: J.M. Walls- CUP Archive, 1990.
7. Introduction to Nanotechnology - Charles P.Pooler, Frank J. Owens- IEEE, 2003

M.Sc. (Physics) (For Colleges) (Semester-IV)

RADIATION PHYSICS
(ELECTIVE PAPER)

Course No. PHY-562 **Course Hrs: 60**
Time: 3 Hrs **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Ionizing Radiations and Radiation Quantities:
Types and sources of ionizing radiation, fluence, energy fluence, kerma, exposure rate and its measurement - The free air chamber and air wall chamber, Absorbed dose and its measurement ; Bragg Gray Principle, Radiation dose units - rem, rad, Gray and sievert dose commitment, dose equivalent and quality factor.

Lectures 15

SECTION-*B*

Dosimeters:
Pocket dosimeter, films, solid state dosimeters such as TLD, SSNTD, chemical detectors and neutron detectors. Simple numerical problems on dose estimation.

Lectures 15

SECTION-*C*

Radiation Effects and Protection:
Biological effects of radiation at molecular level, acute and delayed effects, stochastic and non-stochastic effects, Relative Biological Effectiveness (RBE), Linear energy transformation (LET), Dose response characteristics.
Permissible dose to occupational and non-occupational workers, maximum permissible concentration in air and water, safe handling of radioactive materials, The ALARA, ALI and MIRD concepts, single target, multitarget and multihit theories, Rad waste and its disposal, simple numerical problems.

Lectures 15

SECTION-D

Radiation Shielding:
Thermal and biological shields, shielding requirement for medical, industrial and accelerator facilities, shielding materials, radiation attenuation calculations-The point kernal technique, radiation attenuation from a uniform plane source. The exponential point-Kernal. Radiation attenuation from a line and plane source. Practical applications of some simple numerical problems.

Lectures 15

Books :

1. S. Glasstone and A. Sesonke: Nuclear Reactor Engineering-Van Nostrand Reinhold, 1981
2. Alison. P. Casart: Radiation Theory
3. A. Edward Profio: Radiation Biology-Radiation Bio/Prentice Hall, 1968
4. F.H. Attix: Introduction to Radiological Physics and Radiation Dosimetry-Wiley-VCH, 1986.

M.Sc. (Physics) (For Colleges) (Semester-IV)

REACTOR PHYSICS
(ELECTIVE PAPER)

Course No. PHY-563 **Course Hrs. 60**
Time: 3 Hrs. **Max. Marks: 100**

Note for the Paper Setters:

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Interaction of Neutrons with Matter in Bulk:
Thermal neutron diffusion, Transport and diffusion equations, transport mean free path, solution of diffusion equation for a point source in an infinite medium and for an infinite plane source in a finite medium, extrapolation length and diffusion length-the albedo concept.

Lectures 15

SECTION-B

Moderation of Neutron:
Mechanics of elastic scattering, energy distribution of thermal neutrons, average logarithmic energy decrement, slowing down power and moderating ration of a medium. Slowing down density, slowing down time, Fast neutron diffusion and Fermi age theory, solution of age equation for a point source of fast neutrons in an infinite medium, slowing down length and Fermi age.

Lectures 15

SECTION-C

Theory of Homogeneous Bare Thermal and Heterogeneous Natural Uranium Reactors
Neutron cycle and multiplication factor, four factor formula, neutron leakage, typical calulations of critical size and composition in simple cases, The critical equation, material and geometrical bucklings, effect of reflector,
Advantages and disadvantages of heterogeneous assemblies, various types of reactors with special reference to Indian reactors and a brief discussion of their design feature.

Lectures 15

SECTION-D

Power Reactors Problems of Reactor Control
Breeding ratio, breading gain, doubling time, Fast breeder reactors, dual purpose reactors, concept of fusion reactors, Role of delayed neutrons and reactor period, Inhour formula, excess reactivity, temperature effects, fission product poisoning, use of coolants and control rods.

Lectures 15

Books:

1. The elements of Nuclear reactor Theory: Glasstone & Edlund-Vam Nostrand, 1952.
2. Introductions of Nuclear Engineering: Murray-Prentice Hall, 1961.

M.Sc. (Physics) (For Colleges) (Semester-IV)

PLASMA PHYSICS
(ELECTIVE PAPER)

Course No. PHY-564 **Course Hrs: 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A
Basics of Plasmas: Occurence of plasma in nature, definition of plasma, concept of temperature, Debye shielding and plasma parameter. Single particle motion in uniform E and B, nonuniform magnetic field, grid B and curvature drifts, invariance of magnetic moment and magnetic mirror. Simple application of plasmas.

Lectures 20

SECTION-B
Plasma Waves: Plasma oscillations electron plasma waves, ion waves, electrostatic electron and ion oscillations perpendicular to magnetic field upper hybrid waves, lower hybrid waves, ion cyclotron waves. Light waves in plasma.

Lectures 15

SECTION-C
Boltzmann and Vlasov Equations: The fokker plank equation, integral expression for collision lern zeroth and first order moments, the single equation relaxation model for collision lern. Application kinetic theory to electron plasma waves, the physics of landau damping, elementary magnetic and inertial fusion concepts.

Lectures 15

SECTION-D
Non-linear Plasma Theories: Non-linear Electrostatic Waves, K dV Equations, Non-linear Schrodinger Equation, Solitons, Shocks, Non-linear Landou Damping.

Lecturers 5

Books:
1. Introduction to Plasma Physics and Controlled Fusion: F. F. Chen-Springer, 1984
2. Plasma Physics: R. O. Dendy-Cfambridge University Press, 1995.
3. Ideal Magnetohydrodynamics: J. P. Friedberg-Springer edition, 1987
4. Fundamental of Plasma Physics: S. R. Seshadri-American Elsevier Pub. Co.,1973.

M.Sc. (Physics) (For Colleges) (Semester-IV)

GEOPHYSICS
(ELECTIVE PAPER)

Course No. Phy-565 **Course Hrs: 60**
Time: 3Hrs **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Seismology and Interior of the Earth: Origin of earth, shape, size, mass and density of the earth. Theory of seismic waves. The variation of P and S wave velocity, temperature, density, pressure and elastic parameters with depth. Mineralogical and chemical composition of crust, mental and core. Formation of core. Earthquake; effects, types, mechanism, source parameter, and hazard assessment.

(Lectures 15)

SECTION-B

Geochronology and Geodynamics: Geological Time Scale. Radioactive dating methods; U-Pb, Th-Pb, Pb-Pb, Rb-Sr, K-Ar, and C-14. Fission Track dating. Interpretation and discordant ages, age of earth. Heat flow: thermal and mechanical structure of the continental and oceanic lithosphere. Plate tectonics theory: kinematics, dynamics and evolution of plates; types of boundaries, processes. Geodynamics of Indian plate, formation of Himalya.

(Lectures 15)

SECTION-C

Radioactivity of Rocks: Magnetic differentiation, Browns reaction series. Radioactivity of rocks, soil, water and air. Uranium mineralization and its occurrences in India. Radiometric survey of rocks: ground and air borne surveys. Radiometer and emanometer. Role of radiometry in geophysical prospecting, gamma logging and gamma testing.

(Lectures 15)

SECTION-D

Nuclear Techniques: Gamma-transmission method for determination of rock densitie in Laboratory and in-situ. Gamma spectrometric analysis for U, Th and K in rock/soil. Neutron-activation analysis: Equation for build up of induced activity.

(Lectures 15)

Books:

1. The Solid Earth – C.M.R. Fowler
2. Interior of the earth – M.H.P. Bott
3. The Earth's age and Geochronology- D.York and R.M. Fraquhar
4. Physics of the Earth – F.D. Stacey.
5. Principles and Methods of Nuclear Geophysics- V. L. S. Bhimasankaran and N. Venkat Rao.

M.Sc. (Physics) (For Colleges) (Semester-IV)

NANO TECHNOLOGY
(ELECTIVE PAPER)

Course No. PHY-566 **Course Hrs: 60**
Time: 3 Hrs **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Introduction and Synthesis of Nano Materials:
Introduction, Basic idea of nanotechnology, nanoparticles, metal Nanoclusters, Semiconductor nanoparticles, Physical Techniques of Fabrication, inert gas condensation, Arc Discharge, RF plasma, Ball milling, Molecular Beam Epitaxy, Chemical Vapour deposition, Electrodeposition, Chemical Methods-Metal nanocrystals by reduction, Photochemical synthesis, Electrochemical synthesis, Sol-gel, micelles and microemulsions, Cluster compounds. Lithographic Techniques-AFM based nanolithography and nanomanipulation, E-beam lithography and SEM based nanolithography, X ray based lithography.

(Lectures 15)

SECTION-B

Characterization Techniques:
X-ray diffraction, data manipulation of diffracted X-rays for structure determination, Scanning Probe microscopy, Scanning Electron microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Optical microscopy, FTIR Spectroscopy, Raman Spectroscopy, DTA, TGA and DSC measurements

(Lectures 15)

SECTION-C

Carbon Nanotubes and other Carbon based materials:
Preparation of Carbon nano tubes, CVD and other methods pf preparation of CNT, Properties of CNT; Electrical, Optical, Mechanical, Vibrational properties etc. Application of CNT; Field emission, Fuel Cells, Display devices. Other important Carbon based materials; Preparation and Characterization of Fullerence and other associated carbon clusters/molecules, Graphene-preparation, characterization and properties, DLC and nano doamonds.

(Lectures 15)

SECTION-D

Nanosemiconductors and Nano sensors:
Semiconductor nanoparticles-applications; optical luminescence and fluorescence from direct band gap semiconductor nanoparticles, carrier injection, polymers-nanoparticles, LED and solar cells, electroluminescence. Micro and nanosensors; fundamentals of sensors, biosensor, microfluids, MEMS and NEMS, packaging and characterization of sensors.

(Lectures 15)

Books:

1. Solid State Physics: J.P. Srivastva-Prentice Hall, 2007.
2. Introduction to nanoscience and Nanotechnology: K.K. Chattopadhyay and A.N. Banerjee- PHI Learning Pvt. Ltd. 2009
3. Nanotechnology Fundamentals and Applications: Manasi Karkare, I.K.- International Publishing House, 2008.
4. Nanomaterials: B. Viswanathan- Narosa, 2009.
5. Encyclopedia of Nanotechnology: H.S. Nalwa-American Scientific Publishers, 2004.
6. Introduction to Nanotechnology: Charles P. Poole Jr. and Franks J. Qwens,-John Wiley & Sons, 2003.
7. Nanostructures and Nanomaterials, Synthesis, Properties and Applications: Guoahong Cao- Imperial College Press, 2004.
8. Springer Handbook of Nanotechnology: Bharat Bhushan-Springer, 2004.
9. Science of Engineering Materials: C.M. Srivastva and C. Srinivasan-New Age International, 2005.
10. The Principles and Practice of electron Microcopy: Ian. M. Watt-Cambridge University Press, 1997.
11. Ultrasonic Testing of Materials: J.K. Krammer and H.K. Krammer-Springer Verlag, 1996.
12. Physical Properties of Carbon Nanotube: R. Satio, G. Dresselhaus and M. S. Dresselhaus-Imperial College Press, 1998.
13. Sensors Vol. 8, Micro and Nanosensor Technology: H. Meixner and R. Jones (Editor)-John Wiley and Sons, 2000.

M.Sc. (Physics) (For Colleges) (Semester-IV)

ADVANCED ELECTRONICS
(ELECTIVE PAPER)

Course No. PHY- 568 **Course Hrs 60**
Time: 3 Hrs. **Max. Marks: 100**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Digital logic families :A brief introduction to logic families:RTL, DTL, TTL, ECL, CMOS, MOS, Tri-state logic - switching and propagation delay, fan out and fan in, TTL-CMOS and CMOS-TTL interfaces. Basic concepts of Integrated Circuits : IC technology, Fabrication of monolithic IC's - epitaxial growth, diffusion of impurities, masking and etching; Active and Passive components.

(Lectures 15)

SECTION-B

Microprocessor : Buffer registers, Bus organized computers, SAP-I, Microprocessor (µP) 8085 Architecture, memory interfacing, interfacing I/O devices. Assembly language programming: Instruction classification, addressing modes, timing diagram, Data transfer, Logic and Branch operations, Programming examples (addition, subtraction, multiplication and division).

(Lectures 15)

SECTION-C

Microcontrollers - Overview of the 8051 family, Architecture of 8051, assembly language programming, Jump, Loop and Call instructions, Instruction set, Time delay for various 8051 chips. I/O programming, Addressing modes, arithmetic and Logic instructions and Programs, Pulse width modulation for motor control.

(Lectures 15)

SECTION-D

Communication systems: General communication system, Generation and detection of amplitude modulated, Single-side band, Double-side band suppressed carrier and Frequency modulated wave. Digital transmission, ASK, FSK, PSK, Differential PSK, modulators and detectors.

(Lectures 15)

Books :

1. Microelectronics : Millman and Grabel (Tata McGraw Hill), 1999.
2. Microprocessor Architecture, Programming and Applications with 8085 : R.S. Gaonkar (Prentice Hall) 2002.
3. The 8051 Microcontroller and embedded Systems by M. Ali Mazidi, J.G. Mazidi and R.D.M. Mckinley (Pearson Education) (2009).
4. Modern Electronic Communication: Gary M. Miller and Jeffrey S. Beasley (Prentice Hall) 8th Edition, 2004.
5. Communication Systems : Simon Haykin, (John Wiley and Sons), 2001.
6. Digital Signal Transmission : C.C. Bissell and D.A. Chapman (Cambridge University), 1992.