SCHEME FOR M.Sc. PHYSICS (I – IV Semesters) Session 2012-13

Semester – I

Paper Code	Paper Name	Paper Category	Internal Marks	External Marks	Max. Marks
Paper – I	Mathematical Physics	**Compulsory**	**20**	**80**	**100**
Paper – II	Classical Mechanics	**Compulsory**	**20**	**80**	**100**
Paper – III	Quantum Mechanics - I	**Compulsory**	**20**	**80**	**100**
Paper – IV	Electronic Devices	**Compulsory**	**20**	**80**	**100**
Total					**400**

Semester – II

Paper Code	Paper Name	Paper Category	Internal Marks	External Marks	Max. Marks
Paper – V	Statistical Mechanics	**Compulsory**	**20**	**80**	**100**
Paper – VI	Quantum Mechanics - II	**Compulsory**	**20**	**80**	**100**
Paper – VII	Nuclear and Particle Physics	**Compulsory**	**20**	**80**	**100**
Paper – VIII	Atomic and Molecular Physics	**Compulsory**	**20**	**80**	**100**
Paper – IX	Practical (General)	**Compulsory**			**200**
Paper – X	Practical (Electronics)	**Compulsory**			**200**
Total					**800**

Semester – III

Paper Code	Paper Name	Paper Category	Internal Marks	External Marks	Max. Marks
Paper – XI	Condensed Matter Physics	**Compulsory**	**20**	**80**	**100**
Paper – XII	Solid State Electronics (EL – 2)	**Elective**	**20**	**80**	**100**
Paper – XIII	Any one of the following **i)** Solid State Physics – I **ii)** Electronics – I	**Special Paper - I**	**20**	**80**	**100**
Paper – XIV	Any one of the following **i)** Atomic & Molecular Physics – I **ii)** Computational Methods & Programming – I	**Special Paper - II**	**20**	**80**	**100**
Total					**400**

Semester – IV

Paper Code	Paper Name	Paper Category	Internal Marks	External Marks	Max. Marks
Paper – XV	Electro dynamics and Wave Propagation	**Compulsory**	**20**	**80**	**100**
Paper – XVI	Physics of Nano-materials	**Compulsory**	**20**	**80**	**100**
Paper – XVII	Any one of the following **i)** Solid State Physics – II **ii)** Electronics - II	**Special Paper - I**	**20**	**80**	**100**
Paper – XVIII	Any one of the following **i)** Atomic & Molecular Physics – II **ii)** Computational Methods & Programming – II	**Special Paper - II**	**20**	**80**	**100**
Paper – XIX	Practical (General)	**Compulsory**			**200**
Paper – XX (A)	Practical (Special Paper - I)	**Compulsory**			**100**
Paper – XX (B)	Practical (Special Paper - II)	**Compulsory**			**100**
Total					**800**

Note: Break up of internal assessment marks:

One class test	:	10 marks
Attendance	:	5 marks
Assignment/ & presentation	:	5 marks
Total	**:**	**20 marks**

NOTE:

The M.Sc. Physics programme will be of four semesters (two years) duration. The theory examination will be held at the end of each semester. There will be four theory papers in each semester. The two practical laboratory courses (Paper IX and X) will run at the same time in semester I and II. Similarly the two practical laboratory courses (Paper XIX and XX A&B) will run simultaneously in semester III and IV. The practical examination will be held at the end of semester II and IV. No elective/special paper shall be offered unless the number of students, opting for particular paper is equal to ten or more. Elective papers/Special papers will be offered according to the availability of the teachers in the department.

Specialization:

The specializations offered to the students in paper XIII and XIV of Semester – III will continue for papers XVII and XVIII of Semester – IV. The two specializations based upon the sets of special papers (XIII & XIV) and (XVII & XVIII) shall be printed on the DMC as well as on the M.Sc. Degree of the students.

The distribution of percentage marks in practical papers {IX, X, XIX & XX (A) & XX (B)} will be as follows:

Experiment	60%
Viva	20%
Seminar	10%
Laboratory Report	10%
Total	100%

XX (A) & XX (B) will correspond to the choice of special papers (XIII & XIV) and (XVII & XVIII) respectively,offered to the students in Semester – III & IV

Elective papers (One of the following will be offered depending on the availability of expertise:

EL – 1 Physics of Laser and Laser application
EL – 2 Solid State Electronics

M.Sc Physics Semester I Paper I
Mathematical Physics

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit I Vector spaces and Matrices

Definition of a linear vector space, Linear independence, basis and dimension, scalar Product, Orthonormal basis, Gram-Schmidt Orthogonalization process, Linear operators, Matrices, Orthogonal,Unitary and Hermitian matrices, Eigenvalues and eigenvectors of matrices, Matrix diagonalization.

Unit II Differential equations

Second order linear differential equation with variable coefficients, ordinary point, singular point, series solution around an ordinary point, series solution around a regular singular point; the method of Frobenius, Wronskian and getting a second solution, Solution of Legendre's equation, Solution of Bessel's equation, Solution of Laguarre and Hermite's equations.

Unit III Special Functions

Definition of special functions, Generating functions for Bessel function of integral order $J_n(x)$, Recurrence relations, Integral representation; Legendre polynomials $P_n(x)$, Generating functions for $P_n(x)$, Recurrence relations; Hermite Polynomials, Generating functions, Rodrigue's formula for Hermite polynomials; Laguerre polynomials, Generating function and Recurrence relations.

Unit IV Integral Transforms

Integral transform, Laplace transform, some simple properties of Laplace transforms such as first and second shifting property, Inverse Laplace Transform by partial fractions method, Laplace transform of derivatives, Laplace Transform of integrals, Fourier series, Evaluation of coefficients of Fourier series Cosine and Sine series, Fourier Transforms, Fourier sine Transforms, Fourier cosine Transforms.

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference Books :

Mathematical Physics by P.K. Chattopadhyay (T)
Mathematical Physics by B.S.Rajput
Matrices and Tensors for Physicists, by A W Joshi
Mathematical Physics by Mathews and Walkers
Mathematics for Physicists by Mary L Boas

M.Sc Physics Semester I Paper II
Classical Mechanics

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit I Survey of Elementary Principles and Lagragian Formulation.

Newtonian mechanics of one and many particle systems; conservation laws, constraints, their classification; D' Alembert's principle, Lagrange's equations; dissipative forces generalized coordinates and momenta; integrals of motion; symmetries of space and time and their connection with conservation laws; invariance under Galilian transformation.

Unit II Moving coordinate systems and Motion in a central force field.

Rotating frames; intertial forces; terrestrial applications of coriolis force.Central force; definition and characteristics; two body problem; closure and stability of circular orbits; general analysis of orbits; Kepler's laws and equations; artificial satellites; Rutherford scattering.

Unit III Variational Principle, Equation of motion and Hamilton-Jacobi Equation.

Principle of least action; derivation of equations of motion; variation and end points; Hamilton's principle and characteristic functions; Hamilton-Jacobi equation.

Unit IV Small Oscillations and Canonical Transformations

Canonical transformation; generating functions, properties of Poisson bracket, angular momentum Poisson brackets; small oscillations; normal modes and coordinates.

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Text and Reference Books :

Classical Mechanics by N C Rana and P S Joag (Tata Mcgraw Hill, 1991)
Classical Mechanics by H Goldstein (Addison Wesley, 1980)
Mechanics by A Sommerfeld (Academic Press, 1952)
Introduction to Dynamics by I perceival and D Richards (Cambridge Univ. Press, 1982)

M.Sc Physics Semester I Paper III

Quantum Mechanics -I

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Quantum Mechanics-I

Unit I General formalism of Quantum Mechanics: States and operators; Representation of States and dynamical variables; Linear vector space; Bra Ket notation, Linear operators; Orthonormal set of vectors, Completeness relation; Hermitian operators, their eigenvalues and eigenvectors, The fundamental commutation relation; Commutation rule and the uncertainty relation; Simultaneous eigenstates of commuting operators; The unitary transformation; Dirac delta function; Relation between kets and wave functions; Matrix representation of operators; Solution of linear harmonic oscillator problem by operator methods.

Unit II Angular momentum operator: Angular momentum operators and their representation in spherical polar co-ordinates; Eigenvalues and eigenvectors of L^2, spherical harmonics; Commutation relations among L_x L_y L_z ; Rotational symmetry and conservation of angular momentum; Eigenvalues of J^2 and J_z and their matrix representation; Pauli spin matrices; Addition of angular momentum.

Unit III Solution of Schrodinger equation for three dimensional problems: The three dimensional harmonic oscillator in both cartesian and spherical polar coordinates, eigenvalues eigenfunctions and the degeneracy of the states; Solution of the hydrogen atom problem, the eigenvalues eigenfunctions and the degeneracy.

Unit IV Perturbation Theory : Time independent perturbation theory; Non degenerate case, the energies and wave functions in first order the energy in second order; Anharmonic perturbations of the form λx^3 and λx^4 ; Degenerate perturbation theory; Stark effect of the first excited state of hydrogen.

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Text and Reference Books:

Quantum Mechanics by Ghatak and Loknathan
Quantum Mechanics by Powell and Craseman
Quantum Mechanics by S. Gasiorowicz
Quantum Mechanics by A.P.Messiah
Modern Quantum Mechanics by J.J.Sakurai
Quantum Mechanics by L.I.Schiff
Quantum Mechanics by Mathews and Venkatesan

M.Sc Physics Semester I Paper IV

Electronic Devices

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit I Transistors Bipolar junction Transistor(BJT) Transistor operating modes, Transistor action, Transistor biasing configurations and characteristics, Transistor ratings, The Ebers-Moll model, Field Effect Transistors: Junction Field Effect Transistor(JFET) , Metal Oxide Semiconductor Field Effect Transistor (MOSFET) FET Parameters.

Unit II Integrated circuits and Their Fabrications

Types of Integrated Circuits, Analog and Digital Integrated Circuits, Semiconductor Fabrication : Planar Technology, Fabrication of Monolithic, Integrated Circuits, Monolithic Passive and Active Circuit components, Typical IC Low Frequency Amplifier, New Technology Trends.

Unit III Photoelectirc and other Electronic Devices

Zener Diode, Power Diode, Photodiode, Varactor Diode, Light Emitting Diode (LED), Solar Cell, Transistor Register, Piezo-electric Crystals, Diode Lasers, Condition for Laser Action, Optical Gain, Memory Devices: Transistor Register, Random Access Memory, Read Only Memory.

Unit IV Negative Resistance Devices

Tunnel Diode, Backward Diode, Unijunction Transistor, p-n-p-n devices, p-n-p-n characteristics Thyristor, Silicon Controlled switch, SCS Characteristics, L Addition four Layer Devices. Basic Circuit Principles for NR Switching Circuits: Monostable, Bystable and Astable Operations.

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Text and Reference Books :

Semiconductor Devices - Physics and Technology by S.M .Sze ,Wiley (1985)
Introduction to Semiconductor Devices by M.S. Tyagi, John Wiley & Sons
Measurement, Instrumentation and Experimental Design in Physics and Engineering by M.Sayer and A. Mansingh, Prentice Hall, India (2000)
Optical electronics by Ajoy Ghatak and K. Thygarajan, Cambridge Univ. Press.
Semiconductor Electronics by A.K.Sharma ,New Age International Publisher(1996)
Laser and Non-linear optics by B.B.Laud. ,Wiley Eastern Limited (1985)
Pulse, Digital and Switching Waveforms by Jacob Millman and Herbert Taub ,
Mc Graw Hill Book Company (1965)

M.Sc Physics Semester II Paper V
Statistical Mechanics

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours .

Unit I Phase space, Ensembles, Liouville theorem, conservation of extension, Equation of motion, Equal a priori probability, Statistical equilibrium, Microcanonical ensemble, Quantization of phase space, classical limit, symmetry of wave functions effect of symmetry on counting various distributions using micro canonical ensemble.
Unit II Entropy of an ideal gas, Gibbs paradox, Sackur-Tetrode equation, Entropy of a system in contact with a reservoir, Ideal gas in a canonical ensemble, Grand canonical ensemble, Ideal gas in Grand Canonical ensemble, Comparison of various ensembles. Quantum distribution using other ensembles.
Unit III Transition from classical statistical mechanics to quantum statistical mechanics, Indistinguishability and quantum statistics, identical particles and symmetry requirements, Bose Einstein statistics, Fermi Dirac statistics, Maxwell Boltzmann statistics. Bose Einstein Condensation, Thermal properties of B.E. gas, liquid Helium, Energy and pressure of F-D gas, Electrons in metals, Thermionic Emission.
Unit IV Cluster expansion for a classical gas, virial equation of state, Van der Waals gas, Phase transition of second kind. Ising Model, Bragg Williams Approximation, Fowler Guggenheim Approximation, Ising Model in one and two dimensions, fluctuations in ensembles, Energy fluctuation in quantum statistics, Concentration fluctuation in quantum statistics, One dimensional random walk, Brownian motion.

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Text and Reference Books

Statistical Mechanics by K Huang
Statistical Mechanics by B.K. Aggarwal and M.Eisner
Statistical Mechanics by R.K. Patharia
Statistical Mechanics by Donalad A Mc Quarrie
Elementary Statistical Mechanics by Gupta and Kumar
Statistical Mechanics R Kubo
Statistical Physics Landau and Lifshitz

M.Sc Physics Semester II Paper VI
Quantum Mechanics –II

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit I Variational methods: Ground state of Helium by both variational and perturbation methods; The hydrogen molecule; WKB approximation; Time dependent perturbation theory; Constant perturbation; Harmonic perturbation; Fermi's golden rule; Adiabatic and sudden approximation.

Unit II Semiclassical theory of radiation: Transition probability for absorption and induced emission ; Electric dipole transition and selection rules; Magnetic dipole transitions; Forbidden transitions; Higher order transitions; Einstein's coefficients.

Unit III Collision in 3D and scattering: Laboratory and C.M. reference frames; scattering amplitude; Differential scattering cross section and total scattering cross section; The optical theorem; Scattering by spherically symmetric potentials; Partial waves and phase shifts; Scattering by a perfectly rigid sphere and by square well poetential; Complex potential and absorption; The Born approximation.

Unit IV Idential particles: The principle of indistinguishibility; Symmetric and antisymmetric wave functions; Spin and statistics of identical particles; The Slatter determinant; The Pauli exclusion principle; Spin states of a two electron system; States of the helium atom; Collision of identical particles.

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Text and Reference Books:

Quantum Mechanics by Ghatak and Loknathan
Quantum Mechanics by Powell and Crassman
Quantum Mechanics by S.Gasiorowicz
Quantum Mechanics by A.P.Messiah
Modern Quantum Mechanics by J.J. Sakurai
Quantum Mechanics by L.I..Schiff
Quantum Mechanics by Mathews and Venkatensan.

M.Sc Physics Semester II Paper VII
Nuclear and Particle Physics

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit I Two nucleon problem and nuclear forces:

The deuteron : binding energy, dipole moment quadrupole moment and the evidence of non-central (Tensor) force, spin dependence of nuclear force. Nucleon-nucleon scattering ; s-wave effective range theory, charge independence and charge symmetry of nuclear forces, iso-spin formalism.

Unit II Nuclear Models :

Liquid drop model ,stability of nuclei, fission ; evidence of shell structure, the shell model spin parity and magnetic moment in extreme single particle model, evidence of collective excitations, collective vibration of a spherical liquid drop.

Unit III Nuclear decays and nuclear reactions :

Alpha, Beta and Gamma decays, Selections rules, Fermi's theory of beta decay, selection rules, comparative half lines, Kurie plot Fermi and Gamow -Teller Transitions; parity non-conservation in beta decay. Reaction cross section, compound nuclear reactions and direct reactions, the optical model, Breit-Winger resonance formula for l=0.

Unit IV Elementary Particle :

Basic interactions in nature : Gravitational Electromagnetic, weak and strong, classification of elementary particles, Leptons, Hadrons, Mesons, Baryons. Conservation Laws for Elementary Particles. Baryon, Lepton and Muon number, Strangeness and Hypercharge, Gelleman - Nishijima formula. Quark model, SU (2) and SU (3) Symmetries Parities of subatomic particles, charge conjugation, Time reversal.

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Text and Reference Books :

A.Bohr and B.R. Mottelson, Nuclear Structure, Vol. 1(1969) and Vol. 2 (1975) , Benjamin, Reading A, 1975

Kenneth S. Kiane, Introductory Nuclear Physics, Wiley, New York, 1988

Ghoshal,S.N Atomic and Nuclear Physics Vol. 2.

P.H. Perkins, Introduction to High Energy Physics, Addison-Wesley, London, 1982

A Preston and A Bhaduri : Nuclear Physics

H. Frauenfelder and E. Henley : Subatomic Physics

M.Sc Physics Semester II Paper VIII
Atomic and Molecular Physics

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit I One Electron systems and Pauli principle.

Quantum states of one electron atoms , atomic orbitals , Hydrogen spectrum , Pauli principle, spectra of alkali elements, spin orbit interaction and fine structure in alkali spectra. Spectra of two electron systems, equivalent and non equivalent electrons.

Unit II The influence of external fields, Two electron system Hyperfine structure and Line broadening: Normal and anomalous Zeeman effect, Paschen Back effect, Stark effect, Two electron systems , interaction energy in LS and jj coupling, Hyperfine structure (magnetic and electric, only qualitative).

Unit III Diatomic molecules and their rotational spectra :

Types of molecules, Diatomic linear symmetric top , asymmetric top and spherical top molecules, Rotational spectra of diatomic molecules as a rigid rotator , energy levels and spectra of non-rigid rotor , intensity of rotational lines.

Unit IV Vibrational and Rotational Vibration spectra of Diatomic molecules :

Vibrational energy of diatomic molecule , Diatomic molecules as a simple harmonic oscillator , Energy levels and spectrum , Morse potential energy curve , Molecules as vibrating rotator , vibration spectrum of diatomic molecules , PQR Branches.

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Text and Reference Books :

Introduction to Atomic and Molecular Spectroscopy by V.K.Jain
Introduction to Atomic spectra by H.E. White
Fundementals of molecular spectroscopy by C.B. Banwell
Spectroscopy Vol I and II by Walker and Straughen
Introduction to Molecular spectroscopy by G. M. Barrow
Spectra of diatomic molecules by Herzberg
Molecular spectroscopy by Jeanne . L. McHale
Molecular spectroscopy by J.M. Brown
Spectra of atoms and molecules by P. F. Bemath
Modern spectroscopy by J.M. Holias

M.Sc. Physics (I & II Semester) : Laboratory/ Practical Course

PAPER IX

Max Marks:200
Time: 4 hrs

[1] Design/study of a Regulated Power Supply.
[2] Design of a Common Emitter Transistor Amplifier.
[3] Experiment on Bias Stability.
[4] To study the frequency response of a single state negative feedback amplification for various feedback circuit. Negative Feedback (voltage series/shunt and current series/shunt)
[5] To study rectifier and filter circuits and draw wave shapes.
[6] Study of Network theorems.
[7] To study the frequency variation in RC phase shift, Colpit and Hartley Oscillators.
[8] Frequency response of RC coupled Amplifier.
[9] Temperature effect on a transistor amplifier.
[10] To study the characteristics of a junction transition and determination of FET parameters.
[11] Experiments on FET and MOSFET characterization and application as an amplifier.
[12] Experiment on Uni-junction Transistor and its application.
[13] Digital I : Basic Logic Gates, TTL, NAND and NOR.
[14] Digital II : Combinational Logic.
[15] Flip-Flops.
[16] Operational Amplifier(741)
[17] Differential Amplifier.
[18] Astable, Monostable and Bistable Multivibrater.
[19] Characteristics and applications of Silicon Controller Rectifier.
[20] Study of Emitter follower/Darlington Pair Amplifier model-C024
[21] Push-Pull Amp.
- **a)** To study the output waveforms of push- pull amplifier in different classes of operation.
- **b)** To plot the frequency response of push- pull amplifier in class AB

[22] Chopper Amplifier
- **a)** To study chopper waveforms and the leakage current compensation for FET switch
- **b)** To ensure the gain of chopper amplifier and to study the recovery of original signal

[23] To measure the numerical aperture (NA) of optical fiber

Setting of new experiments will form tutorial for this lab. Course.

M.Sc (Physics) (I & II Semester): Laboratory/Practical Course

Paper X

Max Marks: 200
Time: 4 hrs.

[1] Measurement of resistivity of a semiconductor by four probe method at different temperatures and Determination of band gap.
[2] Measurement of Hall coefficient of given semiconductor: Identification of type of semiconductor and estimation of charge carrier concentration.
[3] To study the fluorescence spectrum of DCM dye and to determine the quantum yield of fluorescence maxima and full width at hall maxima for this dye using monochromator.
[4] To study Faraday effect using He-Ne Laser.
[5] To calibrate the prism spectrometer with mercury vapor lamp and hence to find out the Cauchy's constant.
[6] To study the characteristics of a Photovoltaic cell (p-n junction solar-cell)
- **a)** the illumination characteristics
- **b)** the I-V characteristics
- **c)** Power- load characteristics
- **d)** Areal characteristics
- **e)** Spectral characteristics

[7] To determine the band gap of Ge Crystal.
[8] To determine the Dielectric constant of polar and non polar liquids
[9] To determine the Magnetic susceptibility of a solid sample.
[10] To study B-H curve of a given ferrite sample and find energy loss in case of ferrite Core.
[11] To study the plateau characteristics of G.M counter and to find the absorption co-efficient of Al- foil.
[12] Testing goodness of fit of poison distribution to cosmic ray bursts by chi-square test.
[13] Determination of Half Life of 'In'.
[14] Determination of range of Beta-rays from Ra and Cs.
[15] X-ray diffraction by Telexometer.
[16] Determination of Ionization Potential of Lithium.
[17] Determination of e/m of electron by Normal Zeeman Effects using Febry Perot Etalon.
[18] Determination of Dissociation Energy of Iodine (1) Molecule by photography the absorption bands of I in the visible region.
[19] To find Flashing and Quenching voltage of Neon gas and determine the capacitance of a unknown capacitor.
[20] To determine the value of e/m i.e. specific charge for an electron by Helical Method.
[21] Stefan's constant by the black copper radiation plates (Electrical Method).
[22] To determine the heat capacity of solids
[23] To verify the existence of different harmonics and measure their relative amplitudes using Fourier Analysis kit
[24] To determine Boltzman Constant (k) make use of the black body Radiation and using Wien's displacement law and Stefan' s law
[25] To determine Planck's Constant (h) by measuring the voltage drop across light-emitting diodes (LEDs) of different colours

Setting of new experiments will form tutorial for this lab. Course.

M.Sc Physics Semester III Paper XI

Condensed Matter Physics

Theory Marks:80

Internal Assessment Marks:20

Time : 3 Hours

Unit I Crystal Physics and Crystal Diffraction

Crystalline solids, lattice, the basis, lattice translation, vectors, direct lattice, two and three dimensional Bravais lattice, conventional units cells of FCC, BCC, Nacl, CsCl, Diamond and cubic ZnS, primitive lattice cell of FCC, BCC and HCP; closed packed structures: packing fraction of simple cubic, bcc, fcc, hcp and diamond structures.

Interaction of x-rays with matter, absorption of x-rays, elastic scattering from a perfect lattice, the reciprical lattice and its application to diffraction techniques Ewald's construction, the Laue, powder and rotating crystal methods, atomic form factor, crystal structure fractor and intensity of diffraction maxima. Crystal structure factors of bcc, fcc, monatomic diamond lattice, polyatomic CuZn.

Unit II Lattice Vibration and Defects in Crystals

Vibration of one dimensional mono- and diotonic- chains, phonon momentum, density of normal modes in one and three dimensions, quantization of lattice vibrations, measurement of phonon dispersion using inelastic neutron scattering.

Point defects, line defects and planer (stacking) faults, Fundamental ideas of the role of dislocation in plastic deformation and crystal growth, the observation of imperfection in crystals, x-rays and electron microscopic techniques.

Unit III Electronic Properties of Solids and Energy Bands.

Electron in periodic lattice, block theorem kronig-penny model and band theory, classification of solids, effective mass, weak-binding method and its application to linear lattice, tight-binding method and its application to cubic bcc and fcc crystals, concepts of holes, Fermi surface : construction of Fermi surface in two- dimension, de Hass van alfen effect, cyclotron resonance, magnetoresistanc.

Unit IV Ferromagnetism, Anti-ferromagnetism and Superconductivity

Weiss Theory of Ferromagnetism Heisenberg model and molecular field theory of ferromagnetism of spin waves and magnons, Curie-weiss law for susceptibility. Ferri and Anti Ferro-magnetic order. Domains and Block wall energy.

Occurrence of supercunductivity, Messner effect, Type-I and Type-II superconductors, Heat capacity, Energy gap, Isoptope effect, London equation, Coherence length, Postulates of BCS theory of superconductivity, BCS ground state, Persistent current. High temperature oxide super conductors (introduction and discovery)

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference Books:

Verma and Srivastava : Crystallography for Solid State Physics
Azaroff : Introduction to Solids
Omar : Elementary Solid State Physics
Aschroft & Mermin : Solid State Physics
Kittel : Solid State Physics
Chaikin and Lubensky : Principles of Condensed Matter Physics
H. M. Rosenberg : The solid State.

M.Sc Physics Semester -III Paper XII (Option EL - 1)

Physics of Laser and Laser Applications

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit I Laser characteristics : Spontaneous and Stimulated Emission, Absorption, Laser Idea, Pumping Schemes, Properties of Laser Beams : Monochromativity, Coherence, Directionality, Brightness, Radiation Trapping Superradiance, Superfluorescence, Amplified Spontaneous Emission, Non-radiative delay.

Unit II Pumping process: Optical pumping and pumping efficiency, Electrical pumping and pumping efficiency. Passive Optical Resonators, Rate Equations, Four-level Laser, Three-level Laser, Methods of Q-switching : Electro optical shutter, mechanical shutter, Acousto - optic Q-switches, Mode locking.

Unit III

Ruby Laser, Nd-Yag Laser, N_2 Laser, Dye-Laser, Semiconductor Laser.

Univ IV Multiphoton photo-electric effects, Two-photon, Three-photon and Multiphoton Processes Raman Scattering,Stimulated Raman Effect.Introduction to Applications of Lasers : Physics, Chemistry, Biology, Medicine, Material working ,optical communication, Thermonuclear Fusion, Holography, Military etc.

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Text and Reference Books

Introduction to Atomic and Molecular Spectroscopy by V.K.Jain
Svelto : Lasers
Yariv Optical Electronics
Demtroder: Laser Spectroscopy
Letekhov : Non-Linear Spectroscopy
Principles of Lasers by Svelto
Lasers and Non-linear Optics by B.B. Laud.

M.Sc Physics Semester III Paper XII (Option EL - 2)
Solid State Electronics

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit 1 SEMICONDUCTOR MATERIALS

Energy bands, Metals, Semiconductors and Insulators, Direct and Indirect bands, Variation of energy bands with alloy composition, Electrons and Holes, Effective mass, Intrinsic material, Extrinsic material, The Fermi Level, Electron and Hole concentration at equilibrium, Temperature dependence of carrier concentrations, Compensation and space charge neutrality. Conductivity and Mobility, Effect of Temperature and Doping on mobility. Hall Effect, Invariance of Fermi level.

Unit 2 CARRIER TRANSPORT IN SEMICONDUCTORS

Optical absorption and Luminescence, Carrier lifetime and Photoconductivity: Direct recombination of electrons and holes, Indirect recombination; Trapping, Steady state carrier generation, quasi Fermi levels. Photoconductivity Diffusion of Carrier, Diffusion and Drift of Carrier, Diffusion and recombination, diffusion length, Hayens Shockley experiment, gradient in quasi Fermi level.

Unit 3 INTEGRATED CIRCUITS- FABRICATION AND CHARACTERISTICS

Integrated circuit technology, basic integrated circuits, epitaxial growth, masking and etching- photolithography, Diffusion of impurities, monolithic transistor, monolithic diodes, integrated resistors, integrated capacitors, metal semiconductor contacts, Schottky diodes and transistors, Thin film deposition techniques , Chemical vapour deposition, Physical vapour deposition, Thermal evaporation.

Unit 4 MICROWAVE DEVICES

Resonant Cavity, Klystrons and Magnetron – velocity modulation, basic principle of two cavity klystron and reflex klystron, principle of operation of magnetron, Hot electrons, Transferred electron devices, Gunn effect, principle of operation, Modes of Operation, Read diode, Impatt diode, trapatt diode.

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Text and Reference Books:

Integrated Electronics by J.Millman and C.C.Halkias (Tata-McGraw Hill)
Solid State Electronic Devices by Ben G.Streetman (PHI)
Fundamental of Electronics by J.D.Ryder (Prentice Hall Publication)
Linear Integrated Circuits by D.Roy Choudhury and Shail Jain (Wiley Eastern Ltd)
Physical Model for Semiconductor Devices by J.E.Carrol

M.Sc Physics Semester - III Paper XIII (Option 1) Special Paper – I
Solid State Physics –I

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit 1 : Lattice Dynamics

Interatomic forces and lattice dynamics of simple metals, ionic and covalent crystals. Optical phonons and dielectric constants. Inelastic neutron scattering. Mossbauer effect. Debye - Waller factor. Anharmonicity, thermal expansion and thermal conductivity.

Unit II : Optical Properties of Solids

Interaction of electrons and phonons with photons. Direct and indirect transitions. Absorption in insulators, Polaritons, one phonon absorption, optical properties of metals, skin effect and anomalous skin effect.

Unit III : Electron-Phonon Interaction

Interaction of electrons with acoustic and optical phonons, polarons. Superconductivity: manifestations of energy gap. Cooper pairing due to phonons, BCS theory of superconductivity.

Unit IV : Superconductivity

Ginzsburg - Landau theory and application to Josephson effect : d-c Josephson effect, a-c Josephson effect, macroscopic quantum interference. Vortices and type II superconductors, high temperature superconductivity (elementary).

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference Books :

Madelung Introduction to Solid State Theory
Callaway : Quantum Theory of Solid State
Huang : Theoretical Solid State Physics
Kittel : Quantum Theory of Solids

<u>M.Sc. Physics Semester -III Paper- XIII (Option 2) Special Paper – I</u>
Electronics – I

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

<u>Unit I : NUMBER SYSTEMS</u>
Binary numbers, Octal numbers, Hexadecimal numbers, Inter-conversions of numbers. Binary addition, subtraction, multiplication, signed numbers, 1's complement, 2's complement, 2's complement subtraction, Hexadecimal addition, subtraction, BCD code, Gray code, conversion from binary to Gray code and Gray code to binary code.

<u>Unit II : DIGITAL ELECTRONICS</u>
Positive and negative logic designations, OR gate, AND gate, NOT gate, NAND gate, NOR gate, XOR gate, Circuits and Boolean identities associated with gates, Boolean algebra- DeMorgans Laws, Sum of products and product of sums expressions, Minterm, Maxterm, deriving SOP and POS expressions from truth tables.

<u>Unit III : COMBINATIONAL AND SEQUENTIAL LOGIC</u>
Binary adders, half adders, full adders, decoders, multiplexer, demultiplexer, encoders, ROM and applications, Digital comparator, Parity checker and generator, Flip-Flops- RS, JK, master slave JK, T-type and D-type flip flops, Shift-register and applications, Asynchronous counters and applications.

<u>Unit IV : MOS TECHNOLOGY AND DIGITAL CIRCUITS</u>
Metal oxide semiconductor field effect transistors, enhancement mode transistor, depletion mode transistor, p-channel and n-channel devices, MOS invertors- static inverter, dynamic inverter, two phase inverter, MOS NAND gates, NOR gates, complementary MOSFET technology, CMOS inverter, CMOS NOR gates and NAND gates, MOS shift register and RAM

<u>Note:</u> The syllabus is divided into four units. **<u>Nine</u>** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference books:

1. Integrated Electronics by J. Millman and C.C. Halkias (Tata McGraw Hill)
2. Digital Electronics by William Gothmann (Parentice Hall of India)
3. Digital logic by J. M.Yarbrough (Thomson Publication)

M.Sc Physics Semester - III Paper XIV (Option 1) Special Paper – II
Atomic and Molecular Physics - I

Theory Marks: 80
Internal Assessment : 20
Time : 3 Hrs.

Unit 1

Raman effect - quantum theory - molecular polarisability pure rotational Raman spectra of diatomic molecules - vibration rotation Raman Spectrum of diatomic molecules. Intensity alternation in Raman spectra of diatomic molecules.

Unit II

Electronic spectra of diatomic molecules, Born Oppenheimer approximation - vibrational coarse structure of electronic bands -progression and sequences, intensity of electronic bands - Frank Condon principle. Dissociation and pre-dissociation energy .

Unit III

Rotational fine structure of electronic bands. Experimental set up for Raman spectroscopy - application of IR and Raman spectroscopy in the structure determination of simple molecules.

Unit IV

The origin of X-Rays, X-Ray emission spectra, Dependence of position of Emission lines on the atomic number, X-Ray emission (Doublet) spectra, Satellites, Continuous X-ray Emission, X-Ray Absorption spectra.

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference Books

Introduction to Atomic and Molecular Spectroscopy by V.K.Jain
Introduction to Atomic spectra--H.E. White (T)
Fundamentals of molecular spectroscopy-- C.B. Banwell
Spectroscopy Vol I , II and III -- Walker and Straughen
Introduction to Molecular spectroscopy -- G. M. Barrow
Spectra of diatomic molecules-- Herzberg
Molecular spectroscopy -- Jeanne L McHale
Molecular spectroscopy-- J M Brown
Spectra of atoms and molecules-- P.F. Bemath
Modern spectroscopy--J M Holkas

M.Sc Physics Semester - III Paper XIV (Option 2) Special Paper – II
Computation Methods and Programming – I

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Computational Methods

Unit I Numerical Integration, Differentiation , Roots of Eqns. and Curve Fitting.
Numerical Integration : Newton-cotes formulae : Trapojoidal rule, Simpson's 1/3 rule, error estimates in Trapejoidal rule and Simpson 1/3 rule using Richardson defferred limit approach ; Gauss-Legender quadrature method; Monte carlo (mean sampling) method for single, double and tripple integrals.

Numerical Differentiation: Taylor Series method; Generalized numerical diffrerentiation: truncation errors.
Roots of Linear, Non-linear Algebraic and Transcendental Eqns. : Newton - Raphson methods; convergence of solutions.
Curve Fitting : Principle of least square; Linear regression ; Polynomial regression; Exponetial and Geometric regression.

Unit II Interpolation, Solution of Simultaneous Linear Eqns., Eigen values and Eigen vectors.
Interpolation: Finite differences; Interpolation with equally spaced points; Gregory - Newton's Interpolation formula for forward and backward interpolation; Interpolation with unequally spaced points : Lagrangian interpolation.
Solution of Simultaneous Linear Equations : Gaussian Elimination method, Pivioting; Gauss- Jordan elimination method; Matrix inversion.
Eigen values and Eigen vectors : Jacobi's method for symmetric matrix.

Unit III Numerical Solution of First and Second Order Differential Eqns:
Numertical Solution of First Order Differential Eqns: First order Taylor Series method; Euler's method; Runge Kutta methods; Predictor corrector method; Elementary ideas of solutions of partial differential eqns.
Numerical Solutions of Second Order Differential Eqns: Initial and boundary value problems : shooting methods

Programming

UNIT IV Computer basics, Operating system and FORTRAN 77 :

Computer basics and operating system : Elementary information about digital computer principles; basic ideas of operating system, DOS and its use (using various commands of DOS); Compilers; interpretors; Directory structure; File operators.
Introduction to FORTRAN 77
Data types: Integer and Floating point arithmatic; Fortran variables; Real and Interger variables; Input and Output statements; Formates; Expressions; Built in functions; Executable and non-executable statements; Control statements; Go To

statement; Arithmatic IF and logical IF statements; Flow charts; Truncation errors, Round off errors; Propagation of errors.

Block IF statement; Do statement; Character DATA management; Arrays and subscripted variables; Subprogrammes: Function and SUBROUTINE; Double precision; Complex numbers; Common statement; New features of FORTRAN 90.

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference Books

Sastry : Introductory methods of Numerical Analysis.
Rajaraman: Numerical Analysis.
Ram Kumar : Programming with FORTRAN 77
Press, Teukolsky, Vellering and Flannery : numerical Recipes in FORTRAN.
Desai: FORTRAN programming and Numerical methods.
Dorn and Mc Cracken : Numerical Methods with FORTRAN IV case studies.
Mathew : Numerical methods for Mathematics, Science and Engineering.
Jain, Iyngar and Jain: Numerical methods for Scientific and Engineering Computation"
Gould and Tobochnik : An Introduction to Computer Simulation methods part I and Part II.
Mc Calla : Introduction to Numerical methods and Fortran programming.
Verma, Ahluwalia and Sharma : Computation Physics : An Introduction.

M.Sc Physics Semester IV Paper XV
Electrodynamics and wave propagation

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours .

Unit I Electrodynamics in four-vector notation : Review of four-vector and Lorentz transformation in four dimensional space; Conservation of charge and four current density; Electromagnetic field tensor in four dimensions and Maxwell's equations; Lorentz invariants of electromagnetic fields; Dual field tensor; Transformation of electric and magnetic field vectors; Covariance of force equation.

Unit II Simple radiating systems: Field and radiation of a localized source; Oscillating electric dipole; Centre fed linear antenna; Lienard-Wiechert potential ; Electric and magnetic fields due to a uniformly moving charge and accelerated charge; Linear and circular acceleration and angular distribution of power radiated.

Unit III Radiative reaction : Radiative reaction force; Scattering and absorption of radiation; Thompson scattering and Rayleigh scattering; Normal and anomalous dispersion; Ionoshere; Propagation of electromagnetic wave through ionosphere; Reflection of electromagnetic waves by ionosphere; Motion of charged particles in uniform **E** and **B** fields; Time varying fields.

Unit IV Wave guides and Transmission lines : Fields at the surface of and within a conductor; Wave guides; Modes in a rectangular wave guide; Attenuation in wave guides; Dielectric wave guides; Circuit representation of parallel plate transmission lines; Transmission line equations and their solutions; Characteristic impedance and propagation coefficient; Low loss radio frequency and UHF transmission lines.

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference Books

Classical Electrodynamics by J.D. Jackson
Introduction to Electrodynamics by D.J. Griffiths
Electromagnetic by B.B. Laud
Classical Electricity and Magnetism by Panofsky and Phillips
Fundamentals of Electromagnetics by M.A. Wazed Miah

M.Sc Physics Semester IV Paper XVI
Physics of Nano-materials

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit I
Free electron theory (qualitative idea) and its features, Idea of band structure, Metals, insulators and semiconductors, Density of states in bands, Variation of density of states with energy, Variation of density of states and band gap with size of crystal.

Unit II
Electron confinement in infinitely deep square well, confinement in two and one dimensional well, Idea of quantum well structure, Quantum dots, Quantum wires.

Unit III
Determination of particle size, Increase in width of XRD peaks of nanoparticles, Shift in photoluminescence peaks, Variations in Raman spectra of nanomaterials.

Unit IV
Different methods of preparation of nanomaterials, Bottom up : Cluster beam evaporation, Ion beam deposition, Chemical bath deposition with capping techniques and Top down : Ball Milling.

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference Books :
Nanotechnology Molecularly designed matrials by Gan -Moog Chow, Kenneth E. Gonsalves, American Chemical Society
Quantum dot heterostructures by D. Bimerg, M. Grundmann and N.N. Ledenstov, John Wiley & Sons, 1988.
Nano technology : :molecular speculations on global abundance by B.C. Crandall, MIT Press 1996.
Physics of low dimensional semiconductors by John H. Davies, Cambridge Univ. Press 1997.
Physics of Semiconductors nano structures by K.P. Jain, Narosa 1997.
Nano fabrication and bio system : Integrating materials science engineering science and biology by Harvey C. Hoch, Harold G. Craighead and Lynn Jelinskii, Cambridge Univ. Press 1996.
Nano particles and nano structured films ; Preparation characterization and applications Ed. J.H. Fendler, John Wiley & Sons 1998.

M.Sc Physics Semester IV Paper XVII (Option 1) Special Paper – I
Solid State Physics -II

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit1: Crystal Physics
External symmetry elements of crystals. Concepts of point groups. Influence of symmetry on Physical properties : Electrical conductivity. Space groups, derivation of equivalent point position (with examples from triclinic and monoclinic systems), experimental determination of space group. Principle of powder diffraction method, interpretation of powder photographs.

Unit II : X-Ray Crystallography
analytical indexing: Ito's method. Accurate determination of lattice parameters - least-square method. Applications of powder method. Oscillation and Buerger's precession methods.; Determination of relative structure amplitudes from measured intensities (Lorentz and polarization factors), Fourier representation of electron density. The phase problem, Patterson function.

Unit III : Exotic Solids
Structure and symmetries of liquids, liquid crystals and amorphous solids. Aperiodic solids and quasicrystals; Fibonaccy sequence, Penrose lattices and their extension to 3-dimensions. Special carbon solids; fullerenes and tubules ; formation and characterization of fullerenes and tubules. Single wall and multi-wall carbon tubules. Electronic properties of tubules. Carbon nanotubule based electronic based electronic devices.

Unit IV : Nano Structural Materials
Definition and properties of nanostructured materials. Methods of synthesis of nanostructured materials. Special experimeental techniques for characterization nanostructured materials. Quantum size effect and its applications.

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference Books :
Azaroff : X-ray Crystallography
Weertman & Weertman : Elementary Dislocation Theory
Verma & Srivastava : Crystallography for Solid State Physics
Kittel : Solid State Physics
Azaroff & Buerger : The Powder Method
Buerger: Crystal Structure Analysis
M.Ali Omar: Elementary Solid State Physics
The Physics of Quasicrystals, Eds. Steinhardt and Ostulond
Handbook of Nanostructured Materials and Nanotechnology (Vol. 1 to 4). Ed. Hari Singh Nalwa

M.Sc Physics Semester IV Paper XVII (Option 2) Special Paper – I

Electronics - II

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit I

External Photoelectric Effect detector: Vacuum photodiode, photo-multipliers, microchannels, Internal Photoelectric Effect detectors: pn junction photodiode, solar cell (open circuit voltage, short circuit current, fill factor), pin photodiode, avalanche photodiode, phototransistor, Light emitting diode.

Unit II

Fundamentals of modulation, Frequency spectra in AM modulation, power in AM modulated class C amplifier, Efficiency modulation, linear demodulation of AM waves, frequency conversion, SSB system, Balanced modulation, filtering the signal for SSB, phase shift method, product detector, Pulse modulation: PAM, PTM, PWM, PPM, PCM(in brief)

Unit III

Differential amplifier, CMRR, circuit configuration, emitter coupled supplied with constant current, transfer characteristics, block diagram of Op. Amp. Off-set currents and voltages, PSRR, Slew rate, universal balancing techniques, Inverting and non-inverting amplifier, basic applications- summing, scaling, current to voltage and voltage to current signal conversion, differential dc amplifier, voltage follower, bridge amplifier, AC-coupled amplifier.

Unit IV

Integration, differentiation, analog computation, Butterworth active filter circuits, logarithmic amplifier, antilogarithmic amplifier, sample and hold circuits, digital to analog conversion – ladder and weighted resistor types, analog to digital conversion- counter type, AC/DC converters, comparators, regenerative comparator (Schemitt trigger), Square wave generator, pulse generator, triangle wave generator.

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference books:

Integrated Electronics by J. Millman and C.C.Halkias (Tata-McGraw Hill)
Fundamental of Electronics by J.D.Ryder (Prentice Hall Publication).
Electronics communication Systems by George Kennedy and Bernard George (McGraw Hill).
Linear Integrated Circuits by D.Roy Choudhury and Shail Jain (Wiley Eastern Ltd)
Solid State Electronic Devices by Ben G. Streetman ((Parentice Hall of India)
Semiconductor Optoelectronic devices by Pallab Bhattacharya (Parentice Hall of India)

M.Sc Physics Semester IV Paper XVIII (Option 1) Special Paper – II
Atomic and Molecular Physics - II

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit 1
NMR
NMR, The principle of NMR, NMR spectrometer, Types of NMR, Types of nuclei viewed from the stand point of NMR, High Resolution and Broad line NMR, Relaxation mechanisms, chemical shift; spin-spin coupling. Applications of NMR spectroscopy.
Mossbauer Spectroscopy
Mossbauer Spectrometer, Isomer nuclear transition, Resonance fluorescence, Mossbauer effect, Mossbauer nuclei, Isomer shift, quadrupole splitting, Magnetic hyperfine structure. Applications of Mossbauer spectroscopy.
Unit II
ESR spectrometer, substances which can be studied by ESR, Resonance condition. Description of ESR by Precession, Relaxation mechanisms, Features of ESR spectra (a) the g factor (b) Fine structure (c) hyperfine structure (d) ligand hyperfine structure. Applications of ESR
Unit III
Spontaneous and stimulated emission, Absorption, Einstein coefficients. The laser idea, properties of laser beams, Rate equations, methods of obtaining population inversions, laser resonator;
Unit IV
Nd: YAG Laser, CO_2 laser, Nitrogen laser, Dye laser, Laser Applications: Holography material processing fusion reaction, laser isotope separation.

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference Books
Introduction to Atomic and Molecular Spectroscopy by V.K.Jain
Quantum electronics - A. Yariv
Introduction to non-linear laser spectroscopy - M.D. Levenson
Molecular spectra and Molecular structure II and III –Herzberg

M.Sc Physics Semester IV Paper XVIII (Option 2) Special Paper – II
Computation Methods & Programming – II

Theory Marks:80
Internal Assessment Marks:20
Time : 3 Hours

Unit 1

Introduction to UNIX/LINUX, Conceptual frame work of Computer languages, Introduction to C/C_{++} : constants, variables, data types, declaration of variables, user defined declaration, operators, heirarchy of arithmatic operators, expressions and statements; Control statements: if, switch, conditional operator, goto, if ---- else.

Unit II

Decision making and looping statements : while, do --- while, for; built in functions and programme structure, strings; input and output statement; pointers and arrays; subprograms; function overloading recursion; file access.

Unit III

Object oriented concepts; classes, objects, incapsulation and inheritence, reuse and extension of classes, inheritance and polymorphism; virtual functions and virtual classes; friend functions and friend classes. Case studies and applications using some object oriented programming languages.

Unit IV

Introduction to web enabling technologies and languages: Introduction to HTML, HTML Page Formatting Basics, Tables and Frames, Web Page Forms, Introduction to JAVA, Basic difference between C++ and JAVA.

Note : The syllabus is divided into four units. **Nine** questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit.

Text and Reference Books :

Timothy Bold : An Introduction to Object Oriented Programming 2nd Edition, Addison - Wesley 1997.
Balgurisamy E: Object Oriented Programming with C_{++} ,Tata McGraw Hill, 2000.
Chandra B: Object Oriented programming using C+ +, Narosa, New Delhi, 2002.
Rajaram R: Object Oriented programming and C+ +, New Age, New Delhi, 1999.
Mcgrath Mike: HTML 4, Dreamtech Press, New Delhi, 2001.
Merger David: HTML, Tata Mc Graw Hill, New Delhi, 2002.
Kamthane Ashok N.: Object Oriented Programming with ANSI & TURBO C++, Pearson

M.Sc Physics Laboratory / Practical Course III & IV Semester

Paper XIX **General**

Max Marks: 200
Time: 4 hrs

[1] To study the frequency variation in R-C phase shift, Oscillator, Colpitt Oscillator and Hartley Oscillator.
[2] To determine the e/m for electron by helical method.
[3] To calibrate the prism/grating spectrometer with mercury vapour lamps and hence to find the Cauchy's constant.
[4] To study the characteristics of a photovoltaic cell (p-n) junction solar cell.
[5] To determine the band gap energy for the Ge crystal.
[6] To study the Hall Effect and to determine the Hall co-efficient for a Ge Crystal.
[7] To determine the magnetic susceptibility of $NiSO_4$, $FeSO_4$, $CoSO_4$ by Gauy's method.
[8] To study the B-H curve for a given sample using CRO.
[9] To determine the plate characteristics of G.M. Counter and to find out the absorption coefficient foil absorber using β-Delay source.
[10] To study the astable i.e. free running multivibrator
[11] To study logic gates and filp flops
[12] To study the low pass, High Pass and Band Pass filters using active and passive elements.
[13] Lattice dynamic kit
- **a)** Study of the Dispersion relation for the "Monoatomic Lattice" and Comparison with theory.
- **b)** Determination of the Cut-off frequency of the Monoatomic Lattice.
- **c)** Study of the Dispersion relation for the Di-atomic Lattice, Acoustical mode and Energy gap and Comparison with theory.

[14] To determine the Lande- g factor of DPPH using ESR spectrometer.
[15] To determine the wavelength of He-Ne laser light using an engraved scale as a diffraction grating.
[16] Push Pull amplifier
- **a)** To study the output waveforms of push- pull amplifier in different classes of operation.
- **b)** To plot the frequency response of push- pull amplifier in class AB

[17] Chopper Amplifier.
- **a)** To study chopper waveforms and the leakage current compensation for FET switch
- **b)** To ensure the gain of chopper amplifier and to study the recovery of original signal

[18] Dipole meter: To measure the dielectric constant of non-polar as well as polar liquids.
[19] Fiber Optics communication
- **a)** Setting up a Fiber Optic Analog Link.
- **b)** Study of losses in Optical Fiber:
- **c)** Measurement of Propagation Loss.
- **d)** Measurement of Bending Loss.
- **e)** Study of characteristics of Fiber Optic LED & Detector.
- **f)** Measurement of Numerical Aperture.
- **g)** Study of Frequency Modulation & Demodulation using Fiber Optic Link.
- **h)** Setting up a Fiber Optic Digital Link.
- **i)** Study of Modulation & Demodulation of light source by Pulse Width Modulation (PWM)

j) Study of Modulation & Demodulation of Light source by Pulse Position Modulation (PPM)

k) Forming PC to PC Communication Link using Optical Fiber and RS-232 Interface.

l) Setting up a Fiber Optic Voice Link.

To write computer programs and execute for the following:-

[20] Matrix multiplication for two or more matrices

[21] To arrange numbers in ascending /descending orders

[22] To make a list of prime numbers between 1 and 100

[23] To find the H.C.F. of three numbers.

[24] To find the sum of some special infinite series

Note At least ten of the above experiments must be set up. The student has to perform One experiment from Part-A in the examination.

M.Sc. Physics III & IV Semester Laboratory/Practical Course
Solid State Physics

Paper XX (A) (Special paper –I)

Max Marks: 100
Time: 4 hrs

[1] Measurement of lattice parameters and indenning of powder photographs.
[2] Interpretation of transmission Lauc photographs.
[3] Determination of orientation a/c crystal by back reflection lane method.
[4] Rotation/Oscillation photographs and their interpretation.
[5] To study the modulus of rigidity and internal friction in metals as a function of temperature
[6] To measure the clearage step height of crystal by Multiple Fizeane fringes.
[7] To obtain multiple beak fringes of equal chromatic order. To determine crystal step height and study birefringence.
[8] To determine magneto resistance of a Bismuth crystal as a function of magnetic field.
[9] To study hysteresis in the electrical polarization of a TGS crystal and measure the Curie temperature.
[10] To measure the dislocation density of a crystal by etching.
[11] To study lattice dynamics simulation.
[12] To determine the magnetic susceptibility of a solid sample
[13] To study B-H curve of a given ferrite sample and find energy loss in case of ferrite Core.
[14] To determine the band gap of Ge material
[15] To study temperature effect on transistor amplifier.
[16] To study dielectric properties of liquids & Solids
[17] To study Hall Effect and to determine Hall coefficient.
[18] To study electrical resistivity of Semiconductors by four probe method.
[19] To study of dielectric constant as a function of temperature and determine the Curie temperature
[20] To trace the B-H loop (hysteresis) of a ferromagnetic specimen and evaluation of energy loss in the specimen as the function of temperature
[21] To determine the Dielectric Constant of different solid samples
[22] Lattice dynamic kit
- **a)** Study of the Dispersion relation for the "Monoatomic Lattice" and Comparison with theory.
- **b)** Determination of the Cut-off frequency of the Monoatomic Lattice.
- **c)** Study of the Dispersion relation for the Di-atomic Lattice, Acoustical mode and Energy gap and Comparison with theory.

[23] Study of lead tin phase diagram
[24] To determine the capacitance of a parallel plate Capacitor using Capacitance and permittivity kit

Setting of new experiments will form tutorial for this lab. Course.

M.Sc. Physics III & IV Semester Laboratory/Practical Course
Electronics

Paper XX (A) (Special paper –I) Max Marks: 100
Time: 4 hrs

[1] Pulse position/Pulse width Modulation/Demodulation
[2] FSK Modulation Demodulation using Timer/PLL
[3] Microwave characterization and Measurement
[4] PLL circuits and applications
[5] To study the low pass, High Pass and Band Pass filters using active and passive elements.
[6] BCD to Seven Segment display
[7] To study digital to analog and analog to digital conversion (DAC to ADC) circuit.
[8] Experiments using various types of memory elements
[9] Addition, subtraction, multiplication & division using 8085/8086.
[10] Wave form generation and storage oscilloscope.
[11] Frequency, Voltage, Temperature measurements.
[12] Motor Speed control, Temperature control using 8086.
[13] Trouble shooting using signature analyzer
[14] Assembler language programming on PC
[15] Experiments based on Computer Aided design.
[16] To study various applications of op-amp
  a) Op- amp as an integrator
  b) Op- amp as an differentiator
[17] To study the frequency response of a two stages
  a) Transformer coupled amplifier
  b) Choke coupled amplifier.
[18] To study the digital comparator, 3 to 8 line Decoder and tri-state digital O/P circuits.
[19] To study analog voltage comparator circuit
[20] Integrating & Differentiating Ckt.
[21] To study the binary module-6 and 8 decade counter and shift register.
[22] Half & Full Adder Model-A084
[23] Half & Full Subtractor Model – A094
[24] Exp. Board on Timer (555) Applications Model- A005
[25] Study of frequency Multiplication using PLL, Model –A011
[26] Study of Frequency Modulation and Demodulation
[27] Study of pulse Amplitude Modulations & Demodulation model-C019
[28] Transfer characteristics of TTL inverter and TTL trigger inverter with two digital volt meter, model-D518
[29] Study of Module-N Counter using Programmable Counter IC 74190 with input Logics with LED display model D526

M.Sc. Physics III & IV Semester Laboratory/Practical Course
Atomic and Molecular Physics

Paper XX (B) (Special paper –II) Max Marks: 100
Time: 4 hrs

[1] Study of line spectra on photographed plates/films and calculation of plate factor.
[2] Verification of Hartman's dispersion formula.
[3] Study of sharp and diffuse series of potassium atom and calculation of spin orbit interaction constant.
[4] Determination of metallic element in a given inorganic salt.
[5] To record the spectrum of CN violet bands and to perform vibrational analysis.
[6] To record the visible bands of ALO and to perform vibrational analysis.
[7] To photograph and analyze the reddish glow discharge in air under moderate pressure.
[8] To analyze the whitish glow discharge in air under reduced pressure.
[9] To perform vibrational analysis of a band system of N_2.
[10] To perform vibrational analysis of band system of C2
[11] To photograph and analyze the line spectrum of Calcium atom.
[12] To record/analyses the fluorescence spectrum of a sample.
[13] To record/analyze the Raman spectrum of a sample.
[14] Study of Hyperfine structure of the green line of mercury.
[15] To photograph the (O, O) band of CuH and to perform rotational analysis.
[16] To find Flashing and Quenching voltage of Neon gas and determine the capacitance of a unknown capacitor.
[17] To determine the value of e/m i.e. specific charge for an electron by Helical Method.
[18] To calibrate the prism spectrometer with mercury vapor lamp and hence to find out the Cauchy's constant.
[19] Faraday Effect with laser.
[20] Michelson interferometer.
[21] Analysis of ESR Spectra of transition metals.
[22] Analysis of H-atom spectra in minerals.
[23] LED & Laser Diode Characteristics Apparatus
- **a)** To Study I-V characteristics of LED and Diode Laser.
- **b)** To Study P-I characteristics of LED and Diode Laser.

[24] To measure the numerical aperture (NA) of optical fiber
[25] To measure refractive indices of liquids, transparent and translucent solutions and solids using Abbe- Refractometer
[26] To find the velocity and compressibility of solid/ liquid sample using Ultrasonic Interferometer
[27] Semiconductor Laser
- **a)** To measure the numerical aperture of an optical fiber
- **b)** Determination of wavelength of laser source using grating
- **c)** Determination of Particle size

[28] To determine the wavelength of He-Ne laser light using an engraved scale as a diffraction grating.
[29] Measurement of thickness of thin wire with laser
[30] Determination of Lande's factor of DPPH using Electron - Spin resonance (E.S.R.) Spectrometer.

Setting of new experiments will be tutorial for this lab. Course.

M.Sc. Physics III & IV Semester Laboratory/Practical Course
Computational Methods & Programming

Paper XX (B) (Special paper –II)

Maz Marks: 100
Time: 4 hrs

1. **Computer Graphics**
2. **List of programs using FOTRAN**
   a. Numerical Integration
   b. Least square fitting
   c. Numerical solutions of equations (single veriable)
   d. Interpolation
   e. Numerical solution of simultaneous linear algebraic equations
   f. Numerical differentiation
   g. Matrix inversion
   h. Matrix eigen values.
   i. Numerical solution of ordinary differential equation
   j. Numerical Solution of second order ordinary differential equations
3. **List of C++ programs**
   a. Write and run a program that reads a six digit integer and prints the sum of its six digits.
   b. Write a C++ program to solve a quadratic equation.
   c. Write a C++ program that simulates a calculator.
   d. Write and run a program to find the sum of the series of 'n2', where 'n' is an integer.
   e. Write a C++ program to implement the formula: C(n,k) = n!/k!(n-k)!
   f. Write a C++ program to print the Pascal's Triangle.
   g. Write a program that counts and prints the number of lines, words, and letter frequencies in its input.
   h. Implement a time class. Each object of this class represents a specific time of day, sorting the hours, minutes and seconds as integers. Include a constructor, access functions, a function advance(int h, int m, int s) to advance the current time of an existing object, a function reset (int h, int m, int s)to reset the current time of an existing object, and a print () function.
   i. Implement a Card class, a composite Hand Class and a composite Deck class for plane poker.
   j. Using the concept of function overloading, write a program to calculate the volume of a cube, cylinder and a rectangular box.

Note: The student has to perform one experiment from part B.