M.Sc. Physics (Two year Course)
Choice Based Credit System
Scheme of Examination
Session 2016-17

M.Sc. 1st Semester

Paper No.	Code	Nomenclature	Contact hours (L+T+P)	Credit	Max. Marks
Paper - I	PHY (H) - 101	Mathematical Physics	4+0+0=04	04	80+20
Paper – II	PHY (H) – 102	Classical Mechanics	4+0+0=04	04	80+20
Paper - III	PHY (H) – 103	Quantum Mechanics –I	4+0+0=04	04	80+20
Paper - IV	PHY (H) - 104	Electronic Devices	4+0+0=04	04	80+20
Paper – V	PHY (H) - 105	Practical General	0+0+12=12	06	100
Paper - VI	PHY (H) - 106	Practical Electronics	0+0+12=12	06	100

Note:

- PHY(H) means Hard Core Paper
- Maximum marks of M.Sc. 1st semester will be 600. (Theory 400 marks; Practical 200 marks)
- All papers in M.Sc. 1st semester are mandatory.
- Each theory paper will include 20% marks as internal assessment as per University rules.
- Total credits = 28 [Hard Core = 28; Soft Core =0]

M.Sc. Physics (Two year Course)
Choice Based Credit System
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Session 2016-17

M.Sc. 2nd Semester

Paper No.	Code	Nomenclature	Contact hours (L+T+P)	Credit	Max. Marks
Paper – VII	PHY (H) - 201	Statistical Mechanics	4+0+0=04	04	80+20
Paper – VIII	PHY (H) – 202	Quantum Mechanics -II	4+0+0=04	04	80+20
Paper – IX	PHY (H) – 203	Atomic & Molecular Physics	4+0+0=04	04	80+20
Paper – X	PHY (S) – 204	Solid State Electronics Or	4+0+0=04	04	80+20
Paper – XI	PHY (S) – 205	Physics of Laser and Laser Applications	4+0+0=04	04	80+20
Paper – XII	PHY (H) – 206	Practical General	0+0+12=12	06	100
Paper – XIII	PHY (H) – 207	Practical Electronics	0+0+12=12	06	100
Paper – XIV		Open Elective - I	3+0+0=03	03	
Paper – XV		Fundamental Elective	3+0+0=03	03	

Note:

- PHY (H) and PHY (S) represents Hard core and Soft Core Paper in Physics
- Hard core papers are mandatory for M.Sc. 2nd Semester students.
- Paper XIV will be chosen by M.Sc. Physics Students out of the existing open elective papers.
- Paper XV will be chosen by M.Sc. Physics Students out of the existing fundamental elective papers.
- Maximum marks of M.Sc. 2nd semester will be 600+--- (Theory 400; Practical 200)+---- (OE) +----(FE).
- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 04 hours.
- Total Credits = 34
  [Hard core = 24; Soft core = 04; OE = 03; FE 03]

M.Sc. Physics (Two year Course)
Choice Based Credit System
Scheme of Examination
Session 2017-18

M.Sc. 3rd Semester

Paper No.	Code	Nomenclature	Contact hours (L+T+P)	Credit	Max. Marks
Paper - XVI	PHY (H) - 301	Condensed Matter Physics	4+0+0=04	04	80+20
Paper - XVII	PHY (H) - 302	Electrodynamics and Wave Propagation	4+0+0=04	04	80+20
Paper - XVIII Paper - XIX	PHY (S) – 303 PHY (S) – 304	Solid State Physics - I **or** Electronics - I	4+0+0=04 4+0+0=04	04 04	80+20 80+20
Paper – XX Paper – XXI	PHY (S) – 305 PHY (S) – 306	Computational Methods & Programming –I Or Atomic & Molecular Physics - I	4+0+0=04 4+0+0=04	04 04	80+20 80+20
Paper – XXII	PHY (H) – 307	Practical General	0+0+12=12	06	100
Paper – XXIII Paper – XXIV	PHY (S) - 308 PHY (S) – 309	Practical Solid State Physics - I **or** Electronics – I	0+0+6=06 0+0+6=06	03 03	50 50
Paper –XXV Paper –XXVI	PHY (S) – 310 PHY (S) – 311	Practical; Computational Methods & Programming –I Or Atomic & Molecular Physics - I	0+0+6=06 0+0+6=06	03 03	50 50
Paper XXVII		Open Elective Part - II	3+0+0=03	03	

Note:

- PHY (H) and PHY (S) represents Hard core and Soft core Paper in Physics.
- Paper XXVII will be chosen by M.Sc. Physics Students out of the existing open elective papers.
- Maximum marks of M.Sc. 3rd semester will be 600 + --- (Theory 400; Practical 200)+--- (OE).
- Each theory paper will include 20% marks as internal assessment as per University rules.
- Total Credits = 31 [Hard Core =14; Soft Core =14; OE=03]

M.Sc. Physics (Two year Course)
Choice Based Credit System
Scheme of Examination
Session 2017-18

M.Sc. 4th Semester

Paper No.	Code	Nomenclature	Contact hours (L+T+P)	Credit	Max. Marks
Paper – XXVIII	PHY (H) - 401	Nuclear & Particle Physics	4+0+0=04	04	80+20
Paper – XXIX	PHY (H) – 402	Physics of Nano-materials	4+0+0=04	04	80+20
Paper - XXX Paper – XXXI	PHY (S) – 403 PHY (S) - 404	Solid State Physics – II **or** Electronics - II	4+0+0=04 4+0+0=04	04 04	80+20 80+20
Paper – XXXII Paper – XXXIII	PHY (S) – 405 PHY (S) - 406	Computational Methods & Programming –II Or Atomic & Molecular Physics - II	4+0+0=04 4+0+0=04	04 04	80+20 80+20
Paper – XXXIV	PHY (H) - 407	Practical General	0+0+12=12	06	100
Paper – XXXV Paper – XXXVI	PHY (S) - 408 PHY (S) - 409	Practical Solid State Physics – II **or** Electronics – II	0+0+6=06 0+0+6=06	03 03	50 50
Paper – XXXVII Paper - XXXVIII	PHY (S) – 410 PHY (S) – 411	Practical; Computational Methods & Programming –II Or Atomic & Molecular Physics - II	0+0+6=06 0+0+6=06	03 03	50 50

Note:

- PHY (H) and PHY (S) represents Hard core and Soft core paper in Physics.
- Maximum marks of M.Sc. 4th semester will be 600 (Theory 400; Practical 200).
- Each theory paper will include 20% marks as internal assessment as per University rules.
- Total Credits = 28
  [Hard core = 14; Soft core = 14]

Note:

- No elective paper shall be offered unless the number of students, opting for particular paper is equal to ten or more. Elective papers will be offered according to the availability of the teachers in the department.

- Break up of internal assessment marks:

Assessment Exam. Paper	:	10 marks
Attendance	:	5 marks
Assignment/term paper & presentation	:	5 marks
Total	:	20 marks

- The distribution of percentage marks in practical papers will be as follows:

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

M.Sc Physics Semester I Paper I
Mathematical Physics (PHY (H) - 101)

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 (PHY (H) - 102)

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 coriolisforce.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.

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 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 (PHY (H) - 103)

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

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.

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:

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.ScPhysics SemesterI Paper IV

Electronic Devices (PHY (H) - 104)

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 Photoelectric 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 Thyrostor, Silicon Controlled Switch, SCS Characteristics, L Addition four Layer Devices. Basic Circuit Principles for NR Switching Circuits: Monostable, Bistable and Astable Operations.

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 :

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 AjoyGhatak 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 , McGraw Hill Book Company (1965)

M.Sc. Physics Semester I Paper V
Practical General (PHY (H) -105)

Max Marks : 100
Time : 4 Hrs.

1. To determine the e/m for electron by helical Method.
2. To calibrate the prism spectrometer with mercury vapour lamp.

   and hence to find the Cauchy's constant.
3. To study the characteristics of a photovoltaic cell (p-n junction solar cell).
4. To determine the band gap energy for the Ge crystal
5. Measurement of Hall coefficient of given semiconductor: Identification of type of semiconductor and estimation of charge carrier concentration.
6. To study the plateau characteristics of G.M. counter and to find the absorption co-efficient of Al-foil.
7. To find Flashing and Quenching voltage of Neon gas and determine the capacitance of unknown capacitor.
8. Determination of Ionization Potential & Lithium (Li).

M.Sc. Physics Semester I Paper VI
Practical Electronics (PHY (H) -106)

Max. Marks : 100
Time : 4 Hrs.

1. To study the rectifier and filter circuit and draw wave shapes.
2. Design & study of regulated power supply
3. To study the network theorem in D.C. circuit.
4. To study the frequency variation in R-C phase shift , Colpitt
   and Hartley Oscillators.
5. Temperature effect on a transistor amplifier.
6. Experiments on FET and MOSFET characterization and application as an amplifier.
7. Experiment on Uni-junction Transistor and its application.
8. Digital I : Basic Logic Gates, TTL, NAND and NOR.

M.Sc Physics SemesterII Paper VII
Statistical Mechanics (PHY (H) - 201)

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.

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

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 McQuarrie
Elementary Statistical Mechanics by Gupta and Kumar
Statistical Mechanics R Kubo
Statistical Physics Landau and Lifshitz

M.ScPhysics Semester II Paper VIII
Quantum Mechanics –II (PHY (H) - 202)

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.

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:

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.ScPhysics Semester II Paper IX
Atomic and Molecular Physics (PHY (H) - 203)

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.

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 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.ScPhysics SemesterII Paper X
Solid State Electronics (PHY (S) - 204)

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.

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)
Solid State Electronic Devices by Ben G.Streetman (PHI)
Fundamental of Electronics by J.D.Ryder (Prentice Hall Publication)
Linear Integrated Circuits by D.RoyChoudhury and Shail Jain (Wiley Eastern Ltd)
Physical Model for Semiconductor Devices by J.E.Carrol

M.Sc Physics Semester -II Paper XI
Physics of Laser and Laser Applications (PHY (S) - 205)

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.

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
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 II Paper XII
Practical General (PHY (H) -206)

Max Marks : 100
Time : 4 Hrs.

1. To study the B-H curve for a given sample using CRO.
2. Heat Capacity Kit to determine the heat capacity of Solids.
3. Fourier Analysis Kit to verify the existence of different harmonics and measure their relative amplitude using Fourier Analysis Kit
4. Stefan's Constant Kit to determine Stefan's constant by Black copper radiation plates (Electrical method)
5. To determine Boltzmann Constant (k) make use of the Black Body radiation & Using Wein's s displacement & Stefan's law.
6. 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.
7. Determination of e/m of electron by Normal Zeeman Effects using Febry Perot Etalon.
8. Determination of Dissociation Energy of Iodine (I) Molecule by photography the absorption bands of I in the visible region.

M.Sc. Physics Semester II Paper XIII
Practical Electronics (PHY (H) -207)

Max Marks : 100
Time : 4 Hrs.

1. To study the characteristics of JEET
2. To study the response of single stage negative feed back amplifier for Various feedback circuits.
3. To study the frequency response of RC coupled amplifier.
4. To determine the resistivity of a semiconductor (Ge Crystal) by four probe method, at different temp.
5. Planck Constant Kit To determine Plank's Constant (h) by measuring the voltage drop across light emitting diodes of different colours.
6. Astable, Monostable and Bistable Multivibrater.
7. Characteristics and applications of Silicon Controller Rectifier.
8. Study of Emitter follower/Darlington Pair Amplifier model-C024

M.Sc. Physics Semester II
Open Elective – I
Sources of Energy – I

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

Unit I
Introduction
Limitation of conventional energy sources, need and growth of alternative energy sources, basic scheme and application of direct energy conservation.
Solar Cells:
Solar energy: Introduction, The characteristics of the sun, Definitions related to solar radiations, solar radiation geometry, Estimation of daily solar radiation. Theory of solar cells. Solar cell materials, solar drying, solar furnaces, Solar cooking, solar green house technology, solar thermal power generation, solar cell array.
Unit II
Solar Thermal Energy:
Solar radiations, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.
Unit III
Geothermal Energy:
Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental consideration, estimates of geothermal power, nature of geothermal fields, advantages & disadvantages of geothermal energy forms, applications of geothermal energy. Geothermal power plant.
Fuel Cells:
Principle, working of various types of fuel cells, performance and limitations.
Unit IV
Wind Energy:
Wind power and its sources: Principle of working of Wind Energy, performance and limitations of energy conversion systems. Site selection, criteria, momentum theory, wind characteristics.
Text / References Books:

1. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006
2. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications, 2006.
3. D.S. Chauhan, "Non-Conventional Energy Resources" New Age International.
4. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.
5. Peter Auer, "Advances in energy system and Technology" Vol I & II Edited by Academic Press.
6. G.D. Rai, "Non-conventional Energy sources" Khanna Publishers
7. Raja A.K., "Introduction to Non-Conventional Energy Resources" Scitech Publications.
   Fahrenbruch and Bube, "Fundamentals of Solar cells. Photovoltaic Solar Energy"

M.ScPhysics Semester III Paper XVI

Condensed Matter Physics (PHY (H) - 301)

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 XVII

Electrodynamics and wave propagation (PHY (H) - 302)

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 IIIRadiative 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. WazedMiah

M.ScPhysics Semester - III Paper XVIII
Solid State Physics –I (PHY (S) - 303)

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

M.Sc. Physics Semester -III Paper- XIX
Electronics – I (PHY (S) - 304)

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

Unit I : NUMBER SYSTEMS
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.

Unit II : DIGITAL ELECTRONICS
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.

Unit III : COMBINATIONAL AND SEQUENTIAL LOGIC
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.

Unit IV : MOS TECHNOLOGY AND DIGITAL CIRCUITS
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

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:

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 XX
Computational Methods and Programming – I (PHY (S) - 305)

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

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; RungeKutta 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

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 McCracken : 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.
McCalla : Introduction to Numerical methods and Fortran programming.
Verma, Ahluwalia and Sharma : Computation Physics : An Introduction.

M.Sc Physics Semester- III Paper XXI
Atomic and Molecular Physics – I (PHY (S) - 306)

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 VolI , 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 XXII
Practical General (PHY (H) -307)

Max Marks : 100
Time : 4 Hrs.

[1] To study the frequency variation in R-C phase shift, Oscillator, Colpitt Oscillator and Hartley Oscillator.
[2] To study the characteristics of a photovoltaic cell (p-n) junction solar cell.
[3] To study the Hall Effect and to determine the Hall co-efficient for a Ge Crystal.
[4] To study the astable i.e. free running multivibrator
[5] To measure the numerical aperture (NA) of optical fiber using a semiconductor laser source.
[6] To determine the Lande-g factor of DPPH using ESR spectrometer.
[7] To determine the wavelength of He-Ne Layer light using an engraved scale as a diffraction grating.
[8] Chopper Amplifier.
   a) To study chopper waveforms and the leakage current compensation for FET switch

To ensure the gain of chopper amplifier and to study the recovery of original signal

<u>M.Sc. Physics Semester III Paper XXIII</u>
Practical Solid State Physics – I (PHY (S) -308)

Max Marks : 50
Time : 4 Hrs.

[1] Measurement of lattice parameters and indexing of powder photographs.
[2] Interpretation of transmission Lauc photographs.
[3] To measure the dislocation density of a crystal by etching.
[4] To determine the magnetic susceptibility of a solid sample.
[5] To determine the band gap of Ge material
[6] To study electrical resistivity of Semiconductors by four probe method.
[7] To determine the Dielectric Constant of different solid samples
Study of lead tin phase diagram

M.Sc. Physics Semester III Paper XXIV
Practical Electronics – I (PHY (S) -309)

Max Marks : 50
Time : 4 Hrs.

[1] BCD to Seven Segment display

[2] To study the frequency response of two stages
a) Transformer Coupled Amplifier
b) Choke coupled amplifier.

[3] To study the Digital Comparator, 3 to 8 line decoder and tri-state digital O/P circuits.

[4] To study the Analog Comparator circuit

[5] Integrating & Differentiating Ckt.

[6] Half & Full Adder Model-A084

[7] Half & Full Subtractor Model – A094

[8] Exp. Board on Timer (555) Applications Model- A005

M.Sc. Physics Semester III Paper XXV
Practical Computational Methods & Programming – I (PHY (S) -310)

Max Marks : 50
Time : 4 Hrs.

List of programs using FORTRAN

1. Numerical Integration
2. Least square fitting
3. Numerical solutions of equations (single veriable)
4. Interpolation
5. Numerical solution of simultaneous linear algebraic equations
6. Numerical differentiation
7. Matrix inversion
8. Matrix eigen values.
9. Numerical solution of ordinary differential equation
10. Numerical Solution of second order ordinary differential equations

M.Sc. Physics Semester III Paper XXVI
Practical Atomic & Molecular Physics – I (PHY (S) -311)

Max Marks : 50
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 analyse the reddish glow discharge in air under moderate pressure.
[8] To analyse the whitish glow discharge in air under reduced pressure.

M.Sc. Physics Semester III
Open Elective – II
Sources of Energy –II

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

Unit I
Bio-mass:
Introduction of biogas, Availability of bio-mass and its conversion theory, classification of biogas plants, principle & working of floating drum plant & fixed dome type plant-advantages & disadvantages. Biogas from plant waste, community biogas plants, utilization of biogas.

Unit II
Ocean Thermal Energy Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave:
Principle, working, performance and limitations.

Unit III
Petroleum and Coal energy
Petroleum, origin, composition, production, extraction, octane number, kerosene, LPG, lubricants natural gas, physical properties and uses of coal, generis of coal, molecular structure, determination of fixed carbon content, coal for generation of electricity, zero emission power plants, coal reserves and mining.

Unit IV
Nuclear Energy
Nucleus and its constituents, charge mass, isotopes, isobars, mass defect, binding energy and nuclear stability, radiation and nuclear reactions.
Nuclear fission, chain reaction, U^{235}, U^{238}, controlled nuclear fission and nuclear reactors, fast breeder reactor, nuclear fusion, condition for nuclear fusion reaction, Hydrogen bomb, Nuclear bomb

Text / References Books:

1. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006
2. M.V.R. Koteswara Rao, “Energy Resources: Conventional & Non-Conventional” BSP Publications, 2006.
3. D.S. Chauhan, “Non-Conventional Energy Resources” New Age International.
4. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.
5. Peter Auer, “Advances in energy system and Technology” Vol I & II Edited by Academic Press.
6. Raja A.K., “Introduction to Non-Conventional Energy Resources” Scitech Publications.
7. G.D. Rai, “Non-conventional Energy sources” Khanna Publishers

M.Sc Physics Semester IV Paper XXVIII
Nuclear and Particle Physics (PHY (H) - 401)

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.

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 :

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.ScPhysics Semester IV Paper XXIX
Physics of Nano-materials (PHY (H) - 402)

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 XXX
Solid State Physics –II (PHY (S) - 403)

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 XXXI

Electronics – II (PHY (S) - 404)

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.RoyChoudhury 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 XXXII
Computational Methods & Programming – II (PHY (S) - 405)

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 McGraw Hill, New Delhi, 2002.
Kamthane Ashok N.: Object Oriented Programming with ANSI & TURBO C++, Pearson

M.Sc Physics Semester IV Paper XXXIII
Atomic and Molecular Physics – II (PHY (S) - 406)

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 XXXIV
Practical General (PHY (H) -407)

Max Marks : 100
Time : 4 Hrs.

[1] To determine the e/m for electron by helical method.
[2] To determine the band gap energy for the Ge crystal.
[3] To determine the magnetic susceptibility of $NiSO_4$, $FeSO_4$, $CoSO_4$ by Gauy's method.
[4] To study the low pass, High Pass and Bank Pass filters using active and passive elements.
[5] 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.

[6] 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

[7] Dipolemeter: To measure the dielectric constant of non-polar as well as polar liquids.
[8] 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 & Dtector.
- 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.

M.Sc. Physics Semester IV Paper XXXV
Practical Solid State Physics – II (PHY (S) -408)

Max Marks : 50
Time : 4 Hrs.

[1] To determine magneto resistance of a Bismuth crystal as a function of magnetic field.
[2] To study hysteresis in the electrical polarization of a TGS crystal and measure the Curie temperature.
[3] To study B-H curve of a given ferrite sample and find energy loss in case of ferrite Core.
[4] To study Hall Effect and to determine Hall coefficient.
[5] To study of dielectric constant as a function of temperature and determine the Curie temperature
[6] To trace the B- H loop (hysteresis) of a ferromagnetic specimen and evaluation of energy loss in the specimen as the function of temperature
[7] 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.
[8] 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 Semester IV Paper XXXVI
Practical Electronics – II (PHY (S) -409)

Max Marks : 50
Time : 4 Hrs.

[1] To study digital to analog and analog to digital conversion (DAC to ADC) circuit.

[2] To study various applications of Op. Amp.
   a) Op-amp as an integrator
   b) Op-amp as an differentiator

[3] To study the binary module -6 and 8 decade counter and shift register.

[4] Study of frequency Multiplication using PLL, Model –A011

[5] Study of Frequency Modulation and Demodulation

[6] Study of pulse Amplitude Modulations & Demodulation model-C019

[7] Transfer characteristics of TTL inverter and TTL trigger inverter with two digital volt meter, model-D518

[8] Study of Module-N Counter using Programmable Counter IC 74190 with input Logics with LED display model D526

M.Sc. Physics Semester IV Paper XXXVII

Practical Computational Methods & Programming – II (PHY (S) -410)

Max Marks : 50
Time : 4 Hrs.

List of C++ programs

1. Write and run a program that reads a six digit integer and prints the sum of its six digits.
2. Write a C++ program to solve a quadratic equation.
3. Write a C++ program that simulates a calculator.
4. Write and run a program to find the sum of the series of 'n2', where 'n' is an integer.
5. Write a C++ program to implement the formula: C(n,k) = n!/k!(n-k)!
6. Write a C++ program to print the Pascal's Triangle.
7. Write a program that counts and prints the number of lines, words, and letter frequencies in its input.
8. Implement a time class. Each objects 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 reset the current time of an existing object, and a print () function.
9. Implement a Card class, a composite Hand Class and a composite Deck class for plane poker.
10. Using the concept of function overloading, write a program to calculate the volume of a cube, cylinder and rectangular box.

<u>M.Sc. Physics Semester IV Paper XXXVIII</u>

Atomic & Molecular Physics – II (PHY (S) -411)

Max Marks : 50
Time : 4 Hrs.

[1] Michelson interferometer.
[2] Analysis of ESR Spectra of transition metals.
[3] Analysis of H-atom spectra in minerals.
[4] 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.
[5] To measure the numerical aperture (NA) of optical fiber
[6] To determine the wavelength of He-Ne Laser light using an engraved scale as a diffraction grating.
[7] Measurement of thickness of thin wire with laser
[8] 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.