The Program Specific Outcomes of the Two Year (Four semester) M.Sc. Physics Program:

Learning Outcomes

PSO1 The students would be able to realize various applications with proper understanding of linear vector space and matrices, differential equations, special functions, series expansion and integral transforms. The students are enabled to understand the motion of a mechanical system using Lagrange and Hamilton formalisms, concept of central force motion and moving co-ordinate systems and theory of small oscillations.

PSO2 The students would be able to understand the concepts of Quantum mechanics and capable to solve problems such as hydrogen atom, determination of the energies and wave functions of first and second order. The students would be able to explain ground state of hydrogen and helium molecules and analyse various transitions and their selection rules.

PSO3 The students would be able to explain basic physics and application of different types of electronic devices, familiarization with integrated circuit fabrication technology, design of switching circuits and to seek career in advance research.

PSO4 The students would be able to apply ensemble theory to complex problems, analyze the peculiar gas behaviour and explore the applications of Ising Model and different approximations.

PSO5 Analysis of effect of doping in semiconductor materials, carrier concentration and mobility, fabrication of various active & passive circuit components and metal semiconductor junctions, devices in the microwave region and related applications. In addition, the student will be able to differentiate between different lattice types, explain motion of electron in periodic lattice, understand lattice vibrations in solids and explain various types of magnetic phenomena and possible applications.

PSO6 The student will be able to explain Raman effect and different types of Raman spectra, Electronic spectra and electronic bands using Born Oppenheimer approximation and Frank Condon principle and origin of x-rays and different types of x-rays alongwith emission and absorption spectra. The students would be able to appreciate NMR, ESR and Mossbauer spectroscopy and related applications in the field of spectroscopy/material science/ lasers.

PSO7 Understanding the nature of a specific numerical problem, designing programs in different languages, new necessary basic knowledge of various web enabling languages like HTML and JAVA to acquire a vision for use of computer in research prospective.

PSO8 The students will be able to implement Boolean expressions, design basic building blocks of ICs for different operations and develop building blockes for ICs using MOSFET. The students will be able to understand the fabrication process of solar cells, photodiodes, PMT's etc. and realize operational amplifier and related applications such as comparator, A/D & D/A convertor, oscillators etc.

M.Sc. Physics (Two year Course)
Choice Based Credit System
Scheme of Examination
Session 2018-19

M.Sc. 1st Semester

Paper No.	Code	Nomenclature	Contact hours (L+T+P)	Credit	Max. Marks
Paper - I	18PHY21C1	Mathematical Physics	4+0+0=04	04	80+20
Paper – II	18PHY21C2	Classical Mechanics	4+0+0=04	04	80+20
Paper - III	18PHY21C3	Quantum Mechanics –I	4+0+0=04	04	80+20
Paper - IV	18PHY21C4	Physics of Electronic Devices	4+0+0=04	04	80+20
Paper – V	18PHY21CL1	Practical : General Physics	0+0+8=8	04	100
Paper - VI	18PHY21CL2	Practical : Electronics	0+0+8=8	04	100

Note:

- 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 = 24 [Core = 24; Discipline Specific Elective=0]

M.Sc. Physics (Two year Course)
Choice Based Credit System
Scheme of Examination
Session 2018-19

M.Sc. 2nd Semester

Paper No.	Code	Nomenclature	Contact hours (L+T+P)	Credit	Max. Marks
Paper – VII	18PHY22C1	Statistical Mechanics	4+0+0=04	04	80+20
Paper – VIII	18PHY22C2	Quantum Mechanics -II	4+0+0=04	04	80+20
Paper – IX	18PHY22C3	Nuclear & Particle Physics	4+0+0=04	04	80+20
Paper – X Paper – XI	18PHY22D1 18PHY22D2	Solid State Physics Or Plasma Physics	4+0+0=04 4+0+0=04	04 04	80+20 80+20
Paper – XII	18PHY22CL1	Practical : General Physics	0+0+8=8	04	100
Paper – XIII	18PHY22CL2	Practical : Electronics	0+0+8=8	04	100
Paper – XIV		Open Elective - I	3+0+0=03	03	
Paper – XV		Foundation Elective	2+0+0=02	02	

Note:

- Core Courses are mandatory for M.Sc. 2nd Semester students.
- Paper XIV will be chosen by M.Sc. Physics Students from the basket of Open Elective papers provided by the University.
- Paper XV will be chosen by M.Sc. Physics Students from the pool of Foundation Electives provided by the University.
- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 04 hours.
- Total Credits = 29
  [Core = 20; Discipline Specific Elective = 04; O = 03; F 02]

M.Sc. Physics (Two year Course)
Choice Based Credit System
Scheme of Examination
Session 2019-20

M.Sc. 3rd Semester

Paper No.	Code	Nomenclature	Contact hours (L+T+P)	Credit	Max. Marks
Paper - XVI	19PHY23C1	Atomic & Molecular Physics	4+0+0=04	04	80+20
Paper - XVII	19PHY23C2	Electrodynamics and Wave Propagation	4+0+0=04	04	80+20
Paper - XVIII Paper - XIX	19PHY23DA1 19PHY23DA2	Condensed Matter Physics – I **or** Electronics - I	4+0+0=04 4+0+0=04	04 04	80+20 80+20
Paper – XX Paper – XXI	19PHY23DB1 19PHY23DB2	Computational Physics –I **Or** Radiation Physics - I	4+0+0=04 4+0+0=04	04 04	80+20 80+20
Paper – XXII	19PHY23CL	Practical : General Physics	0+0+8=8	04	100
Paper – XXIII Paper – XXIV	19PHY23DL1 19PHY23DL2	Practical : Condensed Matter Physics **or** Electronics	0+0+8=08 0+0+8=08	04 04	100 100
Paper XXV	-------	Open Elective Part - II	3+0+0=03	03	

Note:
- Paper XXV will be chosen by M.Sc. Physics Students from the pool of Open Electives provided by the University.
- Each theory paper will include 20% marks as internal assessment as per University rules.
- Total Credits = 27 [Core =12; Discipline Specific Elective =12; O=03]

M.Sc. Physics (Two year Course)
Choice Based Credit System
Scheme of Examination
Session 2019-20

M.Sc. 4th Semester

Paper No.	Code	Nomenclature	Contact hours (L+T+P)	Credit	Max. Marks
Paper – XXVI	19PHY24C1	Physics of Laser and Laser Applications	4+0+0=04	04	80+20
Paper – XXVII	19PHY24C2	Physics of Nano-materials	4+0+0=04	04	80+20
Paper - XXVIII	19PHY24DA1	Condensed Matter Physics – II	4+0+0=04	04	80+20
		or			
Paper – XXIX	19PHY24DA2	Electronics - II	4+0+0=04	04	80+20
Paper – XXX	19PHY24DB1	Computational Physics – II	4+0+0=04	04	80+20
		Or			
Paper – XXXI	19PHY24DB2	Radiation Physics - II	4+0+0=04	04	80+20
Paper – XXXII	19PHY24CL	Practical: General Physics	0+0+8=8	04	100
Paper – XXXIII	19PHY24DL1	Practical: Computational Physics	0+0+8=08	04	100
		Or			
Paper - XXXIV	19PHY24DL2	Radiation Physics	0+0+8=08	04	100

Note:

- Each theory paper will include 20% marks as internal assessment as per University rules.
- Total Credits = 24
  [Core = 12; Discipline Specific Elective = 12]

Note:

- Elective papers will be offered according to the availability of the Teachers in the Department.
- Break up of internal assessment marks:

Assessment Exam.	:	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 Physics18PHY21C1

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

COURSE OUTCOMES

CO1 The students would get sufficient exposure /understanding of the linear vector space and applications of matrices to physical problems

CO2 The students would be able to solve problems based on differential equations

CO3 The analysis of special functions would equip a student for effective tackling of specific problems.

CO4 The students would be able to realize various applications with proper understanding of series expansion and integral transforms

Unit I

Vector spaces, Norm of a Vector, Linear independence & dependence, basis and dimension, Isomorphism of Vector spaces, scalar/Inner product of vectors, Orthonormal basis, Gram-Schmidt Orthogonalization process, Linear operators, Matrices, Cayley-Hamiltion Theorem, Inverse of matrix, Orthogonal, Unitary and Hermitian matrices, Eigenvalues and eigenvectors of matrices, Similarity transformation, Matrix diagonalization, Simultaneousdiagonalization and commutativity

Unit II

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, Solutions of Laguarre and Hermite's equations

Unit III

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, orthogonality, Rodrigue's Relation; Hermite Polynomials; Generating functions, Rodrigue's relation &orthogonality for Hermite polynomials; Laguerre polynomials; Generating function and Recurrence relations, Orthogonality, Rodrigue's Relation, The Gamma Function, The Dirac – Delta Function

Unit IV

Integral transform, Laplace transform, Properties of Laplace transforms such as first and second shifting property, Laplace Transform of Periodic Functions, Laplace transform of derivatives, Laplace Transform of integrals, Inverse Laplace Transform by partial fractions method, Fourier series, Evaluation of coefficients of Fourier series Cosine and Sine series, Applications of

Fourier Series, Fourier Transforms, Fourier sine Transforms, Fourier cosine Transforms, Fourier transform of derivatives, Applications of Fourier 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:

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

M.Sc. Physics Semester I Paper II

Classical Mechanics18PHY21C2

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

COURSE OUTCOMES

CO1 Student would be able to describe and understand the motion of a mechanical system using Lagrange and Hamilton formalisms.

CO2 Students would become able to understand the concepts of central force motion and moving co-ordinate systems.

CO3 Student would get basic ideas about the theory of small oscillations and use of poisson's bracket which will lead to understand the concepts of quantum mechanics.

Unit I

Surveyof Elementary Principles and LagrangianFormulation: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 Galilean transformation

Unit II

Moving coordinate systems and Motion in a central force field:Rotating frames; inertial forces; terrestrial applications of Coriolis force, two body problem,Central force; definition and characteristics;general analysis of orbits;closure and stability of circular 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 :

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

M. Sc Physics Semester I Paper III

Quantum Mechanics –I 18PHY21C3

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

COURSE OUTCOMES

CO1 Student would be able to understand the concepts of operators in Quantum mechanics.
CO2 Students would be able to apply Pauli spin matrices to explain angular momentum.
CO3 Students would be capable to solve problems such as hydrogen atom.
CO4 Students can determine energies and wave functions of first and second order.

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:

[1] Quantum Mechanics by Ghatak and Loknathan
[2] Quantum Mechanics by Powell and Craseman
[3] Quantum Mechanics by S. Gasiorowicz
[4] Quantum Mechanics by A.P.Messiah
[5] Modern Quantum Mechanics by J.J.Sakurai
[6] Quantum Mechanics by L.I.Schiff
[7] Quantum Mechanics by Mathews and Venkatesan

M.Sc. Physics Semester-I Paper-IV

Physics of Electronic Devices 18PHY21C4

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

COURSE OUTCOMES

CO1 Students would be able to explain the basic physics and application of different transistor types.

CO2 Students get familiarity with integrated circuit fabrication technology and will be able to seek carrier in advance research.

CO3 Students would be able to appreciate the functioning and applications of various optoelectronic and memory devices.

CO4 Students having familiarization with negative resistance devices and will be in a position to design switching circuits involving these device.

Unit I

Charge Carriers in Semiconductors :Energy Bands: Metals, Semiconductors and Insulators, Direct and Indirect Band Gap Semiconductors, Variation of Energy Bands with Alloy Composition, Electrons and Holes, Effective mass, Intrinsic and Extrinsic Semiconductors, Concept of 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 II

Carrier Transport in Semiconductors: Optical Absorption and Luminescence, Carrier Lifetime and Photoconductivity, Direct/Indirect Recombination of Electrons and Holes, Traps and Defects, Steady State Carrier Generation, Quasi Fermi levels, Diffusion and Drift of Carriers, Diffusion and Recombination, Diffusion Length, Hayens Shockley Experiment, Gradient in Quasi Fermi Level, External and Internal Photoelectric Effect

Unit III

Optoelectronic Devices: Vacuum Photodiode, Photo-Multipliers, Micro-channels, P-N Junction Diode: Basic Structure, Energy Band Diagram, Built-in Potential, Electric Field, Space Charge Width and Qualitative Description of Current Flow, Zener Diode, Power Diode, P-N Junction Photodiode, PIN Photodiode, Avalanche Photodiode, Phototransistor, Solar Cell, Varactor Diode, Light Emitting Diode (LED), Diode Laser: Condition for Laser Action and Optical Gain

Unit IV

Integrated Circuits and their Fabrication: Types of Integrated Circuits, Analog and Digital Integrated Circuits, Semiconductor Device Fabrication: Crystal Growth, Epitaxial Growth, Thermal Oxidation, Photolithography, Dry and Wet Etching, Impurity Doping: Thermal Diffusion and Ion Implantation, Metallization: Thermal Evaporation, e-Beam Evaporation and DC Sputtering, Packaging and Testing, Process Flow for the Fabrication of Monolithic Transistor, Monolithic Diodes, Integrated Resistors, and Integrated Capacitors.

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 & Reference Books

1. Semiconductor Devices - Physics and Technology by S.M. Sze (Wiley).
2. Solid State Electronic Devices by Ben G.Streetman (PHI).
3. Semiconductor Physics and Devices by Donald A Neamen (Tata-McGraw Hill).
4. Integrated Electronics by J. Millman and C.C. Halkias (Tata-McGraw Hill).
5. Semiconductor Devices by Kanaan Kano (PHI).
6. Semiconductor Optoelectronic Devices by Pallab Bhattacharya (Pearson)
7. Semiconductor Device Fundamentals by Robert F Pierret (Addison-Wesley).
8. Electronic Devices and Circuit Theory by Robert L. Boylestad (Pearson).

M.Sc. Physics Semester I Paper V
Practical: General Physics18PHY21CL1

Max Marks: 100
Time: 4 Hrs.

COURSE OUTCOMES

CO1 Students would be able to determine specific charge of an electron and understand helical path of electron in electromagnetic field.
CO2 Students would be able calibrate the prism spectrometer.
CO3 Students would be able to calculate band gap energy bof semiconductors and will understand its dependence on temperature
CO4 Students would be able to understand the plateau characteristics of G.M. counter and its applications.

[1] Measurement of resistivity of a semiconductor by four probe method at different temperatures
[2] Measurement of Hall coefficient of given semiconductor: Identification of type of semiconductor and estimation of charge carrier concentration.
[3] To study Faraday Effect using He-Ne Laser.
[4] Ultrasonic Interferometer for liquids
[5] Experiment with microwaves (microwave training kit, basic version)
[6] To calibrate the prism spectrometer with mercury vapor lamp and hence to find out the Cauchy's constant.
[7] To determine the capacitance of a parallel plate Capacitor using Capacitance and permittivity kit
[8] To determine the curie temperature of Ferrites
[9] Measurement of Magneto-resistance of Semiconductors
[10] To study the characteristics (illumination, I-V, Power-load, Areal and Spectral characteristics) of a Photovoltaic cell
[11] To determine the band gap of Ge Crystal.
[12] To measure the numerical aperture (NA) of optical fiber
[13] To study the plateau characteristics of G.M counter and to find the absorption co-efficient of Al- foil.
[14] To determine the value of e/m i.e. specific charge for an electron by Helical Method.
[15] To find Flashing and Quenching voltage of Neon gas and determine the capacitance of a unknown capacitor.

Note: Out of the list as above, a student has to perform atleast 08 (eight) practical's in the semester

M.Sc. Physics Semester I Paper VI
Practical: Electronics 18PHY21CL2

Max. Marks: 100
Time: 4 Hrs.

COURSE OUTCOMES

CO1 The students would get hands on experience on experiments and relation to theory
CO2 Theoretical results for different networks matched with experiments would enable students for complex circuits
CO3 The students would get equipped for applications based on solid state devices
CO4 The students would be able to differentiate between analog and digital electronics

[1] Design/study of a Regulated Power Supply.
[2] Design of a Common Emitter Transistor Amplifier.
[3] Transistor Biasing and 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, Colpitt and Hartley Oscillators.
[8] Frequency response of RC coupled Amplifier.
[9] To study the characteristics of a junction transition and determination of FET parameters.
[10] FET and MOSFET characterization and application as an amplifier.
[11] Uni-junction Transistor and its application.
[12] Bridge Rectifier using SCR with DC and AC Gate

Note: Out of the list as above, a student has to perform atleast 08 (eight) practical's in the semester

M.Sc. Physics Semester II Paper VII
Statistical Mechanics18PHY22C1

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

COURSE OUTCOMES

CO1 The students are able to appreciate cellular nature of phase space and interface of Statistical Mechanics with Thermodynamics

CO2 Knowledge of ensemble theory would result in greater insight into solutions of various complex problems

CO3 The students would be able to analyse the peculiar gas behavior and are in a position to extend the treatment to complex problems

CO4 The students would be equipped to explore the applications of Ising Model and to understand different approximations

.

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 Entropy of an ideal gas, Equilibrium Conditions, Quasi – Static Process, Entropy of an ideal gas using Microcanonical Ensemble, Gibbs paradox, Sackur-Tetrode equation,Probability distribution and entropy of a two level system.

Unit-II

Entropy of a system in contact with a reservoir, Canonical ensemble, Ideal gas in a canonical ensemble, Equipartition of energy, Third law of thermodynamics, Photons, 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, Saha Theory of Thermal Ionization

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, 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

[1] Statistical Mechanics by K. Huang
[2] Statistical Mechanics by B.K. Aggarwal and M.Eisner
[3] Statistical Mechanics by R.K. Patharia
[4] Statistical Mechanics by Donalad A McQuarrie
[5] Statistical Mechanics by AvijitLahiri
[6] Statistical Mechanics R Kubo

M.Sc.Physics Semester II Paper VIII
Quantum Mechanics –II18PHY22C2

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

COURSE OUTCOMES

CO1 Students would be able to explain ground state of hydrogen and helium molecules.
CO2 Students get enabled to analyze various transitions and their selection rules.
CO3 Students would be capable to understand 3D collisions.
CO4 Students would be capable to calculate spin states of identical particles.

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

Semi-classical 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 potential; Complex potential and absorption; The Born approximation.

Unit IV

Identical particles: The principle of indistinguishibility; Symmetric andantisymmetric wave functions; Spin and statistics of identical particles; The Slater 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:

[1] Quantum Mechanics by Ghatak and Loknathan
[2] Quantum Mechanics by Powell and Crassman
[3] Quantum Mechanics by S.Gasiorowicz
[4] Quantum Mechanics by A.P.Messiah
[5] Modern Quantum Mechanics by J.J. Sakurai
[6] Quantum Mechanics by L.I..Schiff
[7] Quantum Mechanics by Mathews and Venkatensan.

M.Sc. Physics Semester II Paper IX
Nuclear and Particle Physics 18PHY22C3

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

COURSE OUTCOMES

CO1 Students would be able to realize the nature of nuclear force.
CO2 Students would be able to understand the structure of nucleus and would be able to find out spin, parity, magnetic moments etc. of different nuclei.
CO3 Students would be able to understand different nuclear decays and reactions.
CO4 Students would gain a basic knowledge about Elementary Particles and their interactions.

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 Particles: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, Elementary group theory, reducible and irreducible representation,Characters of a representation, Direct Product, Continuous groups, Unitary groups;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 :

[1] A.Bohr and B.R. Mottelson, Nuclear Structure, Vol. 1(1969) and Vol. 2 (1975) ,
[2] Benjamin, Reading A, 1975
[3] Kenneth S. Kiane, Introductory Nuclear Physics, Wiley, New York, 1988
[4] Ghoshal,S.N Atomic and Nuclear Physics Vol. 2.
[5] P.H. Perkins, Introduction to High Energy Physics, Addison-Wesley, London, 1982
[6] A Preston and A Bhaduri : Nuclear Physics
[7] H. Frauenfelder and E. Henley : Subatomic Physics
[8] Elements of Group Theory for Physicists, By A. W. Joshi

M.Sc. Physics SemesterII Paper X

Solid State Physics18PHY22D1

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

COURSE OUTCOMES

The student will be expected to be able to:

CO1 Differentiate between different lattice types and explain the concept of reciprocal lattice and crystal diffraction using X-rays

CO2 Explain motion of electron in periodic lattice of solids under different binding conditions, concept of energy band and effect of same on electrical properties.

CO3 Lattice vibrations in solids and identity different types of defects in crystals

CO4 Explain various types of magnetic phenomena, superconductivity, physics behind them and their possible applications.

Unit I

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 reciprocal lattice and its application to diffraction techniques Ewald's construction, the Laue, powder and rotating crystal methods, atomic form factor, crystal structure factor and intensity of diffraction maxima. Crystal structure factors of bcc, fcc, monatomic diamond lattice, polyatomic CuZn.

Unit II

Vibration of one dimensional mono and diatomic 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, observation of imperfection in crystals, x-rays and electron microscopic techniques.

Unit III

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, magneto-resistance.

Unit IV

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

Occurrence of superconductivity, Meissner effect, Type-I and Type-II superconductors, Heat capacity, Energy gap, Isotope 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:

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

M.Sc. Physics Semester II Paper XI

Plasma Physics18PHY22D2

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

COURSE OUTCOMES

CO1 The students shall be able to realize / understand Plasma formation and basic concepts

CO2 The students will be able to analyze the theoretical concepts in context of time and space variations

CO3 The exposure to distribution functions will lead to analysis of macro parameters of plasma

CO4 The students will be able to analyze drift wave formation in magnetized plasma and theory of non-linear effects

Unit I

Introduction to the Plasma State, elementary concepts and definitions of temperature and other plasma parameters, occurrence and importance of plasma for various applications.Production of Plasma in the laboratory.Physics of glow discharge, electron emission, ionization breakdown of gases, Paschen's laws and different regimes of E/p in a discharge, Townsend discharge and the evolution of a discharge.Plasma diagnostics : Probes, energy analyzers, magnetic probes and optical diagnostics, preliminary concepts.

Unit II

Single particle orbit theory: Drifts of charged particles under the effect of different combinations of electric and magnetic fields. Crossed electric and magnetic fields.Homogenous electric and magnetic fields, spatially varying electric and magnetic fields, time varying electric and magnetic fields, particle motion in large amplitude waves.Fluid description of plasmas : distribution functions and Liouville's equation, macroscopic parameters of plasma, two and one fluid equations for plasma, MHD approximation commonly used in one fluid equations and simplified one fluid and MHD equations.

Unit III

Waves in fluid plasmas : dielectric constant of field free plasma, plasma oscillations, space charge waves of warm plasma, dielectric constant of a cold magnetized plasma, ion-acoustic waves, Alfven waves, Magnetosonic waves.Stability of fluid plasma : The equilibrium of plasma, plasma instabilities, stability analysis, two stream instability, instability of Alfven waves, Plasma supported against gravity by magnetic field, energy principle.Kinetic description of plasma : microscopic equations for many body systems : Statistical equations for a many body system, Vlasov equation and its properties, drift kinetic equation and its properties.

Unit IV

Waves in VlasovPlasma :Vlasov equation and its Linearization, solutions of linearisedVlasov equation, theories of Langumuir waves, Landau damping, Ion Acoustic waves, Drift waves in magnetized plasmas.Non-linear plasma theories :Non linear electrostatic waves, solitons, shocks, non linear Landau Damping.Thermonuclear fusion : Status, problems and technological requirements. Applications of cold low pressure and thermal plasmas.

Note : The syllabus is divided into four units. **Nine** questions will be set in all. QuestionNo.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 Plasma Physics, FF Chen.
Principles of Plasma Physics, Krall and Trievelpiece
Introduction to Plasma Theory, DR Nicholson
The Plasma State, JL Shohet
Introduction to Plasma Physics, M.Uman
Principles of Plasma Diagnostic, IH Hutchinson
Plasma Diagnostic Techniques, RH, Huddelstone and SL Leonard

M.Sc. Physics Semester II Paper XII
Practical: General Physics 18PHY22CL1

Max Marks: 100
Time: 4 Hrs.

COURSE OUTCOMES

CO1 Students would be able to determine the values of Stefan's constant, Boltzmann constant and e/m ratio of electron and experimental errors in each case.
CO2 Students would be able to understand magnetization and related aspects in a ferromagnetic material.
CO3 Students get familiarized with advanced spectroscopy.
CO4 Students would be able to understand the different harmonics and their amplitudes in a Fourier series experimentally which provide direct connect between theory and experiment.

[1] To determine the Dielectric constant of polar and non-polar liquids
[2] Determination of Ionization Potential of mercury
[3] To determine the Magnetic susceptibility of a solid sample.
[4] To study B-H curve of a given ferrite sample and find energy loss in case of ferrite Core.
[5] Determination of e/m of electron by Normal Zeeman Effects using Febry Perot Etalon.
[6] Stefan's constant by the black copper radiation plates (Electrical Method).
[7] To determine the heat capacity of solids
[8] To verify the existence of different harmonics and measure their relative amplitudes using Fourier Analysis kit

[9] To study of dielectric constant as a function of temperature and determine the Curie temperature
[10] To determine the Dielectric Constant of different solid samples
[11] Study of lead tin phase diagram
[12] To determine Boltzman Constant (k) make use of the black body Radiation and using Wien's displacement law and Stefan' s law
[13] To determine Planck's Constant (h) by measuring the voltage drop across light-emitting diodes (LEDs) of different colours
[14] To determine the value of energy levels using Frank-Hertz experiment
[15] Dissociation Energy of I_2 molecule

Note: Out of the list as above, a student has to perform atleast 08 (eight) practical's in the semester

M.Sc. Physics Semester II Paper XIII
Practical -Electronics 18PHY22CL2

Max Marks: 100
Time: 4 Hrs.

COURSE OUTCOMES

CO1 Students will be able to have functional knowledge about BJT's and FET's

CO2 Development of ability to design and analyze electronic circuits using discrete components

CO3 Students will be able to practically verify the frequency response of feedback amplifier single and multistage amplifiers

CO4 Measurement of various analog circuits and comparison of experimental results with theoretical analysis enable the student for problem solving.

[1] Digital I : Basic Logic Gates, NAND and NOR and Flip flops
[2] Astable, Monostable and BistableMultivibrater.
[3] Characteristics and applications of Silicon Controller Rectifier.
[4] Study of Emitter follower/Darlington Pair Amplifier model-C024
[5] To study the characteristics and frequency response of a push- pull amplifier
[6] To study the characteristics and frequency response of a Chopper Amplifier
[7] Wein Bridge and Phase shift oscillator.
[8] To study the frequency response of a two stages
  a) Transformer coupled amplifier
  b) Choke coupled amplifier.
[9] Integrating & Differentiating Circuits
[10] Working of Half & Full Adders
[11] Working of Half & Full Subtractors

Note: Out of the list as above, a student has to perform atleast 08 (eight) practicals in the semester

M.Sc. Physics Semester III Paper XVI
Atomic and Molecular Physics19PHY23C3

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

COURSE OUTCOMES

The student will be expected to be able to explain:

CO1 Atomic spectra of one and two electron atoms.
CO2 The change in behavior of atoms in external applied electric and magnetic field.
CO3 Diatomic molecules and their rotational vibrational and rotational vibrational spectra.

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 :

1. Introduction to Atomic and Molecular Spectroscopy by V.K.Jain

2. Introduction to Atomic spectra by H.E. White
3. Fundamentals of molecular spectroscopy by C.B. Banwell
4. Spectroscopy Vol I and II by Walker and Straughen
5. Introduction to Molecular spectroscopy by G. M. Barrow
6. Spectra of diatomic molecules by Herzberg
7. Molecular spectroscopy by Jeanne . L. McHale
8. Molecular spectroscopy by J.M. Brown
9. Spectra of atoms and molecules by P. F. Bemath
10. Modern spectroscopy by J.M. Holias

M.Sc. Physics Semester III Paper XVII
Electrodynamics and Wave propagation 19PHY23C2

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

COURSE OUTCOMES

CO1 Student would be able to formulate and solve electrodynamic problems in relativistic covariant form in four dimensional space.

CO2 Student would gain the knowledge about electrostatic and magnetic fields produced by static and moving charges in a variety of simple configurations.

CO3 Would be able to analyze the basics of theory of transmission lines and waveguides.

Unit I

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

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 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

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

1. Classical Electrodynamics by J.D. Jackson
2. Introduction to Electrodynamics by D.J. Griffiths
3. Electromagnetic by B.B. Laud
4. Classical Electricity and Magnetism by Panofsky and Phillips
5. Fundamentals of Electromagnetics by M.A. WazedMiah

M.Sc. Physics Semester - III Paper XVIII
Condensed Matter Physics –I19PHY23DA1

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

COURSE OUTCOMES

CO1 The students would be able to understand the bonding in metals, ionic and covalent crystals and also their thermal expansion and thermal conductivity.

CO2 Proper understanding of various theoretical concepts of optical properties of solids.

CO3 The students would understand different phenomena, and theoretical analysis of superconducting materials along with their applications in SQUIDs magnetometer.

CO4 The students would be able to classify superconductor materials in type-I & II and to have an elementary knowledge of high temperature superconductivity.

Unit-I

Difficulties of the classical theory, Free Electron Model, The Fermi Dirac Distribution, Electronic Specific Heats, Para-magnetism of Free Electrons, Thermionic and Field Enhanced Emission From Metals, Change of Work Function, The Contact Potential Between Two Metals, Photo-electric Effect, Electrical Conductivity of Metals: Features, Drift Velocity and Relaxation Time, Boltzmann Transport Equation, Somerfield Theory of Electrical Conductivity, Electron Phonon Collisions, Electrical Conductivity at Low Temperature, Thermal Conductivity of Metals and Insulators.

Unit-II

Static Dielectric Constant, Electronic and Ionic Polarizabilities, Orientation Polarization, Static Dielectric Constant of Gases and Solids, Complex Dielectric Constant and Loses, Dielectric Relaxation, Classical Theory of Electronic Polarization, Debye Equations, Cole-Cole Plots and Equivalent Circuits, Ferroelectrics: Ferroelectric Materials, Dipole Theory of Ferroelectrics, Ionic Displacement in $BaTiO_3$ above Curie Temperature, Ferroelectric Domains

Unit-III

The Optical Constants: Index of Refraction, Damping Constant(k), Characteristic Penetration Depth (W), Absorbance (A), Reflectivity (R), Transmittance (T) Hagen–Rubens Relation, Atomistic Theory of the Optical Properties: Free Electrons With & Without Damping, Reflectivity, Bound Electrons, Discussion of the Lorentz Equations, Contributions of Free Electrons and Harmonic Oscillators to the Optical Constants, Quantum Mechanical Treatment of the Optical Properties: Absorption of Light by Inter-band and Intra-band Transitions, Optical Spectra of Materials, Dispersion, Brief idea of Spectroscopic Ellipsometry.

Unit-IV

Ferromagnetism: Classical Theory of Ferromagnetism, Curie Weis Law, Quantum Theory Ferromagnetism, Exchange Energy, Origin of Domains and Domain Wall, Magnons: Dispersion Relations, Thermal Excitation and Heat Capacity, Anti-ferromagnetism: Neel Two Sub Lattice Model, Anti-Ferromagnetic Ordering, Ferri-magnetism: Spin Arrangement and Two Sub Lattice Model, Soft and Hard Magnetic Materials and Their Uses, Colossal and Giant Magneto-resistance.

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 & Reference Books

1. Solid State Physics by A. J. Dekker (Macmillan)
2. Introduction to Condensed Matter Physics By K.C. Barua (Narosa)
3. Principle of Electronic Materials and Devices by S. O. Kasap (Tata McGraw Hill)
4. Electronic Properties of Materials by Rolf E. Hummel (Springer)
5. Solid State Physics by Ashcroft &Mermin (Cengage Learning).
6. Introduction to Solid State Physics by Charles Kittel (Wiley).

M.Sc. Physics Semester -III Paper- XIX
Electronics – I 19PHY23DA2

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

COURSE OUTCOMES

After successful completion of the course, the students will be able to

CO1 express numbers, alphabets, special characters etc. in binary representation, perform mathematical operation in digitally and application of different codes.

CO2 implement Boolean expression with basic gates and design circuits to achieve desired output.

CO3 design basic building blocks of ICs for different electronics operations such as addition, subtraction, code generation, data register, counting etc.

CO4 develop various building blocks for ICs using MOSFET as MOS devices fabricated on a chip with high packing density and low power intake.

Unit I

Transistors: Bipolar junction Transistor (BJT) Transistor operating modes, Transistor action, Transistor biasing configurations and characteristics, The Ebers-Moll model, Field Effect Transistors: Junction Field Effect Transistor (JFET)

Negative Resistance devices: Tunnel Diode, Backward Diode, Uni-junction Transistor, p-n-p-n devices, p-n-p-n characteristics Thyristor, Silicon Controlled Switch, SCS Characteristics.

Unit II

AC load line, Transistor models and parameters, Equivalent circuits, Two-Port devices and Hybrid model, Transistor Hybrid model, Transistor h-parameters, Conversion for h-parameter for three Transistor Configurations, Analysis of a Transistor Amplifier Circuit for CE, CB, CC, Comparison of Transistor Amplifier Configurations, Linear Analysis of a Transistor Circuit, Miller's Theorem and its Dual, Cascading Transistor Amplifiers, classification of amplifiers, frequency response, RC coupled amplifier and its low frequency response

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. Integration, differentiation, analog computation, Butterworth active filters circuits,

Unit IV

Comparators, AC/DC converters: Half wave & full wave rectifier, clamping circuits, Logarithmic amplifier, antilogarithmic amplifier, sample and hold circuits Digital to analog conversion –ladder and weighted resistor types, analog to digital conversion- counter type, , regenerative comparator (Schemitt trigger), Basic principle of oscillators,: Feedback, Square wave generator, pulse generator, triangle wave generator. Sinusoidal oscillators using op-amp: Phase shift, Colpitts, Hartley and Wein Bridge oscillator

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. Fundamental of Electronics by J.D.Ryder (Prentice Hall Publication).
3. Electronics communication Systems by George Kennedy and Bernard George (McGraw Hill).
4. Linear Integrated Circuits by D.RoyChoudhury and Shail Jain (Wiley Eastern Ltd)
5. Solid State Electronic Devices by Ben G. Streetman ((Prentice Hall of India)
6. Electronic Devices and Circuit Theory by Robert L. Boylestad (Pearson).
7. Electronic Devices and Circuits, by David A. Bell (Oxford)

M.Sc Physics Semester - III Paper XX

Computational Physics – I 19PHY23DB1

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

COURSE OUTCOMES

CO1 Students would acquire a vision for use of computer in research prospective.
CO2 Students would be able to recognize the nature of a specific numerical problem and would develop the acumen for choosing an appropriate numerical technique to find its solution.
CO3 Students would be able to design Fortran programs to solve numerical computationally.

Unit I

Numerical Integration : Newton-cotes formulae : Trapezoidal rule, Simpson's 1/3 rule, error estimates in Trapezoidal rule and Simpson 1/3 rule using Richardson deferred limit approach ; Gauss-Legendre quadrature method; Monte Carlo (mean sampling) method for single, double and triple integrals.Numerical Differentiation: Taylor Series method; Generalized numerical differentiation: truncation errors.Roots of Linear, Non-linear Algebraic and Transcendental equations: Newton-Raphson method; convergence of solutions.Curve Fitting: Principle of least square; Linear regression; Polynomial regression;Exponential and Geometric regression.

Unit II

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 Order Differential Equations: First order Taylor Series method; Euler's method; Runge-Kutta methods; Predictor corrector method; Elementary ideas of solutions of partial differential equations, Numerical Solutions of Second Order Differential Equation: Initial and boundary value problems: shooting methods

UNIT IV

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; interpreters; Directory structure; File operators.

Introduction to FORTRAN 77:Data types: Integer and Floating point arithmetic; Fortran variables; Real and Integer variables; Input and Output statements; Formats; Expressions; Built in functions; Executable and non-executable statements; Control statements; Go To statement; Arithmetic 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; Subprograms: 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

1. Sastry : Introductory methods of Numerical Analysis.
2. Rajaraman: Numerical Analysis.
3. Ram Kumar : Programming with FORTRAN 77
4. Press, Teukolsky, Vellering and Flannery : numerical Recipes in FORTRAN.
5. Desai: FORTRAN programming and Numerical methods.
6. Dorn and McCracken : Numerical Methods with FORTRAN IV case studies.
7. Mathew : Numerical methods for Mathematics, Science and Engineering.
8. Jain, Iyngar and Jain: Numerical methods for Scientific and Engineering Computation"
9. Gould and Tobochnik : An Introduction to Computer Simulation methods part I and Part II.
10. McCalla : Introduction to Numerical methods and Fortran programming.
11. Verma, Ahluwalia and Sharma : Computation Physics : An Introduction.

M.Sc Physics Semester- III Paper XXI
Radiation Physics– I19PHY23DB2

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

COURSE OUTCOMES

After taking the course, students should be able to solve problems related to radiations and can explain

CO1 radioactivity and uses of radio-isotopes.
CO2 radiation quantities and units.
CO3 interaction of radiation with matter and neutrons.

Unit I

The Nucleus and Radioactivity: Atomic structure, Nuclear mass, Binding energy, binding energy curve and its interpretation, Isotopes, Isotones, Isobars, Nuclear size, Radioactivity, Modes of radioactive disintegration, Nature and properties of radioactive radiations, Radioactive decay, Half life time, Radioactive growth and decay, Radioactive equilibrium, Radioactive series, Radioactive branching, Radioactive dating, Artificial radioactivity, and Uses of radio-isotopes

Unit II

Other Sources of Radiations: X-rays: Characteristic X-rays, Bremsstrahlung (continuous) X-rays, X ray targets, and Clinical X ray beams; Cosmic rays: Discovery, Nature of a cosmic rays, soft and hard component, and Geometric effects on cosmic rays; Terrestrial radiations: Radon gas and Radioactive isotopes of lighter elements, Radiation quantities and units: Activity, KERMA, Exposure, Dose, Equivalent Dose, Effective Dose, Annual Limit on Intake (ALI), and Derived Air Concentration (DAC)

Unit III

Interaction of Radiation with Matter: Modes of interaction: ionization, excitation, elastic and inelastic scattering, Bremsstrahlung, Cerenkov radiation, concepts of specific ionization, mean free path; Interaction of Light Charged Particles with matter; Interaction of Heavy Charged Particles with matter; Interaction of Electromagnetic Radiations with matter: Photoelectric effect, Compton Scattering, and Pair production; Attenuation of Gamma Radiation: Linear and mass attenuation coefficient

Unit IV

Neutron Physics: Discovery of neutrons, Neutron sources, Neutron collimators, Properties of neutrons, Classification of neutrons according to energy, Neutron detectors: Slow neutron detectors (Boron trifluride proportional counter, Boron coated proportional counter, Helium-3 proportional counter, Fission counter, and Scintillation counters), Intermediate neutrons detectors, and Fast neutrons detectors, Neutron detection through slowing down of fast neutrons. Neutron monochromators, and nuclear fission

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 & Reference Books:

1. Nulcear and Particle Physics by S. L. Kakani and ShubhraKakani
2. Radiation Oncology Physics: a handbook for teachers and students; International Atomic Energy Agency Vienna, 2005
3. Practical knowledge for Handling Radioactive Sources by Dr. Claus Grupen
4. Introduction to Radiological Physics and Radiation Dosimetry by Frank Herbert Attlx

M.Sc. Physics Semester III Paper XXII
Practical: General Physics19PHY23CL

Max Marks: 100
Time: 4 Hrs.

COURSE OUTCOMES

CO1 Student will be able to conduct experiments, as well as to analyze and interpret data.

CO2 Student would be able to relate experiments with the theoretical aspects of the course.

CO3 Student would be able to learn working with basic laser systems.

[1] To study the low pass, High Pass and Band Pass filters using active and passive elements.
[2] Study of the Dispersion relation for the "Monoatomic Lattice" and Comparison with theory using Lattice dynamic kit
[3] Study of Hybrid parameters of a Transistor
[4] Study of the Dispersion relation for the Di-atomic Lattice, Acoustical mode and Energy gap and Comparison with theory using Lattice dynamic kit
[5] To determine the Lande- g factor of DPPH using ESR spectrometer.
[6] To determine the wavelength of He-Ne laser light using an engraved scale as a diffraction grating.
[7] Characteristics of Phototransistor
[8] Setting up a Fiber Optic Analog Link, Study of losses in Optical Fiber, Measurement of Propagation Loss and Measurement of Bending Loss.
[9] Study of characteristics of Fiber Optic LED & Detector, Measurement of Numerical Aperture and Study of Frequency Modulation & Demodulation using Fiber Optic Link.
[10] Study of Diode Characteristics
[11] To determine magneto resistance of a Bismuth crystal as a function of magnetic field.
[12] To study hysteresis in the electrical polarization of a TGS crystal and measure the Curie temperature.
[13] Measurement of thickness of thin wire with laser
[14] Measurement and analysis of fluorescence spectrum of I_2vapour
[15] To Study the Thermo-luminescence of F-Centers in Alkali Halides Crystals

Note: Out of the list as above, a student has to perform atleast 08 (eight) practicals in the semester

M.Sc. Physics Semester III Paper XXIII
Practical: Condensed Matter Physics 19PHY23DL1

Max Marks: 100
Time: 4 Hrs.

COURSE OUTCOMES

At the end of this laboratory course in Solid State Physics, students would beable to:

CO1 Characterize the semiconductor materialsby determining resistivity, band gap, mobility, and carrier type.
CO2 Understand phase transitions in ferroelectric materials and find the ferroelectric curie temperature (Tc)
CO3 Analyze the experimental data of powder diffraction in terms of indexing of peaks coming from different crystal planes and lattice parameters.
CO4 Find the magnetic susceptibility and energy loss/volume/cycle in ferromagnetic materials.

Observe dislocations and find their density in crystals. Also able to draw phase diagram of binary systems and detect eutectic point

[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 determine the band gap of Si material
[4] To study dielectric properties of liquids & Solids
[5] To study Hall Effect and to determine Hall coefficient.
[6] To study of dielectric constant as a function of temperature and determine the Curie temperature
[7] To determine the Dielectric Constant of different solid samples
[8] Study of lead tin phase diagram
[9] To determine the capacitance of a parallel plate Capacitor using Capacitance and permittivity kit
[10] To determine the curie temperature of Ferrites
[11] Measurement of Magneto-resistance of Semiconductors
[12] X-ray diffraction Simulation Experiment

Note: Out of the list as above, a student has to perform atleast 08 (eight) practicals in the semester

M.Sc. Physics Semester III Paper XXIV
Practical: Electronics 19PHY23DL2

Max Marks:100
Time: 4 Hrs.

COURSE OUTCOMES

CO1 Students would be able to demonstrate relation between the input and the corresponding digital output of various digital systems

CO2 Designing basic building blocks for the ICs for different electronics functions like addition, subtraction, code generation, data register, counting etc. would help in realizing complex circuits.

CO3 Students would be able to appreciate the effect of different types of modulation on the modulating signal.

CO4 Students would be enable for measurement of various digital circuits parameters and comparison of experimental outcomes with theoretical results

[1] Pulse position/Pulse width Modulation/Demodulation
[2] FSK Modulation Demodulation using Timer/PLL
[3] PLL circuits and applications
[4] BCD to Seven Segment display
[5] To study digital to analog and analog to digital conversion (DAC to ADC) circuit.
[6] Addition, subtraction, multiplication & division using 8085/8086.
[7] To study various applications of op-amp
[8] To study the digital comparator, 3 to 8 line Decoder and tri-state digital O/P circuits.
[9] To study analog voltage comparator circuit
[10] To study the binary module-6 and 8 decade counter and shift register.
[11] Exp. Board on Timer (555) Applications
[12] Study of frequency Multiplication using PLL
[13] Study of Frequency Modulation and Demodulation
[14] Study of Pulse Amplitude Modulations & Demodulation
[15] Transfer characteristics of TTL inverter and TTL trigger inverter with two digital volt meter
[16] Study of Module-N Counter using Programmable Counter IC 74190 with input Logics with LED display

Note: Out of the list as above, a student has to perform atleast 08 (eight) practical’s in the semester

M.Sc. Physics Semester IV Paper XXVI

Physics of Laser and Laser Applications 19PHY24C1

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

COURSE OUTCOMES

CO1 Student would be able to understand the diversity of laser designs and various applications.
CO2 Understand the basic concepts of most of the commercially available lasers.
CO3 Student will get the knowledge about the basic principles which form the basis of nonlinear optics.

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

Principle, working, characteristics and applications of Ruby Laser, Nd-Yag Laser, N_2 Laser, Dye-Laser, Semiconductor Laser.

Unit 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

1. Introduction to Atomic and Molecular Spectroscopy by V.K.Jain
2. Svelto : Lasers
3. Yariv Optical Electronics
4. Demtroder: Laser Spectroscopy

5. Letekhov : Non-Linear Spectroscopy
6. Principles of Lasers by Svelto
7. Lasers and Non-linear Optics by B.B. Laud.

M.Sc. Physics Semester IV Paper XXVII
Physics of Nano-materials19PHY24C2

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

COURSE OUTCOMES

CO1 Students would be able to explain the properties of Nanomaterials/nanostructures.
CO2 Students get enabled to analyze the density of states in various nanostructures and related effect on optical properties.
CO3 Students get acquainted with important techniques for preparation of Nanomaterials/nanostructures.
CO4 Understanding quantitatively, the experimental results of x-ray diffraction, photoluminescence and Raman spectra of Nanomaterials opens up avenues of future research.
CO5 Students would find themselves confident to carry out research work in this important field of Nanoscience/ Nano-technology.

Unit I

Free electron theory (qualitative idea) and its features, Idea of band structure, Metals, insulators and semiconductors, Concept of effective Mass, Density of States in Bands, Variation of Density of States with Energy, Variation of Density of States and Band Gap with Size of Crystal, Electronic Structure From Bulk to Quantum Dot, Electronic States in Direct and Indirect Semiconductor Nano-crystals, Excitions in Direct and Indirect Band Gap Semiconductors,

Unit II

Physics of Reduced Dimensional Systems and Devices: Quantum Confinement, Electron confinement in One, Two and Three Dimensional Infinitely Deep Square Well Potentials, Various Low Dimensional Systems: Quantum Well Structure; Idea of Quantum Well Structure, Electron Wave Function and Energy in Quantum Well Structure (Infinite Well Approximation), Density of States and Optical Absorption in Quantum Well, Quantum wires: Electron Wave Function and Energy, Density of States, Quantum Dots: Electron Wave Function and Energy, Density of States, Idea of Hetero-junction LED, Quantum Well Laser and Quantum Dot Laser, Coulomb Blockade and Single Electron Transistor.

Unit III

Synthesis/Fabrication of Nanomaterials/Nanostructures: Bottom up and Top down Approaches for Synthesis of Nano Materials, Synthesis of Zero-Dimensional Nanostructures (Nanoparticles): Sol-Gel Process, Synthesis inside Micelles or Using Micro-Emulsions and Growth Termination, Epitaxial Core-Shell Nanoparticles, Ball Milling, One-Dimensional Nanostructures (Nanowires, Nanorods Nanotubes): Vapor (or solution)-liquid-solid (VLS or SLS) growth and Size Control, Electrochemical deposition, Lithography, Two-Dimensional Nanostructures (Thin Films & Quantum Wells): Molecular Beam Epitaxy (MBE), MOCVD, Cluster Beam Evaporation, Ion Beam Deposition, Chemical Bath Deposition Technique

Unit IV

Characterization of Nanomaterials/Nanostructures: Effect of Particle Size and Strain on Width of XRD Peaks of Nanomaterials, Determination of Crystallite/Particle Size and Strain in Nanomaterials Using Debye Scherrer's Formula and Williamson–Hall's Plot, Transmission Electron Microscopy: Basic principle, Brief Idea of Set up, Sample Preparation, Imaging Modes (Dark & Bright Field), Selected Area Electron Diffraction, Photoluminescence (PL) Spectroscopy: Basic Principle and idea of Instrumentation, Shift in PL Peaks with Particle Size, Determination of Alloy Composition in Thin Films of Compound Semiconductors, Estimation For Width of Quantum Wells, Raman Spectroscopy: Basic Principle and idea of Instrumentation, Variations in Raman spectra of Nanomaterials with Particle Size, Study of Raman Spectra of Carbon Nanotubes and Graphene.

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. Physics of Low Dimensional Semiconductors by John H. Davies (Cambridge Univ. Press).
2. Introduction to Nano-technology by Charles P. Poole & Jr. Frank J. Owens (Wiley Inter-science).
3. Quantum Mechanics for Nanostructures by Vladimir V. Mitin, Dmitry I. Sementsov&Nizami Z. Vagidov (Cambridge University Press).
4. Nanostructures & Nanomaterials: Synthesis, Properties & Applications by Guozhong Cao (Imperial College Press).
5. Introduction to Nano: Basics to Nanoscience and Nanotechnology by AmretashisSengupta&Chandan Kumar Sarkar (Editor) [Springer].
6. Solid State Physics by A. J. Dekker (Macmillan).
7. Essentials in nano-science and nanotechnology by Narendra Kumar, SunitaKumbhat (Wiley)
8. Encyclopedia of Materials Characterization: Surfaces, Interfaces, Thin Films by C. Richard Brundle and Charles A. Evans, Jr.(BUTTERWORTH-HEINEMANN).

M.Sc. Physics Semester IV Paper XXVIII
Condensed Matter Physics –II19PHY24DA1

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

COURSE OUTCOMES

At the end of this theory course in Solid State Physics, students would be able to

CO1 Explain the concepts of point and space groups and experimental methods to find space groups, and to apply these for correct interpretation of x-ray diffraction data for crystal structure.
CO2 Understand the influence of symmetry elements on physical properties of materials.
CO3 Have understanding of exotic solids and their important applications.
CO4 Appreciate the synthesis of few important Nanomaterials as well as characterization techniques.

Unit-I

Interaction of atoms in a solid, Ionic Bonding, Born- Haber Cycle, Ionic Conductivity, Covalent Bonding: Properties, Metallic Bonding: Properties, Comparisons Between Ionic, Covalent and Metallic Bonding, Hydrogen Bonding, Classification, Electrostatic Nature: Properties, Van der Waals Bonding

Unit-II

Principle of Powder Diffraction Methods, Interpretation of Powder Photographs, Indexing of X-ray Diffraction Peaks of Poly Crystalline Materials, Determination of Lattice Parameters – Least Square Method, Oscillation and Burger Method, Calculating the Intensity of Diffraction Using the Structure Factor Equation, Determination of Relative Structure Amplitudes: Multiplicity, Polarization Factor, Lorentz Factor, and Temperature Effects

Unit-III

Definitions of the dielectric function Plasma optics Dispersion relation for electromagnetic waves Transverse optical modes in a plasma Transparency of metals in the ultraviolet Longitudinal plasma oscillations plasmons, Screened coulomb potential Pseudopotential component U(0), Mott metal-insulator transition, Screening and phonons in metals polaritons, Electron-electron interaction: Fermi liquid, Electron-electron collisions, Electron-phonon interaction: polarons

Unit-IV

Synthetic Carbon Allotropes, Fullerene: Formation, Characterization and Applications, Carbon Nanotubes (CNTs): Classification, Physical Structure, Synthesis Methods, Electronic Properties, Optical, Mechanical Properties and CNTs Based FETs, Graphene: Electronic Structure of Graphene, Properties, Synthesis & Applications

Text & References Books

1. Elements of X-ray Diffraction by B. D. Cullity.(Pearson)

2. Solid State Physics by A. J. Dekker (Macmillan)
3. Solid State Physics by Ashcroft &Mermin (Cengage Learning).
4. Introduction to Solid State Physics by Charles Kittel(Wiley).
5. Applied Solid State Physics by Rajnikant (Wiley).
6. Solid State Physics: Structure and Properties of Materials by M.A. Wahab(Wiley).

M. Sc Physics Semester IV Paper XXIX

Electronics – II 19PHY24DA2

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

COURSE OUTCOMES

After successful completion of the course, the students will be able to

CO1 understand the fabrication process of solar cells, photodiodes, PMT's etc.
CO2 analyse the functioning of various communication devices such as TV, Radio, mobile phone etc.
CO3 realize the performance of operational amplifier for various mathematical operationssuch as addition, subtraction, differentiation, integration etc.
CO4 understand circuit analysis and implementation of operational amplifier for various applications like comparator, A/D & D/A convertor, oscillators etc.

Unit I

Binary numbers, Octal numbers, Hexadecimal numbers, Inter-conversions of numbers. Binary addition, subtraction, multiplication, division, Hexadecimal addition, subtraction , Octal addition, subtraction signed numbers, 1's complement arithmetic, 2's complement arithmetic, 9's complement arithmetic, BCD code and arithmetic, Gray code, excess-3 code.
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, K-maps, don't care condition, deriving SOP and POS expressions from truth tables.

Unit II

Combinational Digital circuits: Binary adders:half adders & full adders,Decoders, Multiplexer, Demultiplexer, Encoders, ROM and its application (binary, BCD, Excess-3 Code, Gray Code & BCD to seven segment), Digital comparator, Parity checker and generator
Sequential Digital Circuits: 1-bit memory, Flip-Flops- RS, JK, master slave JK, T-type and D-type flip flops, Shift-register and applications, Asynchronous counters and Synchronous counters

Unit III

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

Unit IV

Fundamentals of modulation, Frequency spectra in AM modulation, power in AM modulated class C amplifier, Efficiency modulation, frequency conversion, SSB system, Balanced modulation, filtering the signal for SSB, phase shift method, product detector, Pulse modulation, Microwave Devices: Resonant Cavity, Klystrons and Magnetron

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).
4. Electronic Fundamentals And Applications by John D. Ryder (Prentice-Hall)
5. Foundation for Microwave Engineering by Robert E. Collin (Wiley)
6. Digital Principles and Applications by Donald P leach, Albert Paul Malvino (McGraw-Hill)

M.Sc. Physics Semester IV Paper XXX
Computational Physics – II 19PHY24DB1

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

COURSE OUTCOMES

CO1 Students would be able to understand framework of computer languages
CO2 Students would be able to solve numerically various physical problems
CO3 Students would gain the necessary basic knowledge of application of MATLAB for problem solving

Unit - I

Random numbers: Random number generators, Mid-square methods, Multiplicative congruential method, mixed multiplicative congruential methods, modeling of radioactive decay. Hit and Miss Monte-Carlo methods, Monte-Carlo calculation of π, Monte-Carlo evaluation of integration, Evaluation of multidimensional integrals, chaotic dynamics: Some definitions, the simple pendulum, Potential energy of a dynamical system, Un-damped motion, Damped motion, Driven and damped oscillator.

Unit-II

Numerical solution of Radial Schrodinger equation for Hydrogen atom using Forth-order Runge-Kutta method(when Eigen value is given), Numerical Solutions of Partial Differential Equations using Finite Difference Method, Algorithms to simulate interference and diffraction of light, Simulation of charging and discharging of a capacitor, current in LR and LCR circuits, Computer models of LR and LCR circuits driven by sine and square functions, Computer model of Rutherford scattering experiment, Simulation of electron orbit in H_2 ion.

Unit –III

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

Unit-IV

MATLAB – II: Linear Algebra; solving a linear system, Gaussian elimination, finding eigenvalues and Eigen vectors, matrix factorization, Curve fitting and Interpolation; polynomial curve fitting, least square curve fitting, interpolation, Data analysis and statistics, Numerical integration; double integration, Ordinary differential equation; first order linear ODE, second order nonlinear ODE, tolerance, ODE suite, event location, Non-linear algebraic equations

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 & Reference Books:

1. Introduction to Numerical Analysis by F B Hildebrand (Tata McGraw Hill)
2. Fortran Programming and Numerical methods by R C Desai (Tata McGraw Hill).
3. Computer Applications in Physics by Suresh Chandra (Narosa Publishing House)
4. Numerical Recipes in Fortran 77 By William H. Press, Saul A Teukolsky, William T Vellerling and Brain P. Flannery (Cambridge University Press)
5. Introduction to Computation Physics by M L De Jong (Addison-Wesley).
6. Computational Physics an Introduction by R C Verma, P K Ahluwalia and K C Sharma (New Age International).
7. Computer Oriented Numerical Method by V Rajaraman (PHI).
8. An introduction to numerical analysis by K E Atkinson (John Wiley and Sons).
9. Getting Started with MATLAB by RudraPratap (Oxford University Press).
10. A concise introduction to MATLAB by William J Palm III (McGraw Hill).

M.Sc. Physics Semester IV Paper XXXI
Radiation Physics – II 19PHY24DB2

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

COURSE OUTCOMES

After taking the course, students should be able to handle and resolve problems related to

CO1 radiation detectors.
CO2 Biological effects of radiation.
CO3 radiation hazard.

Unit I

Principles of radiation detection; Gas filled radiation detectors: ionization chambers, proportion counters, GM counters, and Spark counter. Scintillation (organic/inorganic) counter; Solid State Detector: Crystal detector, Semiconductor Detectors (Junction type detector, Lithium drift Germanium detector, and HPGe), Thermo – Luminescent Dosimeters (TLD), Chemical detectors (Photographic Emulsions Films), Radiation Monitoring Instruments and Calibration check of radiation monitoring equipment.

Unit II

Biological Effects of Ionizing Radiation:Introduction, Cell Biology: Structure and function of living cell, cell division-mitosis, meiosis and differentiation, central dogma of molecular biology, genetic codes-DNA, RNA and Proteins; Effect of Radiation on Cell: inhibition of cell division, chromosome aberrations, genes mutation, and cell death; Biological effects of Radiation on Human: Somatic Effects (Early effect) and Stochastic effect (Late effect).

Unit III

Principles of Radiological Protection: Justification of Practice, Optimization of Practice, and Dose Limitations; Internal Exposure, Dose Limit for (i) Radiation Workers (ii) Public, Occupational Exposure of Women, Apprentices and Students .

Production of Radioisotopes and Labeled Compounds: Introduction, Separation of Isotopes, Production of labeled compounds, Specific Activity of labeled compounds, Storage, Quality, and Purity of Radio-labeled compounds.

Unit IV

Radiation Hazard: Internal Hazards and External Hazards; Evaluation and Control of Radiation Hazard, Radiation Shield, Monitoring of External Radiation, Control of Internal Hazard: (i) Containment of Source (ii) Control of Environment (iii) Contamination (iv) Air Contamination Monitoring (v) Personal Contamination Monitoring (vi) Decontamination Procedures; Radiation Emergency and Preparedness.

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 & Reference Books:

1. Radiation Oncology Physics: a handbook for teachers and students; International Atomic Energy Agency Vienna, 2005
2. Practical knowledge for Handling Radioactive Sources by Claus Grupen
3. Introduction to Radiological Physics and Radiation Dosimetry by Frank Herbert Attlx
4. Radiation Biology: a handbook for teachers and students; International Atomic Energy Agency Vienna, 2010

M.Sc. Physics Semester IV Paper XXXII

Practical: General Physics 19PHY24CL

Max Marks: 100
Time: 4 Hrs.

COURSE OUTCOMES

At the end of this laboratory course in general physics, students would be able to:

CO1 Realize monoatomic and diatomic linear chain of atoms using passive electrical components and able to find the cut off frequency and understand dispersion relation as well as energy gap.

CO2 Devise and understand various filter circuits and frequency response of push – pull amplifier.

CO3 Determine the band gap of semiconductor materials, magnetic susceptibility of magnetic materials and dielectric constants of liquids.

CO4 Comprehend fiber optic communication, different mechanism of signal loss and various type of pulse modulation.

[1] Verification of Hartmann formula for prism spectrogram
[2] Measurement of optical spectrum of an alkali atom
[3] Study of Linear Wave shaping circuits with step and square wave functions
[4] Determination of the Cut-off frequency of the Monoatomic Lattice using Lattice dynamic kit
[5] To study dielectric properties of liquids & Solids
[6] To study Hall Effect and to determine Hall coefficient.
[7] Setting up a Fiber Optic Digital Link, Study of Modulation & Demodulation of light source by Pulse Width Modulation (PWM),
[8] Study of Modulation & Demodulation of Light source by Pulse Position Modulation (PPM) and Setting up a Fiber Optic Voice Link.
[9] To determine the specific heat of Nano Fluids
[10] To study the characterization and phase transition using Nanofluid Interferometer
[11] Study of Energy band gap and diffusion potential of PN junction
[12] Study of NMR spectra using NMR spectrometer
[13] Characteristics of Opto-Electronic Devices
[14] Determination of thermal conductivity of given bar at different temperatures

[15] To measure refractive indices of liquids, transparent and translucent solutions and solids using Abbe- Refractometer

Note: Out of the list as above, a student has to perform atleast 08 (eight) practicals in the semester

M.Sc. Physics Semester IV Paper XXXIII
Practical Computational Physics19PHY24DL1

Max Marks: 100
Time: 4 Hrs.

COURSE OUTCOMES

CO1 Students would develop understanding for programming concepts.
CO2 Students would learn the practical implementation of programming languages for carrying numerical calculations.
CO3 Students would be benefited from their enhanced computational skills in context of higher studiesin physics or business purposes as well.

List of programs using FORTRAN

[1] Numerical Integration
[2] Least square fitting
[3] Numerical solutions of equations (single variable)
[4] Solution of H-atom problem
[5] Solution of RL circuits
[6] Numerical solution of simultaneous linear algebraic equations
[7] Numerical solution of ordinary differential equation
[8] Numerical Solution of second order ordinary differential equations
[9] Motion of Projectile thrown at an angle
[10] Simulation of Planetary Motion
[11] Charging and discharging of Capacitor
[12] Solution of LCR circuit

Note: Out of the list as above, a student has to perform atleast 08 (eight) practicals in the semester

M.Sc. Physics Semester IV Paper XXXIV
Practical - Radiation Physics19PHY24DL2

Max Marks: 100
Time: 4 Hrs.

COURSE OUTCOMES

CO1 Students will get hand on experience on GM counter, Spark Counter, Scintillation counter
CO2 Student will be able measure range of alpha, beta particles, attenuation coefficient
CO3 Students will be aquatinted with different techniques of detection of nuclear radiations
CO4 Students will be appreciate the interaction of nuclear radiation with mater

[1] Investigation of the plateau and optimal operating voltage of a Geiger-Muller counter
[2] Investigation of statistical nature of counting rate
[3] To determine the resolving time of a GM counter
[4] To investigate the relationship between absorber materials (atomic number), absorption thickness and backscattering.
[5] To verify the inverse square relationship between the distance and intensity of radiation.
[6] To investigate the attenuation of radiation via the absorption of beta particles.
[7] To determine the maximum energy of decay of a beta particle.
[8] Measurement of range of α particle range in air using a spark counter
[9] Study of the attenuation coefficients of the γ rays for Al, Fe and Pb using NaIscintillation counter
[10] Measurement of γ ray energy of Cs-137 source using a NaIScintillation detector

Note: Out of the list as above, a student has to perform at least 08 (eight) practicals in the semester