M.Sc. Physics

Scheme and Syllabus

School of Distance Education
Andhra University, Visakhapatnam, Andhra Pradesh

PREVIOUS

S.No.	Paper	Name of the Paper
1	Paper –I	Mathematical Methods of Physics
2	Paper-II	Classical Mechanics
3	Paper-III	Introductory Quantum Mechanics
4	Paper-IV	Electronic Devices and Circuits
5	Paper-V	Atomic and Molecular Physics
6	Paper – VI	Statistical Mechanics
7	Paper – VII	Electrodynamics
8	Paper-VIII	Solid State Physics

FINAL

S.No	Paper	Name of the Paper
1	Paper – I	Advanced Quantum Mechanics
2	Paper – II	P-II: Molecular Spectroscopy and Lasers
3	Paper – III	Fermi Surfaces and Order Disorder Transformations
4	Paper -IV	: Digital Electronics & Microprocessors
5	Paper -V	Computational Methods and Programming in “C”
6	Paper -VI	Nuclear and Particle Physics
7	Paper -VII	Magnetic Materials, Resonance Techniques and Semiconductor Devices
8	Paper -VIII	Communication Electronics

M.Sc. Physics
Two Year Programme Structure

The Programme Objectives (POs) of M.Sc. Physics are:

- To impart quality education in Physics to students through well designed courses offundamental interest and of technological importance.
- To foster scientific attitude, provide in-depth knowledge of scientific and technological concepts of Physics.
- To enable the students to acquire deep knowledge in fundamental aspects of all branches of Physics.
- To enrich knowledge through problem solving, practical training, project work,seminars, tutorials, participation in scientific events, study visits, etc.
- To familiarize with recent scientific and technological developments.
- To assist the students in acquiring basic knowledge in the courses like MathematicalPhysics, Numerical Methods, Classical Mechanics, Quantum Mechanics, Electromagnetic Theory, Electronics, Experimental Methods, Atomic and Molecular Physics, Nuclear Physics, Solid State Physics and in the specialized thrust areas such as Materials Science, Nano Science,Fiber Optics, Communication Electronics and project-based learning.
- To create foundation for research and development in Physics and to train students in skillsrelated to research, education and industry.
- To develop abilities and skills that encourage research and development activities and are useful in day-to-day life.
- To help students to learn various experimental and computational tools thereby developing analytical abilities to address real time problems.
- To inculcate scientific bent of mind and attitude relevant to science such as concern forefficiency, accuracy and precision, objectivity, integrity, enquiry, effectivecommunication, ethical responsibilities, initiative and inventiveness.
- To help students to build-up a progressive and successful career in Physics.

Previous year Subjects:

1. Mathematical Methods of Physics
2. Classical Mechanics
3. Introductory Quantum Mechanics
4. Electronic Devices and Circuits
5. Atomic and Molecular Physics
6. Statistical Mechanics
7. Electrodynamics
8. Solid State Physics

Practical-I Modern Physics
Practical-II Electronics Lab

Final year Subjects:

1. Advanced Quantum Mechanics
2. Molecular Spectroscopy and Lasers
3. Fermi surfaces and Order Disorder Transformations
4. Digital Electronics & Micro Processors
5. Computational Methods and Programming in "C"
6. Nuclear and Particle Physics
7. Magnetic Materials, Resonance techniques and Semiconductor Devices
8. Communication Electronics

Practical-I Solid State Physics Lab
Practical-II Special / Digital Electronics Lab

Course Objectives of M.Sc. Physics Previous year – Paper 1

Mathematical Methods of Physics

- To provide students the ability to hone the mathematical skills necessary to approach problems in advanced physics courses.
- To expose the students towards the fascinating world of complex analysis.
- To make the students learn about special functions essential in solving physics problems.
- To make them understand about Fourier series and Fourier transforms.
- To expose the students, get acquainted with the various numerical methods.
- To make them understand about tensor analysis.
- To understand and apply the mathematical skills to solve quantitative problems in the study of Physics.
- To apply integral transform to solve mathematical problems of interest in Physics.
- To use Fourier transforms as an aid for analyzing experimental data.
- To formulate and express a physical law in terms of tensors, and simplify it by use of coordinate transforms.

Syllabus of Paper 1: Mathematical Methods of Physics

1. SPECIAL FUNCTIONS:

Legendre polynomials, Generating function, Recurrence Relations, and Orthogonality property/Associated Legendre polynomials, Spherial Harmonics] [Hermite polynomials Generating function, Recurrence relations, and orthogonality property [Laguerre polynomials, Generating function, Recurrence Relations and orthogonality property]

2. FOURIER SERIES AND FOURIER TRANSFORMS:

Fourier Series, Complex Representation of Fourier Series/Applications of Fourier Series Fourier Transforms, Fourier Transform of derivatives][Convolution theorem. Applications of Fourier Transforms).

3. FUNCTIONS OF A COMPLEX VARIABLE:

Complex, Algebra, Cauchy-Riemann Conditions, Analytic functions [Cauchy's integral theorem, Cauchy's integral formula,][Taylor's Series, Laurent's expansion][Singularities, Calculus of Residues, Cauchy's Residue theorem, Evaluation of Residues/Evalution of contour integrals.

4.LAPLACE TRANSFORMS:

[Definition and properties of Laplace Transforms Laplace Transforms of elementary functions. Laplace transforms of derivaties] [Inverse Laplace Transform, Convolution theorem][Applications of Laplace Transforms]

5. TENSOR ANALYSIS:

[Introduction. Transformation of Co-ordinates, Contravariant, Covariant and Mixed tensors][Addition and multiplication of tensors, contraction and Quotient Law The line element, fundamental tensors]

6. GROUP THEORY:

[Definition, Subgroups, Conjugate subgroups, Isomorphism,][Representation of groups, Character, Cyclic group, Symmetric Group. Unitary group [Two-and Three dimensional Rotational Groups/Dihedral Group, Crystallographic point groups]

Course Objectives of M.Sc. Physics Previous year – Paper 2

Classical Mechanics

- To demonstrate knowledge and understanding of the following fundamental concepts in dynamics of particles.
- To represent the equations of motion for complicated mechanical systems using the Newtonian, D'Alembert, Lagrangian and Hamiltonian formulation of classical mechanics.
- The course discusses the planetary motion and Kepler's laws, Legendre transformations, canonical transformations, Hamilton's equation of motion, Hamilton-Jacobi equations and its applications.
- It explains the motion of rigid bodies and Euler's angles, Corioliseffect.
- The course discusses the special theory of relativity and its applications and also gave the introduction to the general theory of relativity.
- To know the concepts of classical mechanics describe and understand the motion of a mechanical system using Lagrange-Hamilton formalism.
- To know about canonical transformations, Hamilton's equations of motion.
- To understand the concept of planar and spatial motion of a rigid body.
- To differentiate special theory of relativity and general theory of relativity.

Syllabus of Paper-2 Classical Mechanics

UNIT-I: Mechanics of a particle. Mechanics of a system of particles, constraints, D'Alembert's principle and Lagrange's equations, Velocity Dependent potentials and the Dissipation function Simple applications of the Lagrangian Formulation

Chapter: 1. Section: 1, 2, 3, 4, 5 & 6.

Hamilton's principle, some techniques of the calculus of variations.Derivation of Lagrange's equations from Hamilton's principle. Conservation theorems and symmetry properties, Energy function and the conservation of Energy

Chapter: 2. Section: 1, 2, 3, 5 & 6

UNIT-II: Reduction to the equivalent one body problem. The equation of motion and first Integrals, the equivalent One – Dimensional problem and classification of orbits, the differential equation for the orbit, and Integrable power –law potentials, Conditions for closed orbits (Bertrand's theorem), The Kepler problem inverse square law of force, The motion in time in the Kepler problem, Scattering in a central force field.

Chapter: 3. Section. 1, 2, 3, 5, 6, 7 & 8

Legendre transformations and Hamilton's equations of motion. Cyclic Coordinates, Derivation of Hamilton's equation of motion from variational principle, Principle of Least Action.

Chapter: 7 Section: 1, 2, 3, 4 & 5.

UNIT-III: Equations of canonical transformation, Examples of Canonical transformations, The harmonic Oscillator, Poisson brackets and other Canonical invariants, Equations of motion, Infinitesimal canonical transformations, and conservation theorems in the Poisson bracket formulation, the angular momentum Poisson bracket relations.

Chapter: 8. Section: 1, 2, 4, 5, 6 & 7.

Hamilton – Jacobi equation of Hamilton's principal function, The Harmonic oscillator problem as an example of the Hamilton – Jacobi Method, Hamilton – Jacobi equation for Hamilton's characteristic function. Action – angle variables in systems of one degree of freedom.

Chapter: 9. Section: 1, 2, 3 & 5.

UNIT-IV: Independent coordinates of rigid body. The Euler angles, Euler's theorem on the Motion of a rigid body, Infinitesimal rotations, Rate of change of a vector, The Coriolis Effect.

Chapter: 4. Section: 1, 4, 6, 8 & 9.

The Inertia tensor and the moment of inertia, The Eigenvalues of the inertia tensor and the principal axis transformation, Solving rigid body problems and Euler equations of motion, Torque – free motion of a rigid body

Chapter: 5 Section: 3, 4, 5 & 6.

The Eigenvalue equation and the principal axis transformation, Frequencies of free vibration, and normal coordinates, free vibrations of a linear triatomic molecule

Chapter 10 Section: 2, 3 & 4.

UNIT – V: Special Theory of Relativity, Basic Postulates of the Special Theory, Lorentz Transformations, Velocity Addition and Thomas Precession, Relativistic Kinematics of Collisions and Many-Particle Systems, Relativistic Angular Momentum, Lagrangian Formulation of Relativistic Mechanics, Covariant Lagrangian Formulations, Introduction to the General Theory of Relativity.

Chapter 7 Sections 1 to 11.

Course Objectives of M.Sc. Physics Previous year – Paper 3

Introductory Quantum Mechanics

- To experiment a wave with a precise wavelength (momentum) does not possess a precise location and vice versa.
- To conjugate measurable properties and the consequences there of, constitute the essential content of quantum mechanics.
- To focus Elementary quantum mechanics.
- To provide an understanding of the formalism and language of non-relativistic quantum mechanics.
- To help in understanding the concepts of time-independent perturbation theory and their applications to physical situations.
- To formulate and solve problems in quantum mechanics using Dirac representation.
- To grasp the concepts of spin and angular momentum, as well as their quantization and addition rules.
- To be familiar with various approximation methods applied to atomic, nuclear and solid-state physics.
- To organize in such a way that a student at the end, is skilled enough to understand the advance level Quantum Mechanics.

Syllabus of Paper3: Introductory Quantum Mechanics

1. The Conceptual aspect (Thankappan Sec 1.1) Wave particle duality, Bohr's complementarity principle Wave function and its interpretation Principle of superposition Wave packets –phase velocity and group velocity Uncertainty relation
2. Postulates of Quantum Mechanics Schrodinger wave equation, Conservation of probability Operators and their properties. Equation of Motion for operators, Hermitian operators and their Eigenvalues and eigenfunctions Stationary states, Bohr's correspondence principle Coordinate and Momentum representation Ehrenfest's theorem Commutator Algebra.
3. Dirac Delta function, definition and properties "Dirac Delta Normalization
4. One dimentional problems Free Particle Potential step Rectangular Potential Barrier Potential Well Linear Harmonic Oscillator
5. Angular Momentum Angular Momentum in spherial polar coordinates, Eigenvalues and eigenfunctions of 2 Lˆ , Lz ˆ , L+ ˆ and Lˆ operators Commutation relations Rigid Rotator, Hydrogen atom.
6. Time- independent perturbation theory for (i) non - degenerate systems and (ii) degenerate systems Application to linear Stark effect in Hydrogen, Variation method and its application to Helium atom. Electron spin , spin -orbit interaction, fine structure , Lande's interval rule.

Course Objectives of M.Sc. Physics Previous year – Paper 4

Electronic Devices and Circuits Module

- To make the students familiar about the concepts of components used in various electronic devices.
- To make the students learn and understand the basics of analogue electronics.
- To develop an understanding of fundamentals of electronics in order to deepen the understanding of electronic devices that are part of the technologies that surround us.
- To use techniques for analyzing analogue electronic circuitsand formulate the concepts of semiconductor devices, microwave devices, operational amplifier circuits and electronic measurements, instrumentation and experimental methods.
- To understand the fundamentals behind analog devices.

Syllabus of Paper – 4 Electronic Devices and Circuits Module

1 Semi – Conductor & Microwave Devices : Tunnel Diode,Photo diode, Solar Cell, LED, Varactor diode, Silicon Controlled Rectifier, Phototransistor, Uni Junction Transistor, Field Effect Transistor, JFET MOSFET, Klystron, Magnetron, Traveling wave tube, Gunn Dioide, IMPATT diode, TRAPATT diode, PIN Diode, Schottky Barrier Diode, APD. Module :

2 Feedback in Amplifiers : Feedback concept, transfer gain with feedback, general characteristics of negative feedback in amplifiers, voltage series feedback, current series feedback, current shunt feedback, voltage shunt feedback. Module :

3 Tuned Amplifiers : Classification of tuned amplifier, single – tuned capacitor –coupled amplifier, single –tuned inductor – coupled amplifier, double – tuned amplifier. Module :

4 Power Amplifier : Class A large signal amplifier, transformer – coupled amplifier, push – pull amplifier, Class B amplifier, Class AB amplifier. Module :

5 Oscillators and Multi-Vibrators : Classification of oscillators, Colpitts oscillator, Hartley oscillator, Wien-bridge oscillator, Crystal oscillator, Astable, Bi-stable and Monostable Multi-vibrators. Module :

6 Operational Amplifiers (OP AMP) : The ideal Op Amp – Practical inverting and non inverting Op Amp Stages. Op Amp Architecture – differential stage, gain stage, DC level shifting, output stage, offset voltages and currents. Operational Amplifier parameters input offset voltage (V io), input bias current (Ib) – Common Mode Rejection Ratio (CMRR), Slew Rate, Open loop voltage gain. Operational Amplifier Applications :Summing amplifier (adder), Integrator, Differentiator, Voltage – Current converter, Current – Voltage converter

Course Objectives of M.Sc. Physics Previous year – Paper 5

Atomic and Molecular Physics

- To provide an understanding of the fundamental aspects of atomic and molecular physics.
- To make the students understand various couplings effects.
- To study spectroscopy of the one electron, one valence electron, multi-electron atoms and diatomic molecules.
- To make the students understand about various absorption/emission spectroscopic transitions.
- To make the students understand Quantum mechanical phenomenon at the atomic and molecular level.
- To make the students understand the molecular orbits using Electronic Spectroscopy and Resonance Raman Spectra.
- To understand the normal and anomalous splitting of atomic and molecular energy levels.
- To undertand quantum behavior of atoms in external electric and magnetic fields.
- To understand infrared spectroscopy.
- To unserstand the spectroscopy of molecules using Raman Effect.
- To understand the molecular vibrations using the Group Theory.

Syllabus of Paper-5Atomic and Molecular Physics

UNIT-I: One Electron Atoms

Derivation of Quantum numbers, Term values, Relation between Magnetic dipole moment and angular momentum of an orbiting electron, Spin- orbit interaction, relativistic kinetic energy correction and dependence of energy on J value only, Selection rules. Fine structure of Hydrogen spectra, Fowler series of ionized Helium, Hyperfine structure of Hα line of hydrogen ($I = ½$).

One Valence Electron Atoms:

Modified term values (quantum defect) due to lifting of orbital degeneracy by core penetration (penetrating orbits), core polarization (non-penetrating orbits) by nl electrons. Term values, Fine structure of chief spectral series of sodium, Intensity rules and application to doublets of sodium. Hyperfine structure of ^2P-^2S transition of sodium ($I= 3/2$).

UNIT-II: Many Electron Atoms

Indistinguishable particles, bosons, fermions, Pauli's principle, Ground states, LS coupling and Hund's rules based on Residual columbic interaction and spin-orbit interaction, Lande's interval rule, Equivalent and non-equivalent electrons, Spectral terms in LS and JJ coupling (ss,s2 ,pp,p2 configurations), Exchange force and Spectral series of Helium.

UNIT – III

Atoms in External Magnetic Field: Normal Zeeman effect, Anomalous Zeeman effect and Paschen-Back effects and application to ^2P-^2S, ^3P-^3S, transitions.
Atoms in External Electric Field: Linear stark pattern of Hα line of hydrogen, Quadratic stark pattern of D1 and D2 lines of Sodium.

UNIT-IV: Diatomic Molecules

Molecular quantum numbers, Bonding and anti-bonding orbitals from LCAO's, Explanation of bond order for N2 and O2 and their ions, Rotational spectra and the effect of isotopic substitution, Effect of nuclear spin functions on Raman rotation spectra of H2 (Fermion) and D2 (Boson), Vibrating rotator and its spectrum, Combination relations and evaluation of rotational constants (infrared and Raman), Intensity of vibrational bands of an electronic band system in absorption.(The Franck-Condon principle), Sequences and progressions, Deslandre's table and vibrational constants.

UNIT- V: Molecular Vibrations

Symmetry elements, operations and identification of point Groups of AH_2, A_2H_2, ABH_2, AB_2H_2, AH_3, and ABH3 type molecules, Properties of irreducible representations and C2v character table. Reducible representation and symmetry in fundamental vibrations of H_2O. Structure determination of AB_2 type molecules from observed and expected fundamental bands of Raman and IR Spectra.

Molecular orbitals:

Walsh diagram, electronic spectroscopy, Herzberg – Teller effect, Resonance Raman Scattering, Fluorescence and Resonance Raman Spectra, Nonlinear effects and Raman Spectra.

Course Objectives of M.Sc. Physics Previous year – Paper 6

Statistical Mechanics

- To introduce statistical mechanics and includes the concepts of phase space, ensembles and calculations of thermodynamic parameters using the concepts of ensembles.
- To discuss partition functions and their properties and its applications.
- To explain quantum statistics such as Maxwell-Boltzmann statistics, Bose-Einstein and Fermi-Dirac statistics, Bose-Einstein condensation, theory of dwarf stars.
- To describe phase transitions and calculation of partition function for non-ideal classical gas.
- T be able to understand the concepts of phase space, different kinds of ensembles and how to obtain the thermodynamic parameters using these concepts.
- To be able to know what Gibb's paradox is and how to resolve it.
- To be able to differentiate types of quantum statistics and able to know the difference between ideal and non-ideal classical gas.
- To be able to understand types of orders of phase transitions.

Syllabus of Paper 6 Statistical Mechanics

1. Basic Methods and Results of Statistical Mechanics: Specification of the state of a system, phase space and quantum states, Liouvilles theorem, Basic postulates, Probability calculations, concept of ensembles, thermal interaction, Mechanical interaction, quasi static process, distribution of energy between systems in equilibrium, statistical calculations of thermo dynamic quantities, Isolated systems (Microcanonical ensemble). Entropy of a perfect gas in microcanonical ensemble.Canonical ensemble - system in contact with heat reservoir, system with specified mean energy, connection with thermodynamics, Energy fluctuations in the canonical ensemble.Grand canonical ensemble, Thermodynamic function for the grand canonical ensemble.Density and energy fluctuations in the grand canonical ensemble.Thermodynamic equivalence of ensembles.

2. Simple Application of Statistical Mechanics: Partition functions and their properties. Calculation of thermo dynamic quantities to an ideal mono atomic gas.Gibbs paradox, validity of the classical approximation.Proof of the equipartition theorem. Simple applications - mean K.E. of a molecule in a gas, Brownian motion. Harmonic Oscillator, Specific heats of solids (Einstein and Debye model of solids), Paramagnetism, Partition function for polyatomic molecules, Electronic energy, vibrational energy and rotational energy of a diatomic molecule. Effect of Nuclear spin • ortho and para hydrogen.

3. Quantum Statistics : Formulation of the statistical problem. Maxwell - Boltzmann statistics. Photon statistics, Bose - Einstein statistics, Fermi - Dirac statistics, Quantum statistics in the classical limit calculation of dispersion for MB, BE & FD statistics equation of state of an ideal Bose Gas, Black body radiation, Bose - Einstein condensation, Equation of state for a weakly degenerate and strongly degenerate ideal Fermi gas. Thermionic emission. The body of white dwarf stars.

4. Non Ideal Classical Gas : Calculation of the partition function for low densities. Equation of state and viral coefficients (Van Der Walls equation)

5. Phase Transition and Critical Phenomena : Phase transitions, conditions for phase equilibrium, First order Phase transition the Clausius - Clayperon equation, Second order phase transition, The critical indices, Vander waals theory of liquid gas transition. Curie - Weiss theory of magnetic transitions. Order parameter Landau theory, Correlation of fluctuation and correlation length, Scaling hypothesis,

Course Objectives of M.Sc. Physics Previous year – Paper 7

Electrodynamics

- To evaluate fields and forces and potentials in Electrodynamics and Magneto dynamics using basic scientific method.
- To make the students understand the propagation behavior of electromagnetic waves in different media.
- To be capable of understanding the physical interpretation of Maxwell's Equations.
- To provide concepts of relativistic electrodynamics and its applications in branches of Physical Sciences.
- To be able to explain and solve advanced problems based on classical electrodynamics using Maxwell's equation.
- To be able to analyze radiation systems in which the electric dipole, magnetic dipole or electric quadruple dominate.
- To have an understanding of the covariant formulation of electrodynamics and the concept of retarded time for charges undergoing acceleration.
- To lay the foundation for the modern optics, photonics, telecommunications and ionosphere.

Syllabus of Paper -7 Electrodynamics

1 Gauss Theorem, Poisson’s equation, Laplace’s equation, Solutions to Laplace’s equation in Cartesian coordinates spherical coordinates and cylindrical coordinates, use of Laplace’s equation in the solutions of electrostatic problems. Chapter-

2 Ampere’s circuital law, magnetic vector potential, Maxwell’s displacement current, Faraday’s law of electromagnetic induction, Maxwell’s equations, differential and integral forms, physical significance of Maxwell’s equations.

3 Wave equation in free space, in non-conducting isotropic medium, in conducting medium, electromagnetic vector and scalar potentials, uniqueness of electromagnetic potentials, concept of gauge, Lorentz gauge and Coulomb gauge.

4 Lienard-Wiechert potentials, electromagnetic fields for a moving point charge, electromagnetic fields for a point charge moving with uniform velocity, radiation damping, Abraham– Lorentz formula, Cherenkov radiation.

5 Condition for plasma existence, occurrence of plasma, magnetohydrodynamics, plasma waves, charged particle behaviour in electric and magnetic fields: Charged particles in uniform electric field, charged particles in homogeneous magnetic fields, charged particles in simultaneous electric and magnetic fields and charged particles in non-homogeneous magnetic fields.

6 Transformation of electromagnetic potentials, Lorentz condition in covariant form, invariance or covariance of Maxwell’s field equations in terms of four vectors, electromagnetic field tensor, Lorentz transformation of electric and magnetic fields.

<u>Course Objectives of M.Sc. Physics Previous year – Paper 8</u>

Solid State Physics

- To provide extended knowledge of principles and techniques of Solid-State Physics.
- To make the students familiar with the structures having regular and irregular arrangements of atoms and their bonding etc.
- To explain the peculiar behavior of materials.
- To understand various thermal properties of materials under different length scales.
- To explain the free electron Fermi gas energy levels and density of orbits.
- To understand the band theory of solids.
- To be able to formulate basic models for electrons and lattice vibrations for describing the physics of crystalline materials.
- To be able to understand the relation between band structure and the thermal properties of a material.
- To be able to understand various physical phenomena and the reasons behind them.

Syllabus of Paper - 8 Solid State Physics

1. CRYSTAL STRUCTURE: Periodic array of atoms, Fundamental types of 3 dimensional lattices, Index system for crystal planes, simple crystal structures - sodium chloride, cesium chloride and diamond,

2. CRYSTAL DIFFRACTION AND RECIPROCAL LATTICE: The incident beam: X-rays, neutrons and electrons Bragg's law, Derivation of scattered wave amplitude - Bragg's Law in Fourier space Fourier analysis - Reciprocal lattice to b.c.c. and f.c.c. Lattices. (Chapters 1 & 2 C.Kittel)

3. PHONONS AND LATTICE VIBRATIONS: Vibrations of monoatomic lattices - group velocity, long wave length limit - First Brilloum Zone. Lattices with two atoms per primitive cell - Quantization of Lattice Vibrations -Phonon momentum.

4. FREE ELECTRON FERMI GAS: Energy levels and density of orbitals in one dimension - Free electron gas in 3 dimensions Heat capacity of the electron gas - experimental heat capacity of metais - Motion in magnetic fields - Hall effect, Ratio of thermal and electrical Conductivity. (Chapter-VII - C.Kittel).

5. THE BAND THEORY OF SOLIDS: The B lock Theorem and derivation, electron motion in periodic potential - Kronig - Penny Model - Derivation of important consequences, The distinction between metals, insulators and semiconductors. (Chapter - 10, AJ.Dekker.)

6. SEMICONDUCTORS: Band gap - Intrinsic carrier concentration - Mobility in the intrinsic region. Impurity Conductivity - N type and P type semiconductors, mobility in the presence of impurity.

7. DIELECTRICS AND FERROELECTRICS: Macroscopic electric field - depolarization field, Local electric field at an atom - field of diploes inside a cavity. Dielectric constant and polarizability - derivation of Clausius -Mossolti relation - Ferroelectric materials - classi-fication. (Chapter -13, C.Kittel)

8. MAGNETIC MATERIALS: Dia magnetism and paramagnatismLangevim diamagnetism equation - Theory- of para-magnetism - weiss theory of Ferromagnatism, Relation of weiss constant with exchange integral, temperature dependence of satu-ration magnezation.

9. SUPERCONDUCTIVITY: (No theory, Experimental survey only) Occurance, Meissner effect, heat capacity optical properties (infra red), isotope effect. Higle To super conduc-tors

Course Objectives of M.Sc. Physics Previous year – Practical 1

Modern Physics Lab

- The aim of this laboratory course is to make the students perceive some of the fundamental laws of Physics through experiments.

- To be capable of handling sophisticated instruments besides learning the Physics concepts behind these experiments.

Syllabus of Practical -1 Modern Physics Lab

01 Atomic Spectrum of Zinc
02 Atomic Spectrum of Sodium
03 Vibrational analysis of Ale green system
04 Raman Spectrum of Carbon Tetrachloride
05 Rotational Constants of 'Σ - Σ bands
06 Absorption Spectrum of lodine
07 Identification of symmetry operations and point groups
08 Experiments with He-Ne Laser
09 Rydberg constant
10 Specific Charge of an electron
11 Determination of Plancks Constant
12 The Franck - Hertz experiment
13 Susceptibility of a substance - Gouy's method
14 Thermo EMF and Thermistor
15 Band-gap of a semiconductor
16 Reciprocal dispersion curve
17 Atomic Spectrum of Calcium
18 Band spectrum of CN in the violet
19 Rotational analysis of II - bands
20 Spectrochemical analysis

Course Objectives of M.Sc. Physics Previous year – Practical 2

Electronics Lab

- To make the students familiar with analog electronic components.
- To provide hands-on experience to the students to make them familiar with the working and handling of the analog electronic devices and circuits.
- To become skilled enough to handle and understand the use of analog devices.

Syllabus of Practical -2 Electronics Lab

1. FetAmplifer
2. Phase Shift Oscillator
3. Wein Bridge Oscillator
4. Power Supply
5. First Order Active Filters
6. Negative Feedback Amplifer
7. RF Amplifier
8. Colpitt's Oscillator
9. AstableMultivibrator
10. Uni Junction Transistor (UJT)
11. Tunnel Diode Characteristics
12. Silicon Controlled Rectifier
13. Power Amplifier-Complementary Symmetry Type
14. Hartley Oscillator
15. MonostableMultivibrator

Course Objectives of M.Sc. PhysicsFinal year – Paper 1

Advanced Quantum Mechanics

- To understand the concepts of the time-dependent perturbation theory and their applications to physical situations.
- To understand the basics of scattering theory.
- To understand the quantum dynamics through Schrödinger picture and Heisenberg picture.
- To understand linear vector spaces in quantum mechanics.
- To understand the relativistic quantum mechanics.
- To understand the concept of field quantization, this is very much useful in the area of quantum computing.
- To develop knowledge and understanding of the concept that quantum states live in a vector space.
- To develop a knowledge and understanding of the meaning of measurement.
- To elate this abstract formulation to wave and matrix mechanics.
- To develop a knowledge and understanding of perturbation theory, level splitting, and radiative transitions.
- To develop a knowledge and understanding of the relation between conservation laws and symmetries.
- To develop a knowledge and understanding of the role of angular momentum in atomic and nuclear physics.
- Develop a knowledge and understanding of the scattering matrix and partial wave analysis.
- To solve quantum mechanics problems.
- To use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.
- To take up research in frontier areas like quantum information, quantum computation, quantum entanglement, quantum fields and quantum gravity besides quantum mechanics for learning and appreciating phenomena in several other disciplines like condensed matter, statistical mechanics and modern optics.

Syllabus Paper-1: Advanced Quantum Mechanics

1. Linear Vector Spaces in Quantum Mechanics: Vectors and operators, change of basis, Dirac's bra and ket notations. Eigen value problem for operators. The continuous spectrum. Application to wave mechanics in one dimension.
2. Quantum Dynamics: The equation of motion. Quantization postulates, canonical quantization Constants of motion and invariance properties, Heisenberg picture. Harmonic Oscillator.
3. Development of time-dependent perturbation theory, The golden rule for constant transition rates, (Merzbacher Chapter 18 relevant parts)
4. Addition of two angular momenta. Tensor operators. Wigner-Eckart theorem. Matrix elements of vector operators, Parity and time reversal symmetries.
5. Scattering: Concept of differential cross-section. Scattering of a wave packet. Born approximation. Partial waves and phase shift analysis.
6. Relativistic Quantum Mechanics: Klein-Gordon equation, Dirac equation for a free particle, Fanation of continuity Rein of a Diran particle Solutions of free particle Direc equation, Negative energy states and hole theory.

<u>Course Objectives of M.Sc. PhysicsFinal year – Paper 2</u>

Molecular Spectroscopy and Lasers

- To explain the basics of LASER.
- To describe the construction and working of various types of lasers and the applications of lasers.
- To derive the relation between Numerical Aperture and Refractive indices.
- To explain about the attenuation mechanisms.
- To absorb and spontaneous and stimulated emission in two level system, the effects of homogeneous and inhomogeneous line broadening, and the conditions for laser amplification.
- To operate the cavity including mode separation and line-widths, laser gain conditions, gain clamping in both homogeneous and inhomogeneous line broadened media.
- To learn basic properties of the most common laser types such as Ruby, He-Ne, Nd:YAG and knowledge of other main laser types.
- To identify various laser systems, the simple homogeneous laser and its output behavior and optimal operating conditions.
- To study spectral properties of longitudinal and transverse modes, mode locked laser operation, schemes for active and passive mode locking in real laser system.
- To study Matrix optics of the laser cavity and stability conditions.
- To study the basics of Gaussian beam in laser cavity and optical properties of laser output, design of stable laser cavities using Gaussian beam optics, the ABCD law for Gaussian beams.

Syllabus of Paper-2: Molecular Spectroscopy and Lasers

1. DIATOMIC MOLECULES: Molecular Quantum numbers and classification of electronic states. Molecular orbitals and ground states of H_2 C_2 N_2 and O_2 selection rules. Symmetry properties. Hund's coupling cases 'a' and 'b'. (Ch. 6.2).

2. ROTATIONAL SPECTROSCOPY: Microwave spectrum of a diatomic molecule. Rigid rotator and non- rigid rotator approximations. The effect of isotopic substitution. Moment of Inertia and bond lengths of diatomic and linear triatomic molecule. Quantum theory and mechanism of Raman scattering. Rotational Raman spectra. The stark effect. Nuclear hyperfine splitting. Vibrational satellites. Symmetry properties of rotational levels. Influence of nuclear spin and statistical weights on pure rotational Raman spectra of CO_2 O_2 H_2 N_2 (Ch. 1.3, 4.2, 4.4, 4.8)

3. VIBRATIONAL SPECTROSCOPY: The vibrating- rotating diatomic molecule. Harmonic and anharmonic oscillator energy levels. Evaluation of rotational constants from Infrared spectra Evaluation of rotational constants from Raman vibration-rotation spectra. Force constants and bond lengths. The influence of nuclear spin on IR and Raman vibration-rotation spectrum of CO, (Ch. 5.1, 5.2.4)

4. MOLECULAR VIBRATIONS: Symmetry elements and C point groups. C, and C,, Character tables from the properties of irreducible representations. Relationship between reducible and irreducible representations. Selection rules for IR and Raman spectra. Reducible representation fundamental vibrational modes and their activity of HO, NH, CH, CO, HCN and formaldehyde molecules. Expected vibrational modes for different structures of AB, and AB, type molecules. Direct product representation and their activity of Overtones, combination tones, hot bands. Forbidden fundamental frequencies from permitted overtones and combination bands. Fermi resonances of CO,, H,O and CCI, molecules. Group vibrational modes of CH, in CCI,-CH-CCI, molecule. (Group theory by Raman Ch. 4, 5.2, 6, 7 and 8).

5. ELECTRONIC SPECTROSCOPY OF DIATOMIC MOLECULES: Vibrational analysis of an electronic band system of a diatomic molecule. Progressions and sequences. Deslandres table and vibrational constants. Isotope effect in vibrational spectra and its applications. Dissociation energy and dissociation products. Selection rules and rotational fine stru… matrices and cavity stability criteria for stable resonators. Control of Laser output: Q-factor, Q-switching, Laser spiking self focussing, mode locking narrow frequency selection. Laser structure and excitation mechanism of N, Laser, CO, Laser, Excimer Laser and Dye Lasers. (Ch. 8)

6. ELECTRONIC POLYATOMIC MOLECULES: Walsh M.O. diagram for AH, molecules. Molecular orbitals, electronic configuration and ground states of BeH, BH, CH, NH and H,O. The ground states of formaldehyde, NH, CH and CO, molecules. The symmetry type of bonding and non-bonding orbitals in formaldehyde. Allowed - (A,- 4,) and n-o *(B-A) electronic transitions and forbidden n- *(A,-A,) vibrionic transitions in formaldehyde. Ch. 6.3.1.

7. LASERS: Line broadening (natural, collision, Doppler) and its influence on Laser operation. Rate equations for steady state inversions in 3 and 4 level systems. Longitudinal and transverse modes. Single mode operation. ABCD raymatrices and cavity stability criteria for stable resonators. Control of Laser output: Q-factor, Q-switching, Laser spiking self focussing, mode locking narrow frequency selection: Laser structure and excitation mechanism of N Laser, CO, Laser, Excimer Laser and Dye Lasers. (Ch. 8)
8. LASERS IN SPECTROSCOPY: Distinction between Single rovibronic level fluorescence and Resonance Raman Spectroscopy. Hyper Raman spectroscopy, Stimulated Raman and Raman gain spectroscopy. Inverse Raman spectroscopy. CARS and CSRS. (Ch.8)

Course Objectives of M.Sc. PhysicsFinal year – Paper 3

Fermi Surfaces and Order - Disorder Transformations

- To reveal signature Fermi surfaces in a diverse range of materials families, with breakthrough advances made by a synthesis of theoretical modelling, experimental vision, materials preparation, and advances in measurement technique.

- To transcend this traditional paradigm in the field of correlated electron systems and define a new framework for the observation of quantum oscillations associated with a novel Fermi surface in the absence of a conventional Fermi liquid.

- To access the intervening region of unconventional quantum critical physics where a Fermi surface in the absence of a conventional Fermi liquid transitions to a Fermi surface underpinned by a conventional.

- To investigate the Fermi surface of these regimes of correlated materials phase space that defy conventional Fermi liquid behaviour by the use of advanced quantum oscillation techniques in selected high purity correlated materials, under either ambient pressure conditions or under lattice-density tuning, and using high magnetic fields.

Syllabus of Paper-3: Fermi Surfaces and Order - Disorder Transformations

1. Latice Dynamics: 6 Hrs. Anbarmonic crystal interactions - thermal expansion, thermal conductiarty, lattice thermal resistiarty, unklapp processes, imperfections.

2. Energy bands in solids : 8 Hrs. Nearly free electron model, origin of the energy gap-wave equation of electron in a periodic potential - Crystal momentum of an electron-Approximate solution near a zone boundary- Number of orbitals in a hand - metals. and isolators.

3. Fermi Surfaces of Metals: 10 Hrs. Reduced Zone scheme - Periodic Zone scheme - construction of Fermi surfaces-Electron orbits, hole orbits and open orbits Calculation of energy bands - Tight binding method for energy bands - Experimental methods for Fermi s… Super conductivity:

4. Ferro Electricity: 10 Hrs. Classification of ferro electric crystals Polarization catastrophe Landau theory of the phase transition - Second order transition-First order transition-Soft optical phonons- Antiferroelectricity - Ferroelectric domains-Piezo electricity-Ferroelasticity.
5. Point Defects and Allays: 8 Hrs. Lattice vacancies- Diffusion in metals-Colour centers- F-Centers and other centers in alkalihalides - Allays, order -disorder transformation-elementary theory or order.
6. Super Conductivity : 8 Hrs Thermo dynamics of the superconducting transition-London equation - Coherence length the accomplishments of the B.C.S. theory-B.C.S. ground state-Type II super conductors-Vortex state-Estimation of H and H

Course Objectives of M.Sc. PhysicsFinal year – Paper 4

Digital Electronics and Microprocessor

- To make the students learn the basics of digital electronics.
- To Introduce the concept of digital and binary systems
- To be able to design and analyze combinational logic circuits.
- To be able to design and analyze sequential logic circuits.
- To understand the basic design and implementation of digital circuits and systems.
- To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
- To prepare students to perform the analysis and design of various digital electronic circuits.
- Reinforce theory and techniques taught in the classroom through experiments in the laboratory.
- To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
- To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
- To provide strong foundation for designing real world applications using microprocessors and microcontrollers.
- To convert different type of codes and number systems which are used in digital communication and computer systems.
- To employ the codes and number systems converting circuits and compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency.
- To analyze different types of digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.
- To design different types of with and without memory element digital electronic circuits for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.
- To apply the fundamental knowledge of analog and digital electronics to get different types analog to digitalized signal and vice-versa converters in real world with different changing circumstances.
- To assess the nomenclature and technology in the area of memory devices and apply the memory devices in different types of digital circuits for real world application.
- To learn microprocessor with the help of basic knowledge of digital electronics.

Syllabus Paper-4: Digital Electronics and Microprocessor

1. Digital Circuits:
The binary system, Boolean Algebra-AND, OR, NOT, NAND, NOR EX-OR and EX-NOR gates. Logic gate characteristics Applications of Boolean Algebra-Binary Adder (Half adder and Full adder).

Digital comparator.Decoder and Encoder. Seven segment Decoder/driver. Flip-Flops - RS, JK, T and D Flip Flops. Shift Register, Ripple counters. Synchronous Counters. Applications of Counters-Frequency counter.

2. A/D and D/A Converter: .
Signals and Signal processing, Sample and Hold Systems. D/A Converter (linear weighted and ladder type). A/D converter (Counting A/D Converter, Successive approximation, Dual slope).

3. Architecture of INTEL 8085 Microprocessor:
Functional Description, Pin description. Timing processes - Read Cycle and Write Cycle Timing, Hold and Halt States, SID and SOD Signals.

4. Programming the 8085 processor:
Addressing methods, Instruction Set-Assembly Language Programming - Addition of two 8-bit binary numbers, Multiple Precision addition, Sum of an array of data, Largest element in the given array.

5. Data transfer techniques:
Synchronous transfer, Asynchronous transfer, Direct Memory Access, Serial transfer.

6. Input/Output Interfacing:
Input/Output port 8212.Programmable Peripheral.Interface 8255, Input/Output timer system of 8155 Programmable communication Interface 8251, programmable interval timer 8253.

Course Objectives of M.Sc. PhysicsFinal year – Paper 5

Computational Methods and Programming in "C" Numerical Methods

- To identify situations where computational methods and computers would be useful.
- To give a computational problem, identify and abstractthe programming task involved.
- To approach the programming tasks using techniques learned and write pseudo-code.
- To choose the right data representation formats based on the requirements of the problem.
- To use the comparisons and limitations of the various programming constructs and choose the right one for the task in hand.
- To write the program on a computer, edit, compile, debug, correct, recompile and run it.
- To identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.
- To provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future.
- To be able to develop applications.

Syllabus of Paper-5: Computational Methods and Programming in "C" Numerical Methods

1. ROOTS OF EQUATIONS:
   Iteration Method, Bisection Method, New-Raphson Method.

2. SOLUTION OF SIMULTANEOUS LINEAR ALGEBRAIC EQUATIONS:Matrix Inversion Method, Gauss elimination method, Iteration Methods, Jacobi's Method, Gauss-Seidel Method.

3. INTERPOLATION:
   Finite Difference operators, Newton's Forward difference Interpolation formula, Newton's Backward difference Interpolation formula, Newton's divided difference formula, Lagrange's interpolation formula.

4. SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:
   Picard's Method, Euler's Method, Runge-Kutta (second -order and fourth-order) methods, Adams - Bashforth method.

5. SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS
   Wave equation, Laplace equation.

PROGRAMMING IN "C"

6. INTRODUCTION TO "C"
   Characters, constants, variables, Keywords and Instructions in C. Arithmetic Instructions, Assignment statements, Input/Output functions, conditional statements. Writing a program, simple 'C' Program examples

7. EXPRESSIONS IN "C":
   Logical Expressions and Control Statements, Decision Control, Loop Control and Case Control Structures, Functions, Arrays, Syntax rules, Global, Local and static variables, Data types and stacks, Structures, Pointers, Lists and Trees

8. "C" PROGRAMMING APPLIED TO NUMERICAL METHODS: Roots of equations, Solutions of Simultaneous equations, Numerical Interpolation, Numerical integration, Solutions of ordinary differential equations and partial differential equations Fourier Transforms, Z-Transforms.

Course Objectives of M.Sc. PhysicsFinal year – Paper 6

Nuclear and Particle Physics

- To familiarize about the essential properties of the nucleus such as its shape, size, radius, density, magnetic moment, electric quadruple moment etc.
- To probe properties several models have been proposed such as liquid drop model, shell models, collective models.
- Carbon dating, modern medical applications, radio-physics all require the knowledge of radio-activity.
- The ultimate aim of particle physics is to unify these interactions.
- To demonstrate knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter.
- To discuss nuclear and radiation physics connection with other physics disciplines – solid state, elementary particle physics, radiochemistry.
- To discuss nuclear and radiation physics applications in medical diagnostics and therapy, energetic, geology, archaeology.
- To describe experimental techniques used (or developed) for nuclear physics purposes (gamma cameras, semiconductor detectors) and discuss their influence on development of new technologies.
- To explore an application of nuclear and/or radiation physics and communicate their understanding to a group of their peers in a short presentation.

Syllabus of Paper-6: Nuclear and Particle Physics

1. INTRODUCTION: .
   Objective of Studying Nuclear Physics, Nomenclature, nuclear radius, mass & Binding energy, angular momentum, magnetic dipole moment, Electric quadrupole moment, parity and symmetry, domains of instability, Energy levels, mirror nuclei. H.A. ENGE. Chapter: 1.

2. NUCLEAR FORCES: The deuteron: Introduction, experimental data, simple theory of the deuteron, root mean square radius, spin dependence of nuclear forces, tensor forces, scattering cross-sections, qualitative discussion of neutron-proton and proton-proton scattering, exchange forces, characteristics of nuclear forces, meson theory of nuclear forces. (Yukawa's potential) H.A. ENGE Chapters: 2 and 3.

3. NUCLEAR MODELS:
   Liquid drop model: Introduction, Weissacker's semi- emperical mass formula, Mass-parabolas. Nuclear shell model: Spin-orbit coupling, magic numbers, prediction of angular momenta and parities for ground states, Magnetic moments, Schmidt's lines, Collective model of Bohr & Mottelson, rotational and vibrational states of nuclei
4. NUCLEAR DECAY:
   BETA-DECAY: Beta ray spectra, neutrino hypothesis, Fermi's Theory of 6-decay, Kurie plots, comparative half-lives, allowed and forbidden transitions, selection rules, parity violation in 6-decay, Detection and properties of neutrino, Electron capture. GAMMA DECAY: Multipole moments, selection rules, angular correlation, internal conversion, Nuclear isomerism, measurement of life times of excited states. Mossbauer effect.
5. NUCLEAR REACTIONS:
   Introduction, reaction dynamics, the Q-cauation, different types of nuclear reactions, Direct reactions, compound nucleus, compound nuclear reactions, resonance reactions. H.A ENGE. Chapter: 13 And K.S. Krane Chapter: 11.
6. NUCLEAR ENERGY:
   The fission process, stability against spontaneous fission, Bohr-Wheeler theory of fission, neutrons released in fission process, delayed neutrons, fission reactor operating with natural Uranium (neutron cycle and four factor formula), Nuclear fusion, Carbon - Nitrogen cycle, prospects of continued fusion energy. H.A. ENGE. Chapter: 14.
7. ELEMENTARY PARTICLE PHYSICS: Particle interactions and families, symmetries and conservation laws (energy and momentum, angular momentum, parity, Baryon number, Lepton number, isospin, strangeness and charm), Elementary ideas of CP and CPT invariance, Hadrons and Leptons, Classification of Hadrons, SU(2), SU(3) multiplets, Quark model.

Course Objectives of M.Sc. PhysicsFinal year – Paper 7

Magnetic Materials, Resonance Techniques and Semiconductor Devices

- To describe the discovery of magnetic material by the ancient Greeks,
- To describe natural and artificial magnets,
- To identify the different types of magnets,
- To identify the different sizes and shapes of artificial magnets,
- To classify materials as magnetic or nonmagnetic.
- To introduce the operation of semiconductor devices To provide the knowledge about number system, arithmetic operation and sequential codes of digital electronic circuits.
- To fulfill all of the detailed objectives listed under each individual section.
- To solve road-map problems which may require the interpretation of ^{1}H NMR spectra in addition to other spectral data
- To introduce the fundamental concepts and working principle of JT, JFET, FET, MOSFET
- To provide the understanding of basic Boolean laws, K-maps, SOP and POS method to design logic circuits and different class of digital circuits like unipolar, bipolar logic families -DTL, RTL

Syllabus of Paper-7: Magnetic Materials, Resonance Techniques and Semiconductor Devices

1. **Paramagnetism**
   Rare oath Non-Hand's miles from group ions-Crystal BolisplitingQuenching of the orbital angular momentum -Cooling by adiabatic demagnetization - Nuclear denganparamagnen susceptibility of conduction

2. **Ferromagnetism and Antiferromagnetism:**
   Saturation magnetization at absolute Zero-magnons- Thermal excitation of magnons-Ferrimagnetic order- Care temperature and susceptibility of ferrimagnets- Anibromagnetic order-susceptibility below Nee'etomportare-Ferromagnetic domains-Anisotropy energy -Transition region bewoon domains

3. **Magnetic resonance:**
   Nuclear magnetic resonance-Equations of motion-line width-motional narrowing-Hyperfine splitting-Electron paramagnetic resonance – Exchange narrowing – Zero field spliting

4. **Mossbaner effect and its applications:**
   Isomershift-quadnepole splitting - magnetic hyperfine splitting -Applications (V.G Bhide-Mossbaner effect and its applications)

5. **Semi Conductor Devices:**
   The contact potential –
   Equilibrium Fermi levels-Space charge at a junction-Forward and reverse bias junctions -Steady state conditions-carrier injections - minority and majority carrier injection-transient and A.C. conditions- Time variation of stored charge - capacitance of P-N junction.
   Degenerate semiconductors - Tunnel diode operation - current and voltage in an illuminated junction - solar cells- light emitting diodes - LED materials.

Course Objectives of M.Sc. PhysicsFinal year – Paper 8

Communication Electronics

After the completion of the course the student will be able to:

- learn the basic wave spectra.
- introduce students to the basic idea of signal and system analysis and its characterization in time and frequency domain.
- understand the mathematical description of continuous and discrete time signals and systems.
- classify signals into different categories.
- Analyze Time Invariant systems in time transform domains.
- understand the concept of modulation and its needs.
- understanddifferent types of AM (Analog Modulation) techniques and their principles.
- learndifferent AM systems (generation and detection).
- learn different types of angle modulation schemes (FM & PM), their generation and detection.
- understand the principles of PAM, PTM, PCM, DPCM, Delta Modulation, Digital Carrier Systems such as ASK, PSK, FSK and DPSK.
- Analyze the noise characteristics of a communication system using different modulation schemes.
- understand the application of wave spectra.
- understand use of transforms in analysis of signals and system in continuous and discrete time domain.
- understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
- compare the performance of AM, FM and PM schemes.
- evaluate the performance of PCM, DPCM and DM in a digital communication system.
- understand the digital Line Codes, M-ary encoding, differential encoding and sampling.
- understand noise and its effect on AM and FM communication systems.

Syllabus of Paper-8 : Communication Electronics

1. CW Modulation: Amplitude Modulation (AMD:
   Introduction, Amplitude modulation, modulation index, Frequency spectrum, Average power for sinusoidal AM Amplade demodulator circuits, Double side band suppressed camer (DSBSC) Mochalation, AM transmitter, Super beterodyne receiver

   Single Side Band Modulation (SSB):
   SSB principles Balanced Modulator, SSB gonoration.

   Angle Modulation:
   Frequency modulation (EMD), sinusoidal FM, Frequency spectrum for sinusoidal FM frequency deviation, modulation index Average power in sinusoidal FM, Phase Modulation, Equivalence between PM and FM, FM detectors: Ratio detector, Foster-Sealy discriminator, Phase lockedloop Amplitude limiter, PM generation, FM

2. Pale Modulation:
   Sampling theorem. Principles of pulse Amplitude Modulation (PAM) and Pulse Time Modulation (PTM) Pulse code modulation (PCM), quantization, Nonlinear quantization, companding, differential pulse code modulation, Dela Modulation.

Digital Carrior Systems: ASK, PSK, FSK and DPSK

3. Special Communication circuits: Tuned amplifiers Hybrid-equivalent for me BIT, Short Circul current gain For the BJT, CE and CB timed amplifiers, Cascod amplifier. Mixer Circuits: Diode mixer, IC balanced mixer.

   Filters: Active filters, Ceramic, Mechanical and crystal filters. Oscillators: Crystal oscillator,
   Voltage controlled oscillator, Frequency synthesizer, phase locked loops.

4. Antennas: Antenna parameters: Gain and effective area, Impedence, Practical Antennas: Dipole, folded dipole, Yagi Ida, parabolic reflector.

5. Noise in Communication Systems:
   Thermal Noise, Shot Noise, Signal-to-Noise ratio, Noise factor, Noise temperature. Noise in AM, Noise in FM systems.Noise in pulse modulation systems.
   (Qualitative treatment with BLOCK DIAGRAMS only)

Course Objectives of M.Sc. PhysicsFinal year – Practical 1

Solid State Physics Lab

- To experiment in solid state physics covering a broad range of topics representative of the field.
- To provide a valuable theoretical introduction and an overview of the fundamental applications of the physics of solids.
- To includes theoretical description of crystal and electronic structure, lattice dynamics, and properties of different materials (metals, semiconductors, dielectrics, magnetic material), based on the classical and quantum physics principles.
- To receive a handout that briefly outlines the theory, procedure and analysis expected.
- To master the topic of the experiment in depth and produce an experiment procedure before attempting data collection.
- To write a record that includes experimental results, and analysis and discussion of these results.
- To learn how to construct and perform experiment, and properly draw meaningful conclusion.
- To conduct experiments like X-ray diffraction, Raman Scattering, etc., will be carried out in the Research Physics Lab followed by their theoretical discussion.
- To observe and analyze physical data relevant to some of the experiments in solid state physics.
- To Provide students with a thorough understanding of the basic concepts of physics and the methods scientists use to explore natural phenomena, including observation, hypothesis development, measurement and data collection, experimentation, evaluation of evidence, and employment of mathematical analysis.
- To interprete results through analyzing data and analysis, writing record.
- Students will master their skills for oral presentations on the selected topics of the modern Solid-State Theory.

Syllabus for M.Sc. Physics Final year – Practical 1

1. Determination of Cell parameters from X-ray Diffraction
2. Determination of grain size of metallic sample using metallurgical microscope
3. Estimation of activation energy in an ionic crystal from conductivity studies..
4. Determination of density of F centres in alkali halides crystals.
5. Optical Activity.
6. Photo-Elasticity.
7. Observation of Dislocations
8. Mobility of Dislocations.
9. Estimation of active energy of ionic solids from Conductivity studies
10.Determination of transition temperature of ferroelectric Barium Titanate ceramic
11. Determination of dielectric constant of a solid at a microwave frequency.
12. Determination of band gap of a semiconductor using P-N junction diode
13. Determination of band gap of a semiconductor by studying temperature varying resistivity
14. Determination of resistivity of a given semiconductor
15. Determination of mobility and carrier concentration of a material using Hall Effect..
16, Intensity and voltage response of a light dependent resistance (LDR) and Voltage dependence resistance (VDR).
17. Determination of coefficient of thermal conductivity of a bad conductor
18. Determination of heat capacity in solids
19. Determination of Curie temperature and Curie constant of a given ferrite material
20. Determination of elastic modulli of a given material using composite piezoelectric oscillator.
21. Verification of dispersion relation for mono-atomic lattice
22. Verification of dispersion relation for diatomic lattice
23. Determination of thickness of a thin metallic film.
24. The Creep deformation of a material
25. Determination of the hardness of a given material using Brinell hardness testing machine.
26. Determination of hardness of a material using Rockwell hardness testing
27. Determination of fatigue strength using flexural stress machine..
28. Coupled Oscillations..
29. Ultrasonic velocity in liquids - diffraction method.
30. Electron Spin Resonance Spectroscopy.

Course Objectives of M.Sc. PhysicsFinal year – Practical 2

Special/Digital Electronics Lab

- To acquire the basic knowledge of digital logic levels.
- To know the concepts of Combinational circuits.
- To prepare students to perform the analysis and design of various digital electronic circuits.
- To understand the concepts of digital circuits and systems with adequate introduction to both combinatorial and sequential logic circuits, such as, adders, comparator, decode counter, etc. and various combinations of these.
- To describe the architectures of 8085 microprocessors and draw timing diagram.
- This course introduces the assembly language programming of 8085.
- To introduce the basic concepts of microprocessor and to develop in students the assembly language programming skills and real time applications of Microprocessor as well as microcontroller.
- To distinguish between the different modules of operation of microprocessors and Interface peripherals.
- Ro understand the concept of amplitude modulation.
- To familiarize the students with basic analog communication systems.
- To integrate theory with experiments so that the students appreciate the knowledge gained from the theory course, e.g., amplitude modulation.
- To familiarize students with the rapidly evolving world of modern communications.
- To apply the above concepts to real world electrical and electronics problems and applications.
- To understand various Modulation techniques in time domain and frequency domain to impart hands on experience and train the students to analyze various modulation techniques and understand their performance to comprehend various coding techniques on transmission medium in Digital communications.

Syllabus for M.Sc. PhysicsFinal year – Practical 2

01. Flip Flops
02. Decade Counter Using IC 7490.
03. Encoder & Decoder
04. Multiplexer and De-Multiplexer
05. Numeric Counting Module
06. MonostableMultivibrator Using IC 555
07. AstableMultivibrator Using IC 555.
08. IC Voltage Regulator Using IC 723.
09. Wein Bridge Oscillator Using IC 741
10. Phase Shift Oscillator Using IC 741
11. Amplitude Modulation
12. Boot Strap Saw Tooth Generator
13. Microprocessor 8085
14. Digital Comparator
15. Binary Up-Down Counter (74193)