आज दिनांक 17.11.2011 को विश्वविद्यालय परिसर में निम्न विषय की पाठ्यक्रम समिति की एक आवश्यक बैठक हुई, जिसमें निम्न प्राध्यापकगण उपस्थित हुए :–

Date :- 17.11.2011 Subject :- Physics Committee Place :- Central Library

1. Dr. S. K. Agarwal
2. Dr. Veer Pal Singh
3. Dr. Neeraj Rathore
4. Dr. Pramod Kumar Verma
5. Dr. Avinash Agarwal

PROPOSED UNIFORM SYLLABUS FOR

U.P. STATE UNIVERSITIES

Three Years Degree Course

PHYSICS

B.Sc.- FIRST YEAR

		Max. Marks
PAPER I	MECHANICS AND WAVE MOTION	50
PAPER II	KINETIC THEORY AND THERMODYNAMICS	50
PAPER III	CIRCUIT FUNDAMENTALS AND BASIC ELECTRONICS	50
PRACTICAL	TWO PRACTICALS (30 MARKS) + VIVA (10 MARKS) + RECORD (10 MARKS)	50
TOTAL		200

Candidate must obtain minimum pass marks in Theory and Practical Examinations separately.

PAPER I - MECHANICS AND WAVE MOTION

UNIT-I

Inertial reference frame, Newton's laws of motion, Dynamics of particle in rectilinear and circular motion, Conservative and Non -conservative forces, Conservation of energy, liner momentum and angular momentum, Collision in one and two dimensions, cross section.

UNIT -II

Rotational energy and rotational inertia for simple bodies, the combined translation and rotational and motion of a rigid body on horizontal and inclined planes, Simple treatment of the motions of a top. Relations between elastic constants, bending of Beams and Torsion of Cylinder.

UNIT - III

Central forces, Two particle central force problem, reduced mass, relative and centre of mass motion, Law of gravitation, Kepler's laws, motions of planets and satellites, geo-stationary satellites.

UNIT IV

Simple harmonic motion, differential equation of S. H. M. and its solution, uses of complex notation, damped and forced vibrations, composition of simple harmonic motion.

Differential equation of wave motion, plane progressive waves in fluid media, reflection of waves, phase change on reflection, superposition, stationary waves, pressure and energy distribution, phase and group velocity.

Text and Reference Books

EM Purcell, Ed: "Berkeley Physics Course, Vol. 1, Mechanics" (McGraw-Hill). RP Feymman, RB Lighton and M Sands; "The Feymman Lectures in Physics", Vol. 1 (BI Publications, Bombay, Delhi, Calcutta, Madras).

J.C. Upadhyay: 'Mechanics'.

D.S, Mathur "Mechanics",
P.K. Srivastava: "Mechanics" (New Age International).

PAPER II- KINETIC THEORY AND THERMODYNAMICS

UNIT-I

Ideal Gas: Kinetic model, Deduction of Boyle's law, interpretation of temperature, estimation of r.m.s. speeds of molecules. Brownian motion, estimate of the Avogadro number. Equipartition of energy, specific heat of monatomic gas, extension to di- and triatomic gases, Behaviour at low temperatures. Adiabatic expansion of an ideal gas, applications to atmospheric physics.

Real Gas: Vander Waals gas, equation of state, nature of Van der Waals forces, comparison with experimental P-V curves. The critical constants, gas and vapour. Joule expansion of ideal gas, and of a Vander Waals gas, Joule coefficient, estimates of J-T cooling.

UNIT -II

Liquefaction of gases: Boyle temperature and inversion temperature. Principle of regenerative cooling and of cascade cooling, liquefaction of hydrogen and helium. Refrigeration cycles, meaning of efficiency.

Transport phenomena in gases: Molecular collisions, mean free path and collision cross sections. Estimates of molecular diameter and mean free path.

Transport of mass, momentum and energy and interrelationship, dependence on temperature and pressure.

UNIT - III

The laws of thermodynamics: The Zeroth law, various indicator diagrams, work done by and on the system, first law of thermodynamics, internal energy as a state function and other applications. Reversible and irreversible changes, Carnot cycle and its efficiency, Carnot theorem and the second law of thermodynamics. Different versions of the second law, practical cycles used in internal combustion engines. Entropy, principle of increase of entropy. The

thermodynamic scale of temperature; its identity with the perfect gas scale. Impossibility of attaining the absolute zero;
third law of thermodynamics. Thermodynamic relationships: Thermodynamic variables; extensive and intensive, Maxwell's general relationships, application to Joule-Thomson cooling and adiabatic cooling in a general system, Van der Waals gas, Clausius-Clapeyron heat equation. Thermodynamic potentials and equilibrium of thermodynamical systems, relation with thermodynamical variables. Cooling due to adiabatic demagnetization, production and measurement of very low temperatures.

UNIT -IV

Blackbody radiation: Pure temperature dependence, Stefan-Boltzmann law, pressure of radiation, spectral distribution of Black body radiation, Wien's displacement law, Rayleigh-Jean's law, Plank's law the ultraviolet catastrophy.

Text and Reference Books

G.G. Agarwal and H.P. Sinha "Thermal Physics"
S.K. Agarwal and B.K. Agarwal "Thermal Physics"

PAPER III - CIRCUIT FUNDAMENTALS AND BASIC ELECTRONICS

UNIT-I

Growth and decay of currents through inductive resistances, charging and discharging
in R.C. and R.L.C. circuits, Time constant, Measurement of high resistance.
A.C. Bridges, Maxwell's and Scherings Bridges, Wien Bridge.
THINLY, NORTON and Superposition theorems and their applications.

UNIT -II

Semiconductors, intrinsic and extrinsic semiconductors, n-type and p-type semiconductors, unbiased diode forward bias and reverse bias diodes, diode as

a rectifier, diode characteristics, zener diode, avalanche and zener breakdown, power supplies, rectifier, bridge rectifier, capacitor input filter, voltage regulation, zener regulator.

Bipolar transistors, three doped regions, forward and reverse bias, DC alpha, DC beta

transistor curves.

UNIT - III

Transistor biasing circuits: base bias, emitter bias and voltage divider bias, DC load line.

Basic AC equivalent circuits, low frequency model, small signal amplifiers, common emitter amplifier, common collector amplifiers, and common base amplifiers, current and voltage gain, R.C. coupled amplifier, gain, frequency response, equivalent circuit at low, medium and high frequencies, feedback principles.

UNIT-IV

Input and output impedance, transistor as an oscillator, general discussion and theory of Hartley oscillator only.

Elements of transmission and reception, basic principles of amplitude modulation and demodulation. Principle and design of linear multimeters and their application, cathode ray oscillograph and its simple applications.

Text and Reference Books

B.G. Streetman; "Solid State Electronic Devices", IInTdi Edition (Prentice Hall of India, New Delhi, 1986).

W.D. Stanley: "Electronic Devices, Circuits and Applications" (Prentice-Hall, New TTC'A 1flOO\ JL4y, JJI. 1OO).

J.D. Ryder, "Electronics Fundamentals and Applications", lI'' Edition (Prentice-Hall of India, New Delhi, 1986).

J Millman and A Grabel, "Microelectronics", International Edition (McGraw Hill Book Company, New York, 1988).

PRACTICALS

Every institution may add any experiment of the same standard in the subject.

Mechanics

1. Study of laws of parallel and perpendicular axes for moment of inertia.
2. Study of conservation of momentum in two dimensional oscillations.

Oscillations

1. Study of a compound pendulum.
2. Study of damping of a bar pendulum under various mechanics.
3. Study of oscillations under a bifilar suspension.
4. Potential energy curves of a 1-Dimensional system and oscillations in it for various amplitudes.
5. Study of oscillations of a mass under different combinations of springs.

Properties of matter

1. Study of bending of a cantilever or a beam.
2. Study of torsion of a wire (static and dynamic methods)

Kinetic theory of matter

1. Study of Brownian motion.
2. Study of adiabatic expansion of a gas.
3. Study of conversion of mechanical energy into heat.
4. Heating efficiency of electrical kettle with varying voltages.

Thermodynamics

1. Study of temperature dependence of total radiation.
2. Study of temperature dependence of spectral density of radiation.
3. Resistance thermometry.

4. Thermo-emf thermometry
5. Conduction of heat through poor conductors of different geometries.

Circuit fundamentals

1. Charging and discharging in R.C. and R.C.L. circuits.
2. High resistance by leakage.
3. A.C. Bridges.
4. Half wave and full wave rectifiers.
5. Characteristics of a transistor in CE,CB and CC configurations
6. Frequency response of R.C. coupled amplifier.

Waves

I. Speed of waves on a stretched string.
2. Studies on torsional waves in a lumped system.
3. Study of interference with two coherent sources of sound.

Text and reference books

D.P. Khandelwal, "A laboratory manual for undergraduate classes" (Vani Publishing
House, New Delhi).
S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).
Worsnop and Flint- Advanced Practical physics for students.

PHYSICS

B.Sc.- SECOND YEAR

		Max. Marks
PAPER I	PHYSICAL OPTICS AND LASERS	50
PAPER II	ELECTROMAGNETICS	50
PAPER III	ELEMENTS OF QUANTUM MECHANICS, ATOMIC AND MOLECULARS SPECTRA	50
PRACTICAL	TWO PRACTICALS (30 MARKS) + VIVA (10 MARKS) + RECORD (10 MARKS)	50
TOTAL		200

Candidate must obtain minimum pass marks in Theory and Practical Examinations separately.

PAPER I - PHYSICAL OPTICS AND LASERS

UNIT-I

Interference of a light: The principle of superposition, two-slit interference, coherence requirement for the sources, optical path retardations, lateral shift of fringes, Rayleigh refractometer and other applications. Localised fringes; thin films, applications for precision measurements for displacements.

Haidinger fringes: Fringes of equal inclination. Michelson interferometer, its application for precision determination of wavelength, wavelength difference and the width of spectral lines. Twymann Green interferometer and its uses. Iriensity distribution in multiple beam interference, Tolansky fringes, Fabry-Perrot interferometer and etalon.

UNIT -II

Fresnel diffraction: Fresnel half-period zones, plates, straight edge, rectilinear propagation.

Fraunhoffer diffraction: Diffraction at a slit, half-period zones, phasor diagram and integral calculus methods, the intensity distribution, diffraction at a circular aperture and a circular disc, resolution of images, Rayleigh criterion, resolving power of telescope and microscopic systems, outline of phase contrast microscopy.

Diffraction gratings: Diffraction at N parallel slits, intensity distribution, plane diffraction grating, reflection grating and blazed gratings. Concave grating and different mountings. Resolving power of a grating and comparison with resolving powers of prism and of a Fabry-Perrot etalon.

UNIT - III

Polarization, Double refraction in uniaxial crystals, Nicol prism, polaroids and retardation plates, Babinet's compensator. Analysis of polarised light.

Optical activity and Fresnel's explanation, Half shade and Biquartz polarirneters.

Matrix representation of plane polarized waves, matrices for polarizers, retardation plates and rotators, Application to simple systems.

UNIT-IV

Laser system: Purity of a special line, coherence length and coherence time, spatial coherence of a source, Einstein's A and B coefficients, spontaneous and induced emissions, conditions for laser action, population inversion.

Application of Lasers: Pulsed lasers and tunable lasers, spatial coherence and directionality, estimates of beam intensity; temporal coherence and spectral energy density.

Text and Reference Books

A K Ghatak, "Physical Optics" (Tata McGrew Hill).

D P Khandelwal; "Optics and Atomic Physics" (Himalaya, Publishing House, Bombay, 1988).

F Smith and JH Thomson; "Manchester Physics sries; Optics" (English Language Book Society and Joh Wiley, 1977).

Born and Wolf; "Optics"

KD Moltey; "Optics" (Oxford University Press).

Sears; "Optics".

Jonkins and White; "Fundamental of Optics" (McGraw-Hill).

Smith and Thomson; "Optics" (John Wiley and Sons).

B.K; Mathur; "Optics".

P.K. Srivastava; "Optics" (CBS).

B.B. Laud; "Lasers" (New Age).

PART II- ELECTROMAGNETICS

UNIT-I

Electrostatics

Coulomb's law, Electric Field and potentials, Field due to a uniform charged sphere, Derivations of Poisson and Laplace Equations, Gauss Law and its application: The Field of a conductor. Electric dipole, Field and potential due to an electric dipole, Dipole approximation for an arbitrary charge distribution, Electric quadruple, Field due to a quadruple , Electrostatic Energy of a charged uniform sphere, Energy of a condenser.

Magnetostatics

Magnetic field, Magnetic force of a current, Magnetic Induction and Biot-Savart Law, Lorentz Force, Vector and Scalar Magnetic potentials, Magnetic Dipole, Magnetomotive force and Ampere's Circuital theorem and its applications to calculate magnetic field due to wire carrying current and solenoid.

UNIT-Il

Electromagnetic Induction

Laws of Induction, Faraday's laws and Lanz's Law. Mutual and Self Induction, Vector potential in varying Magnetic field, Induction of current in continuous media, Skin effect, Motion of electron in changing magnetic field , Betatron , Magnetic energy in field, Induced magnetic field (Time varying electric field), Displacement current, Maxwell's equations, Theory and working of moving coil ballistic galvanometer.

UNIT-III

Dielectrics

Dielectric constant, polarization, Electronic polarization, Atomic or ionic Polarization Polarization charges, Electrostatic equation with dielectrics, Field, force and energy in Dielectrics.

Magnetic Properties of Matter

Intensity of magnetization and magnetic susceptibility, Properties of Dia, Para and Ferromagnetic materials, Curie temperature, Hysteresis and its experimental determination.

UNIT -IV

Electromagnetic Waves

The wave', equation satisfied .by E and B, plane electromagnetic waves in vacuum, Poynting's vector, reflection at, a plane boundary of dielectrics, polarization by reflection and total internal reflection, Faraday effect; waves in a conducting medium, reflection and refraction by the ionosphere

Text and Reference Books

Berkeley Physics Course; Electricity and Magnetism, Ed. E.M. Purcell (Mc GrawHill). Halliday and Resnik; "Physics", Vol 2.

D J Griffith; "Introduction to Electrodynamics" (Prentice-Hall of India). Reitz and Milford; "Electricity and Magnetism (Addison-Wesley).

A S Mahajan and A A Rangwala; "Electricity and Magnetism" (Tata McGraw-Hill). A M Portis; "Electromagnetic Fields".

Pugh and Pugh; "Principles of Electricity and Magnetism" (Addison-Welsley).

Panofsky and Phillips; "Classical Electricity and Magnetism" (India Book House). S S Atwood; "Electricity and Magnetism" (Dover).

PART III - ELEMENTS OF QUANTUM MECHANICS, ATOMIC AND MOLECULAR SPECTRA

UNIT-I

Matter Waves

Inadequacies of classical mechanics, Photoelectric phenomenon, Compton effect, wave particle duality, de- Broglie matter waves and their experimental verification, Heisenberg's Uncertainty principle, Complementary principle, Principle of superposition, Motion of wave packets.

UNIT -II

Schrodinger Equation and its Applications

Schrodinger wave equation Interpretation of wave function, Expectation values of dynamical variables, Ehrenfest theorem, Orthonormal properties of wave functions, One dimensional motion in step potential, Rectangular barrier, Square well potential, Particle in a box, normalization Simple Harmonic Oscillator.

UNIT - III

Atomic spectra

Spectra of hydrogen, deuteron and alkali atoms, spectral terms, doublet fine structure, screening constants for alkali spectra for s, p. d, and f states, selection rules. Singlet and triplet fine structure in alkaline earth spectra, L-S and J-J couplings. Weak spectra: continuous X-ray spectrum and its dependence on voltage, Duane and Haunt's law. Characteristics X-rays, Moseley's law, doublet structure and screening parameters in X-ray spectra, X-ray absorption spectra.

UNIT -IV

Molecular spectra

Discrete set of electronic energies of molecules, quantisation of vibrational and rotational energies, determination of internuclear distance, pure rotation and rotation- vibration spectra, Dissociation limit for the ground and other

electronic states, transition rules for pure vibration and electronic vibration spectra.

Text and Reference Books

H S Mani and G K Mehta; "Introduction to Modern Physics" (Affiliated East-West Press 1989). A Beiser, "Perspectives of Modern Physics".

H E White; "Introduction to Atomic Physics".

Barrow; "Introduction to Molecular Physics".

R P Feymann, R B Leighton and M Sands; "The Feyrnann Lectures on Physics, Vol. III (B I Publications. Bombay. Delhi, Calcutta, Madras).

T A Littlefield and N Thorley; "Atomic and Nuclear Physics" (Engineering Language Book Society).

Eisenberg and Resnik; "Quantum Physics of Atoms, 'Molecules, Solids, Nuclei and Particles" (John Wiley).

D P Khandelwal: "Optics and Atomic Physics", (Himalaya Publishing House, Bombay, 1988).

PRACTICALS

Every institution may add any experiment of the standard in the subject.

Physical optics

1. Study of interference of light (biprism or wedge film).
2. Study ofF-P etalon fringes.
3. Study of diffraction at a straight edge or a single slit.
4. Use of diffraction grating and its resolving limit.
5. Resolving limit of a telescope system.
6. Polarization of light by the reflection.
7. Study of optical rotation for any system.

Electrostatics

1. Characteristics of a ballistic galvanometer.
2. Setting up and using an electroscope or electrometer.

Moving charges and magnetostatics

1. Use of a vibration magnetometer to study a field.
2. Study of field due to a current.
3. Measurement of low resistance by Carey-Foster bridge or otherwise.
4. Measurement of inductance using impedance at different frequencies.
5. Measurement of capacitance using impedance at different frequencies.
6. Study of decay of currents in LR and RC circuits.
7. Response curve for LCR circuit and resonance frequency and quality factor.

Varying fields and electromagnetic theory

1. Sensitivity of a cathode-ray oscilloscope.
2. Characteristic of a choke.
3. Measurement of inductance.
4. Study of Lorentz force.
5. Study of discrete and continuous LC transmission lines.

Atomic Physics

1. Study of spectra of hydrogen and deuterium (Rydberg constant and ratio of masses of electron to proton).
2. Absorption spectrum of iodine vapour.
3. Study of alkali or alkaline earth spectra using a concave grating.
4. Study of Zeeman effect for determination of Lande g-factor.

Molecular Physics

1. Analysis of a given band spectrum.
2. Study of Raman spectrum using laser as an excitation source

Lasers

1 Study of laser as a monochromatic coherent source

2 Study of divergence of a laser beam

Text and Reference Books

D.P. Khandelwal, “A Laboratory Manual for Undergraduate Classes (Vani Publishing

House, New Delhi).

S.P. Singh, “Advanced Practical Physics” (Pragati Prakashan, Meerut).

Worsnop and Flint- Advanced Practical physics for students.

PHYSICS

B.Sc.- THIRD YEAR

		Max. Marks
PAPER I	RELATIVITY AND STATISTICAL PHYSICS	75
PAPER II	SOLID STATE AND NUCLEAR PHYSICS	75
PAPER III	SOLID STATE ELECTRONICS	75
PRACTICAL	TWO PRACTICALS (50 MARKS) + VIVA (15 MARKS) + RECORD (10 MARKS)	75
TOTAL		300

Candidate must obtain minimum pass marks in Theory and Practical Examinations separately.

PAPER I - RELATIVITY AND STATISTICAL PHYSICS

UNIT-I

Relativity

Reference systems, inertial frames, Galilean invariance and conservation laws, propagation of light, Michelson-Morley experiment; search for ether.

Postulates for the special theory of relativity, Lorentz transformations, length contraction, time dilation, velocity addition theorem, variation of mass with velocity, mass-energy equivalence, particle with a zero rest mass.

UNIT -II

Statistical physics

The statistical basis of thermodynamics: Probability and thermodynamic probability, principle of equal a prior probabilities, probability distribution and its narrowing with increase in number of particles. . The expressions for average properties. Constraints; accessible and inaccessible states, distribution of particles with a given total energy into a discrete set of energy states.

UNIT - III

Some universal laws: The ji- space representation, division of i- space into energy sheets and into phase cells of arbitrary size, applications to one-dimensional harmonic oscillator and free particles. Equilibrium before two systems in thermal contact, bridge with macroscopic physics. Probability and entropy, Boltzmann entropy relation. Statistical interpretation of second law of thermodynamics. Boltzmann canonical distribution law and its applications; rigorous form of equipartition of energy.

UNIT -IV

Maxwellian distribution of0 speeds in an ideal gas: Distribution of speeds and of velocities, experimental verification, distinction between mean, r.m.s. and most probable speed values. Doppler broadening of spectral lines.

Transition to quantum statistics: 'h' as a natural constant and' its implications, cases of particle in a one-dimensional box and one-dimensional harmonic oscillator, Indistinguishability of particles and its consequences, Bose-Einstein, and Fermi-Dirac distributions, photons in black body chamber, free electrons in a metal, Fermi level and Fermi energy.

Text and Reference Books

A. Beiser, "Concepts of Modern Physics" (McGraw-Hill).

B B Laud, "Introduction to Statistical Mechanics" (Macmillan 1981).

F Reif, "Statistical Physics" (McGraw-Hill 1988).

K Haung, "Statistical Physics" (Wiley Eastern, 1988).

PAPER II- SOLID STATE AND NUCLEAR PHYSICS

UNIT-I

Crystal Structure

Lattice translation vectors and lattice, Symmetry operations, Basis and Crystal structure, Primitive Lattice cell, Two-dimensional lattice types, systems, Number of lattices, Point groups and plane groups, Three dimensional lattice types, Systems, Number of Lattices, Points groups and space groups. Index system for crystal planes Miller indices, Simple crystal structures, NaCI, hcp, diamond, Cubic ZnS; and hexagonal , Occurrence of Nonideal crysal structures, random stacking of polyprism, glasses.

Crystal Diffraction and Reciprocal Lattice

Incident beam, Bragg law, Experimental diffraction method, Laue method, Rotating crystal method, Powder method, Derivation of scattered 'wave amplitude, Fourier analysis, Reciprocal lattice vectors, Diffraction conditions, Ewald method, Brillion zones, Reciprocal lattice to sc, bcc and face lattices , Fourier analysis of the basis and atomic form factor.

UNIT -II

Crystal Bindings

Crystal of inert gases, Van der Walls-London interaction, repulsive interaction, Equilibrium lattice constants, Cohesive energy, compressibility and bulk modulus, ionic crystal, Madelung energy, evaluation of Madelung constant, Covalent crystals, Hydrogen-bonded crystals, Atomic radii.

Lattice Vibrations

Lattice Heat capacity, Einstein model, Vibrations of monatomic lattice, derivation of dispersion relation, First brillouin zone, group velocity, continuum limit, Force constants, Lattice with two atoms per primitive cell, derivation of dispersion relation, Acoustic and optical modes, Phonon momentum. Free electron theory, Fermi energy, density of states, Heat capacity of electron gas, Paramagnetic susceptibility of conduction electrons, Hall effect in metals. Origin of band theory, Qualitative idea of Bloch theorem, Kronig-Penney model, Number of orbitals in a band, conductor, Semi-conductor and insulators, Effective mass, Concept of holes.

UNIT - III

Nuclear Physics

1. **General Properties of Nucleus:**

   Brief survey of general Properties of the Nucleus, Mass defect and binding energy, charges, Size, Spin and Magnetic moment, Bainbridge mass spectrograph.

2. **Nuclear Forces:**

   Saturation phenomena and Exchange forces, Deutron ground state properties.

3. **Nuclear Models:**

   Liquid drop model and Bethe Weiszacker mass formula, Single particle shell model (only the level scheme in the context of reproduction of magic numbers).

4 Natural Radioactivity:

Fundamental laws of radioactivity, Soddy-Faj an's displacement law and law of radioactive disintegration, Basic ideas about α, β and ϒ decay.

UNIT-IV

1. Nuclear Reactions:

Nuclear reactions and their conservation laws, Cross section of nuclear reactions, Theory of fission (Qualitative), Nuclear reactors and Nuclear fusion.

2. Accelerators and detectors:

Vande Graff, Cyclotron and Synchrotron, Interaction of charged particles and gamma rays with matter (qualitative), GM counter, Scintillation counter and neutron detectors.

3. Elementary Particles:

Basic classification based on rest mass, Spin and half life, particle interactions (gravitational, Electromagnetic, week and strong Interactions).

Text and Reference Books

Pun and Babbar, "Solid State Physics" (S. Chand).

C. Kittel, "Introduction to Solid State Physics"- Vth Edition (John Wiley & Sons). H.S. Mani and G.K. Mehta, "Introduction to Modern Physics" (Affiliated East-West Press— 1989).

A. Beiser, "Perspectives of Modern Physics".

T.A. Littlefield and N. Thoreley, "Atomic and Nuclear Physics" (Engineering Language Book Society). Eisenberg and Resnik, "Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and Particles" (John Wiley).

Ghoshal S.N.- Nuclear Physics - S. Chand & Co.

PAPER III - SOLID STATE ELECTRONICS

UNIT-I

Diffusion of minority carriers in semiconductor, work function in metals and semiconductors Junctions between metal and semiconductors, Semiconductor and semiconductor, p.n. Junction, Depletion layer, Junction Potential Width of depletion layer, Field and Capacitance of depletion layer, Forward A.C. and D.C. resistance of junction, Reverse Breakdown.

Zener and Avalanche diodes, Tunnel diodes, Point contact diode, their importance at High frequencies, LED photodiodes, Effect of temperature on Junction diode Thermistors.

UNIT -II

Transistor parameters, base width modulation, transit time and life-time of minority carriers, Base- Emitter resistance Collector conductance, Base spreading resistance, Diffusion capacitance, Reverse feedback ratio, Equivalent circuit for transistors, Basic model, hybrid model and Y parameter equivalent circuit, Input and output impedances.

UNIT III

Current and Voltage gain, Biasing formulae for transistors, Base bias, emitter bias and mixed type bias and mixed type biasing for small and large signal operation. Transistor circuit application at law frequencies, their AC and DC equivalent for three different modes of operation, Large signal operation of transistors, Transistor Power amplifiers, Class A and B operation, Maximum power output Effect of temperature, heat sinks, thermal resistance Distorsion in amplifiers, cascading of stages, Frequency response, Negative and positive feedback in transistor amplifiers.

UNIT -IV

Field effect transistors and their characteristics, biasing of FET, use in preamplifiers , MOSFET and their simple uses.

Power Supplies:

Electronically regulated low and high voltage power supplies, Inverters for battery operated equipments.

Miscellaneous:

Basic linear integrated circuits, phototransistors, Silicon Controlled rectifiers, Injunction transistor and their simple uses.

Text and Reference Books

B G Streetman; "Solid State Electronic Devices", UK Edition (Prentice-Hall of India. New Delhi, 1986).

W D Stanley; "Electronic Devices, Circuits and Applications" (Prentice-Hall, New Jersey, USA. 1988).

J D Ryder; "Electronics Fundamentals and Applications" 1jnd Edition\ (Prentice-Hall of India. New Delhi, 1986). I Miliman and A Grabel; "Microelectronics", International. Edition (McGraw-Hill Book Company, New York, 1988).

PRACTICAL

NOTE:

This is a suggested list. Every institution may add any experiment of same standard in the same subject area.

Statistical Physics

1. Data from n-option systems of several relative weightages to be examined and interpreted.
2. Plotting F-D distribution in the neighbourhood of Fermi energy for different temperature values.
3. Solar wind as a thermal expansion of solar corona at one million Kelvin.
4. Study of dilute gas for experimental verification of Maxwell-Boltzman statistics.
5. Number of microscopic states of perfect gas (Gibbs-paradox).

Solid State Physics

1. Goniometric study of crystal faces.
2. Determination of dielectric constant.
3. Hysteresis curve of transformer core.
4. Hall-probe method for measurement of magnetic field

Solid State Devices

1. Specific resistance and energy gap of a semiconductor
2. Characteristics of a transistor
3. Characteristics of a tunnel diode

Electronics

1. Study of voltage regulation system
2. Study of, a regulated power supply
3. Study of Lissajuous figures using a CR0
4. Study of VTVM

5. Study of RC and TC coupled amplifiers
6. Study of AF and RF oscillators

Nuclear Physics

1. Study of absorption of alpha and beta rays.
2. Study of statistics in radioactive measurement.

Text and Reference Books

B.G. Strechman, "Solid State Electronic Devices". II Edition (Prentice-Hall of India, New Delhi, 1986).

W.D. Stanley, "Electronic Devices, Circuits and Applications" (Prentice-Hall, New Jersey, USA, 1988).

D.P. Khandelwal, "A Laboratory Manual for Undergraduate Classes (Vani Publishiing House, New Delhi). S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).

Instructions for Paper Setting

All questions carry equal marks.

Section A: One compulsory question with four parts. One part (numerical or short answer type) from each unit.

Section B: Two questions (long answer or numerical type) from each unit but only one question from each unit is to be attempted.

(iv) Liquid drop model–semi empirical mass formula, nuclear fission.

(v) Qualitative discussion of extreme single particle model, quantitative treatment of single particle orbitals, explanation of spins and parities of nuclei. Introduction of spin orbit tern and reproduction of magic numbers and spins parities.

(vi) Collective model :– Simple discussion of rotational and vibrational states.

2. Two body problem and nuclear forces

(i) Ground state of deuteron (using central force) qualitative and quantitative discussion.

(ii) Neutron proton scattering below 10 Mev, elementary discussion of quantum mechanical theory of scattering, effective range theory, comparision of theoretical results with the experimental values and explanation of spin dependence of nuclear forces.

(iii) Existence of non–contral (tensor) forces, general form of non central forces aad their properties, qualitative and quantitative discussion of ground states of deuteron and its magnetic moment using non central forces.

(iv) Exchange forces–qualitetive discussion and formal definitions. Isospin formalism and general form of the nucleon–nucl.on interaction.

3. Nuclear Transformations

(i) Alpha–decay : Measurenent of alpha-particle energies, experimental decay constant & Geiger–Nutal Law, Gammonstheory of alfa–decay Nuclear energy levels as deduced from alpha–decay data.

(ii) Beta–decay : Beta-decay processes, measurement of Betaray energies, Neutrinohypothesis and simple theory of Beta-decay, curil plots, allowed and forbidden transitions, selection rules parity violation in Beta-decay.

(iii) Gamma Transitions : Gamma rays and measurement of Gamma ray energies—Bent crystal spectrometer, pair spectrometer, measurement of life time of excited states, internal conversion, angular correlation, assignment of spin and parity of nuclear Coefficients.

4. Accelerators and Nuclear reactions :

(i) Accelerating machines; Betatron, Synchro Cyclotron, Bevatron. Particle detector – G. M. counter, scaling circuit, scintillation counter, semi conductor, radiation detectors. Neutron detection techniques,

(ii) Description of nuclear reactions, Reaction kinematics—Q—Value equation, reaction cross-section, nuclear reaction, theories-resonance. Breit-Wigns dispersion relation for the compound nucleus theory-stripping & pick-up reaction, connection with shell models,

5. Classification of elementary particles. Nishijima Scheme, Mass formula, Symmetries & Conservation Laws, external and internal symmetries.

Books recommended :

1. Theoretical Nuclear Physics : Blatt and Weiskoff
2. Nuclear Physics : Roy and Nigam
3. —do— : Enge
4. —do— : M. A. Preston
5. —do— : Halliday
6. —do— : Elton
7. Theory of elementary particles : Keon

Paper III

ADVANCED ELECTRONICS

Note : There shall be no sections in the paper.

1. Transmissisn Lines :

Transmission line equation, line characteristics, line distortion and attenuation, line termination, impedance matching, standing wave ratio, transmission line as a circuit element. Transmission line charts (Smith Chart)

2. Antenna :

Radiation from linear antenna in space, effect of ground, field at a point above surface of the earth due to vertical antenna, power radiated from antenna and radiation resistance, quarter and half wave antenna antenna arrays, TV Antenna.

3. Propagation of Radio Waves :

Factors involving in propagation of radio waves, ground wave, space and sky waves, Appleton Hartree formula, nature of ionosphere and and its stratification, refraction and reflection of waves, skip distance, critical frequency, exploration of ionosphere.

4. Modulation & Detection :

(i) Amplitude modulation principle, modulation circuits, simple AM transmitter circuit (ii) Frequency modulation principle, Armstrong FM system, frequency discriminators.

Diode detectors, A-V-C frequency conversion; mixer, Intermediate frequency amplifier, AM Transistor Receiver.

5. T. V. and Radar :

Scanning, T. V. Camera (Videocon and Orthicon), Kinescope, Block diagram of B/W and Colour TV receiver, TV receiver and transmitter, elementary idea of radar.

6. High frequency Amplifier :

Common emitter short circuit current frequency response, Alpha cut off frequency, hybrid-pi-common alpha emitter model. CE short circuit gain with hybrid-pi-model.

7. Microwaves :

High frequency limitation in conventional tubes, velocity modulation theory of bunching and power deliverd by reflex klystron, types of magnetrons, modes of operation, tuning and output pewer of a multicavity magnetron, Basic principle of travelling wave tube.

Gunn Effect, and Gunn characteristic and modes, IMPATT and TRAPATT diode and its operation under small signal conditions, Rectangular and circular wave guides, TM, TM modes, Attenuation factor and Q of wave guides.

PAPER IV

Operational Amplifier Microprocessor and Digital Electronics :

Note : There shall be no sections in the paper

1. Operational amplifier

Difference amplifier circuit, details of op – Amp. 741, Inverting configuration and non-inverting configuration, Measurement of op – Amp parameters, frequency response of op-Amp, active filter, op-Amp application-Mathematical operation, solution of differential equations,high resistance voltmeter.

2. Microprocessor

Organization of micro-computer, progrmming of microprocessor, DATA representation, organization and programming of a microprocessor, interfacing memory & I/O Device, Application of Microprocessor.

3. Digital

TTL NAND operation,TTL open Collector NAND gate, Boolean function and truth table, 2, 3, 4 variable Karnaugh map, Karnaugh simplification, Don't-care conditions.

4. Flip-Flop

R-S latch, D-latch, D-Flop-flop, J-K Flip-flop, J-K Master-slave Flip-Flop Timer 555, T-Flip-Flop.

5. Register and Counter

Buffer Register, Control Register, Shift Register, Control Shift Register, Ripple Counter, Ring Counter, Synchronous counter, TTL Counter, Organization of Computer.

6. Memories

ROM, PROM and EPROM, RAM , A small TTL memory, Hexadecimal addresses, D to A and A to D converter.

Books Recommended

1. Antenna Theory & Practice by Chatterjee
2. Modern Digital Electronics by Jain
3. Electronics Devices & Circuits by Allen Mottershead
4. Integrated Electronics by Millman & Halkias
5. Digital Electronics by Malvino
6. Digital Electronics by Radha Krishnan
7. Digital Electronics by Gothmann
8. Microprocessor by A.P. Mathur

List of experiments of M.Sc. (F) Physics for those offering Group B (Advance solid state Physics)

1. Study of solid state power supply
2. Study of multivibrator
3. Hall effect
4. Energy gap measurements
5. Electron spin resonance studies
6. Elastic constant of cubic crystals
7. Thermal conductivity of a crystal and its temperature variation
8. Photo conductivity of CdS
9. Conductivity of semiconductors by four probe method
10. Electrical conductivity measurements of thin films
11. Study of conduction in ionic crystal (Ionic conductivity of NaCl)
12. Production of study of colour centres.
13. Lave perotographs
14. Powder photographs
15. Fleurescence intensity determination by photomultipliers
16. Transistor amplifier and its study
17. Mossbauer effects studies

18. Growing of metal crystal and their studies
19. Study of Hysterisis and transit on temperature of ferro electric crystal
20. Diffusion length of current carrier in semi conductors
21. Study of characteristics of FET
22. Study of phase and frequency response of FET

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Physics

M. Sc. (Prev.)

PAPER I

Mathematical Physics and Classical Mechanics

1. The Elements of the Theory of the complex variable.

Introduction — General Functions of a complex variable. The Derivative and Cauchy–Rieman Differential Equations, Line Integrals of complex Functions, Cauchy's Integral Theorem — Cauchy's Integral Formula— Taylor's series — Lawrent's series — Residues — Cauchy 's Residue Theorem—Singular points of an analytic Function — The point at Infinity—Evaluation of Residues – Evaluation of Definite Integrals Jordon Lemma — Integrals Involving Multiple — valued functions — Simple exercises.

2. The Wave Equation and the Poisson's Equation

Introduction—The Transverse vibrations of a stretched string, D'Alembert's solution — Waves on Strings – Harmonic Waves — Fourier series solution – Orthogonal Functions— The Oscillations of a hanging Chain — The Vibrations of a Rectangular Membrane — The vibrations of a circular Membrane— The Telegraphists, or Transmission line, Equations – Tidal waves in a canal—Sound Waves in a Gas —The Magnetic Vector Potential — The Inhomogeneous Wave Equation — The Theory of wave Guides — Green's Function — Solution of Poisson's Equation using Greens's Function.

3. Group Theory

Concepts of a group – Abelian Group— The generators of a Finite Groups— The cyclic group—The group Multiplication Table—The Rearrangement Theorem — Subgroups—Cosets— Conjugate Elements and classes—

The product of classes – complexes – Conjugate subgroups-Normal subgroups and Factor groups. Isomorphism and Homomorphism – Permutation groups – The group of symmetry of an equilateral Triangle – group of symmetry of a square—Representation of groups – Reducible and Irreducible Representations – The orthogonality Theorem – The character of a Representation – Character Tables – The Unitary group – Point groups – Simple Problems.

4— Variational Principles and Lagrange's Equations

Hamilton's principle — Techniques of the calculus of variations — Derivation of Lagrange's Equations from Hamilton's principle — Extension of Hamilton's. principle to non – holonomic systems Advantages of a variational principle formulation – Conservation Theorems and symmetry properties.

5— The Hamilton Equations of motion - Canonical Transformations and Hamilton-Jacobi Theory

Legendre's Transformations and the Hamiltons equations of motion – Hamiltonian in the canonical equations of motion — The equations of canonical Transformation— Examples of canonical transformations – Poisson's Brackets-Equations of motion, canonical transformat ons and conservation theorems in the poisson's Bracket Formulation. The Hamilton jacobi equation for Hamilton's principle function. The harmonic oscillator problem as an example of the Hamilton — Jacobi method.

Books Recommended

1— Applied Mathematics for Engineers and Physicists by Louis A. Pipes, Ph. D. ; Mc – graw – Hill Book Company Inc. , New York, Toronto, London.

2— Mathematical Physics (Including classical Mechanics) by Satya Prakash, Sultan Chand & sons, Daryaganj, New Delhi –110002.

3— Classical Mechanics by Herbert Goldstein, Narosa Publishing House, 6 Community Centre, Panchsheel part, New Delhi—110017.

PAPER II :

Spectroscopy and Quantum Mechanics

Spectroscopy (60%)

Atomic Spec ra

Different modes of coupling. Spectra of alkaline earth and carbon group of elements.

Elementary ideas of hypofine structure, quantum number F, Examples of hyperfine structure, Back & Goudsmit Effect .

Weak Field and Strong Field. Stark effect in Hydrogen.

Dopple width, Natural width. Collision and pressure induced width. Width due to stark effect,

MOLECULAR SPECTRA

Observed Molecular spectra and their representation by Empirical Formulae : Spectra in the visible and ultraviolet regions, spectra in the infra red region, Radio Frequency spectra, Raman spectra.

Interpretation of Infra red and Raman Spectra ; Interpretation of the Principal features of Infra red and Raman spectra by means of the models of the Rigid Rotator and of the harmonic oscillator, Interpretation of the fine details of Infra red and Raman spectra by means of the models of an harmonic oscillator, Non rigid Rotator vibrating rotator and symmetric top, Intensities in Rotation-Vibration spectra, Symmetry properties of Rotational levels.

Electronic states and Electronic transitions : Electronic Energy and total energy, Vibrational structure of Electronic transtions, Rotational structure of Electronic bands, Intensity distribution in the vibrational structure, Frank–Condon principle.

Books Recommended :

(1) Introduction to Atomic Spectra —H. E. White (Text Book)

(2) Spectra of Diatomic Molecules —G. Herzberg (Text Book)

(3) Atomic spectra and atomic structure G. Herzberg (Reference Book)

(4) Introduction to Molecular Spectra—R.C. Johnson (Reference book)

Quantum Mechanics (40%)

1– Matrix Formulation and angular momentum

Matrix Formulation of states and operators, Linear vector space Expansion theorem, Hilbert space. Diagonalization of operator matrix, projection operator. matrix formulation of H.O. problem—theory.

Elementary representation, theory Unitary transformation, pauli spin matrices, Matrix elements of J^2, Jz, J+ J-Operators, coupling of two angular momentra, Clebsch Gordon Coeff, and their matrices.

2— Approximation Methods

(a) Time independent perturbation theory— non-degenerate and degenerate cases with examples of Harmonic Oscillator, Ground state of He—atom, Zeeman Effect and Stark Effect.

(b) Variat onal methods – Ground state & excited states of He—atom.

(c) W.K.B. Method. its application to α - decay problem.

Books Recommended :

(1) Quantum mechanics—L. I. Schiff, IIIrd Edition, Mc-graw

(2) Quantum Mechanics. Ghatak and Leknathan—Mc-Millan.

(3) A Text book of Quantum Mechanics. Mathews and Venkatesan. Tata—Mc-graw Hill.

PAPER III

Advanced Solid State Physics

1. Crystal diffraction and Reciprocal Lattice

Diffraction of X-rays, electrons and neutrons from Crystals. Reciprocal lattice, Interplanar spacing. Reciprocal lattice to Sra. s. c. b. c. c. f. c. and hexagonal lattices; Diffraction conditions, Laue equations, Ewald construction, Brillouin zones; Atomic Scattering factor; Geometrical structure factor for bcc and fcc lattices and for SCl, KCl, KBr and diamond structures; Determination of crystal structures. Laue, rotating crystal and powder methods.

2. Crystal Binding and point defects in Crystals

Inert gas crystals, Lennard-zones potential, Cohesive energy and compressibility : Ionic crystals, Madelung energy, Evjen method for Madelung constant, cohesive energy and compressibility.

Frenkel and Schottky defects in ionic crystals, concentration of defects as a function of temperature. Ionic conductivity and diffusion in Ionic crystals, color centres in alkali halide crystals deBoer model for F-centres.

3. Elastic constants and Elastic Waves

Stress-Strain relations. Elastic compliance and stiffness constants, Elastic energy density; Elastic stiffness constants of cubic crystals, compressibility : Elastic waves in cubic crystals waves in (100), (110) and (111) directions; Experimental determination of elastic constants.

4. Phonons and lattice Vibrations

Quantization of lattice Vibrations. Inelastic scattering of photons and neutrons by phonons, Vibration of mono-atomic and diatomic linear lattices; optical and acoustical phonons, Dielectric function and Lyddane-

Sache-Teller relation, Local phonon modes; lattice thermal resistivity; Phonon-Phonon collisitions, crystal size effect.

5. Free electron Fermi Gas

Dielectric response of electron gas, transverse optical modes in a plasma, Transparency of alkali metals in ultraviolet. Longitudinal optical modes in a plasme.

Boltz mann transport equation, sommer field's theory of electrical conductivity of metals, motion of free electrons in magnetic field, cyclotron frequency, static magneto resistance and Hall effect in metals.

6. Energy Bands of Electrons in solids

Fermi surfaces; Electrons, Holes and open orbits, effective mass of electrons in crystals; Cyclotron resonance and Hall effect in semi-conductors : High field magneto resistance; The de Hass-Van Alphen effect.

7. Magnetism

Ferro, antiferro and ferri magnetism, Wiess molecular field theory, Hei-senberg exchange interaction, spin waves and magnon. dispersion relation for one dimensional and simple cubic crystals, Bloch $T^{3/2}$ law, Ferromagnetic domains, Bloch wall.

8. Exciton, Photoconductivity. Luminescence, Laser and maser

Weakly and tightly bound excitons; photo–conductivity and a simple model of a photo conductor, influence of traps, space charge effects; Luminescence, thallium–activated alkali halide phosphors.

Principle of Laser and Maser, stimulated emission. Ruby laser and semi conductor junction laser, three lavel Ruby Maser, applications of Lasers and Masers.

NMR ESR and Mossbauer effect

NMR, Bloch equations, power absorption, line width, experimental method and applications; ESR, experimental study and applications.

Mossbauer effect, recoilless transition, fraction of recoilless events, Lamb-Mossbauer factor Experimental study and applications of Mossbauer effect.

10. Supper Conductivity

Properties in super conducting state, Meissner-effect, type I and II super conductors thermodynamics of super conducting transition, Rutger's formula, London equations, penetration depth, coherence length, basic ideas of BCs theory.

Books Recommended

1. C. Kittel — Introduction to solid state Physics
2. A. J. Dekker — Solid state Physics
3. R. L. Shinghal — Solid state Physics

PAPER IV :

Electronics 60% and Electrodynamics 40% Electronics

1. Network Theorems : Thevenin, Norton, Millman, Compensation and superposition theorems, Decible notation, Impedance matching.
2. Semi-Conducting Devices : Shottky Diode, Tunnel-Diode, Varactor Diode, LED, Liquid Crystal Diode, Diac, Triac and S. C. R., Thermistors and L. D. R. and their use in A. C. Voltage regulators.
3. Electronically regulated power supply : Shunt ragulator, series regulator (using emitter follower and Darlington pair) short circuit overload protection, parameters of a regulated power supply, block diagram of a mono-lithic regulator, power control using SCR and triac, SMPS power supply.

4. Power Amplifiers : Class A power amplifier, Push pull class AB power amplifier, complimentary Symmetry, Tone Control and frequency compensation, Class C-amplifier.
5. Wave Shaping and Pulse Technique : Differentiating. integrating and summation circuits, Generation of a voltage step from cramp, square wave from a triangular wave. Narrow pulses from rectangular wave form, A stable, monostable, bistable multivibrator, Schmidt trigger circuit.
6. JFET and MOSFET : Operation of an N-Channel JFET, Transfer and output characteristics of a JFET, parameters of JFET, JFET as an amplifier, biasing of JFET, Principle and operation of MOSFET in Depletion and Enhancement mode.

Books Recommended

1 Electronic Devices & Circuits by Allen Mottershead,
2 Integrated Electronics Fundamental by Milman-Halkias
3 Hand Book of Eiectronics by Kumar & Gupta
4 Electronic Devices & Circuits by Mathur, Chaddha & Kulshrestha
5 Electronic Devices By A. Singh

Electro-dynamics

Electromagnetic Field equation :

Electric field and potential in terms of charge distribution Multiple expansion, electric field in di-electric media, theory of polarisation, field energy in free space and di-electrics, Maxwell stress tensor.

Electromagnetic field equation :

Displacement current, Maxwell's equations, propagation of plane waves in non-conducting and conducting media, Poynting vector boundary conditions at interfaces, laws of reflection at the inter face of non-conducting media, reflection from a conducting plane: electromagnetic scalar and vector potential, radiation from an oscillating dipole, scattering of electromagnetic waves and dispersion.

Electrodynamics of moving charge:

Lienard-wichert potentials, field of a charge in uniform motion, radiation from an accelerated charge.

Electrical neutrality in a plasma, equation of motion of charge in constant uniform electric and magnetic field, particle orbits and drift motion in a plasma, hydromagnetic equation, pinch effect, plasma oscillations and wave equation.

LIST OF EXPERIMENTS FOR MSc. PREVIOUS

1. e/m by Thomson's method.
2. e/m by Magnetron valve method or Bush method.
3. Verification of Hartmann Formula.
4. Verification of Cauchy's formula.
5. Verification of Fresnel's formula for reflection.
6. Study of elliptically polarised light by Babinet's compensator.
7. Michelson's Interferrometer.
8. Fabry Perot's elation.
9. Determination of Stephen constant.
10. Determination of planck's constant by Photo cell.
11. Determination of velocity of light.
12. B.H Curve.
13. Self Inductance by Anderson bridge.
14. Study of valve characteristics Triode, tetrode and pentode.
15. Study of transistor characteristics.
16. Study of C. R. O.
17. Study of H. W. and F. W. rectifiers.
18. Study of R. C. Amplifiers.
19. Study of ionisation and excitation potentials.
20. Ultra sonic velocity in liquids.
21. Study of Zeeman effect.
22. Measurement of Magnetic susceptibility.
23. Study of G. M. Counter.

Physics

M. Sc. (Final)

PAPER I

ADVANCED QUANTUM MECHANICS

Note : There shall be no sections in the paper

1. Time Dependent Perturbation Theory

Schrodinger, Heisenberg and Interaction representation, operator formalism of time dependent perturbation theory, Dyson chronological operator. Constant and harmonic perturbations, Transition probability per unit time, Radiative transitions in atoms, Dipole transitions and selection rules, Adiabatic and sudden approximations.

2. Scattering Theory

Scattering cross section Laboratory and centre of mass system, Normalization of incoming wave, method of partial waves. The Scattering amplitude, Integral equation of scattered wave, Born Approximation, Validity of Born Approximation for square well and screened coulomb potentials, Scattering between identical particles, Formal theory of scattering and Lippmann – Schwinger equation, The scattering amplitude and the transition matrix, the scattering of an electron by an atom (Neglecting exchang e) S—matrix, Rotational and Time reversal invariance of S—matrix.

3. Relativistic Wave Equations

The Klein – Gordan equation for free—particle and electro – magnetic potential Inadequacy of Klein—Gordon Equation, The Dirac equation, free particle solution, Soluions for electro—magnetic potential and for central field, Energy levels of Hydrogen atom, Negative energy states.

4. Occupation number representation and Quantisation of fields

Second quantisation of Harmonic Oscillator, Creation, Annihilation and Number operators, Vaccum state, One-body and two-body operators in occupation number representation, Co-ordinates of the Schrodinger Field. The Klein – Gordan Field, The Dirac Field, and the Electromagnetic Field.

5. Interacting Fields and Fynman's diagrams

Feynman Diagrams, Normal products, Dyson & Wick's chronological products, contraction Wick's Theorem, S-Matrix and the scattering processes of various orders.

Books Recommended

1. Quantum Mechanics : VK. Thankappan, Wiley Eastern Limited, 1986.
2. Quantum Mechanics ; E. Merzbacher, John Wiley & Sons, 1970.
3. Many-body Problems : G.E. Brown, North Holland Publ. 1972.
4. Many-body Theory and Diagram techniques : S. Muttack
5. Quantum Mechanics : B.S. Rajput, Pragati Prakashan
6. Quantum Mechanics : Schiff 3rd Ed.
7. Quantum Mechanics : Mathews & Venkatesan, Tata Mc-Graw Hill

Paper II

NUCLEAR PHYSICS AND PARTICLE PHYSICS

Note :- There shall be no sections in the paper

1. Basic properties of Atomic nucleus and Nuclear models

(i) Nuclear size and charge distribution, High energy electron scattering (Hofstadter method).

(ii) Electromagnetic moments – electric dipole moment, electrical quadrupole moment, magnetic moment, experimental determination of magnetic moment and electric quadrupole moment.

(iii) Angular momentum, parity and statistics of the nucleus.

Course outcomes (Physics)

B.Sc. (Physics) CO1 Mechanics and wave motion: Basic of the mechanical system and understanding of planetary system and wave propagation.

B.Sc. (Physics) CO2 Kinetic theory and thermodynamics: description of thermodynamics systems and black body radiation.

B.Sc. (Physics) CO3 Circuit fundamentals and Basic Electronics: Gives a basic knowledge of semiconductors and semiconductor devices.

B.Sc. (Physics) CO4 Physical optics and Lasers: Gives knowledge of Interference of light, Diffraction of light and polarization of light and characteristics of laser lights and its uses.

B.Sc. (Physics) CO5 Electromagnetics: Gives a knowledge about E-M waves, their composition and their advantages.

B.Sc. (Physics) CO6 Element of Quantum mechanics, Atomic and Molecular spectra in this basic of Q. mech. And basics of atomic & molecular spectra are included.

B.Sc. (Physics) CO7 Relativity and Statistical Physics: Consequence of Einstein theory of relativity and statistical mechanics gives quantum information of thermodynamics.

B.Sc. (Physics) CO8 Solid state and nuclear physics: Gives a knowledge crystal structure and structure of nucleus, radioactivity, nuclear reactions, accelerators, detectors and elementary particles.

B.Sc. (Physics) CO9 Solid state electronics: Describes the application of solid state electronics, e.g. transistor, LED, Amplifiers etc.

M.Sc. (Physics) CO1 Mathematical physics and classical mechanics: Basic of mathematical physics and classical physics, Language equation; Ha Milton equation.

M.Sc. (Physics) CO2 Spectroscopy and Quantum mechanics: Describe Atomic spectra, molecular spectra, Infrared and Raman spectra, Electronic state and electronic transitions, Zeeman effect and stark effect.

M.Sc. (Physics) CO3 Advanced solid state physics: Describe crystal diffraction, Reciprocal lattice, Crystal binding, point defect, elastic constant and elastic waves photon and Lattice vibration, free e-Fermi gas, magnetism, LASER and MASER NMR, ESR, Mossbauer effect, superconductivity.

M.Sc. (Physics) CO4 Electronics and Electrodynamics: Classify Network theorems semiconductor devices, power supply, power amplifiers, JFET, MOSFET, E-M field equations and electrodynamics of moving charge.
M.Sc. (Physics) CO5 Advanced Quantum Mechanics: Describes time dependent perturbation theory, scattering theory, relativistic equations, occupation number representation and quantization of fields, interacting field and fymann diagrams.

M.Sc. (Physics) CO6 Nuclear Physics and Particle Physics: Describes basic properties of Atomic nucleus, Nuclear models, two body problem and nuclear force, nuclear transformations, accelerations and nuclear reactions.

M.Sc. (Physics) CO7 Advanced electronic: Classify transmission lines, Antenna, propagation of Radiowaves, modulation and detection. TV and radar, High frequency Amplifier, microwaves

M.Sc. (Physics) CO8 Operational and Amplifier microprocessor and Digital Electronics: Describes Op. Amp. Microprocessor, Digital, Flip-Flop, register, counter and memories

Programme outcomes (Physics)

B.Sc. (Physics) PO1 Understand the mechanical system, planetary motion thermo dynamical system, black body radiation and basic knowledge of semiconductor devices.
B.Sc. (Physics) PO2 Communicate the effective knowledge of properties of light, laser and its uses, E-M theory and its uses, and basic of quantum mechanics, atomic and molecular spectra.
B.Sc. (Physics) PO3 Gives a knowledge of Einstein theory of relativity, crystal structure, the structure of the nucleus, radioactivity, elementary particles, detectors and accelerators and application of solid state electronics like LED, Transistor, Amplifier, Oscillator etc.

M.Sc. (Physics) PO1 Communicate the effective knowledge of Lagrange equation, Hamilton equation , Group theory, Atomic & molecular spectra, perturbation theory.

M.Sc. (Physics) PO2 Understand crystal structure, magnetism, LESER and MASER, NMR, ESR Mossbauer effect, superconductivity and semiconducting devices power supply, power amplifier, JFET and MOSFET and Electro dynamics.
M.Sc. (Physics) PO3 Gives a knowledge of scattering theory, Fyman's diagram, Atomic nucleus, Nuclear models, elementary particles, accelerator, transmission lines

modulationand detection, T.V., Radar, Op.Amp, Microprocessor, flip-flap and memories.

Programme specific outcomes (Physics)

B.Sc. (Physics) PSO1 Understand the basic physics behind any natural phenomenon.

B.Sc. (Physics) PSO2 Electrical appliances can be maintained by Electrician this course imparts basic knowledge.
B.Sc. (Physics) PSO3 Competitive exam preparation can be done.

M.Sc. (Physics) PSO1 Minimum Qualification of Radiation officer in medical colleges after a course from BARC Mumbai.
M.Sc. (Physics) PSO2 Can apply for NET/SLET/GATE etc.

M.Sc. (Physics) PSO3 Teaching profession is open for all meritorious students.