M.Sc. Examination 2009-10

Physics

M.Sc. Previous

1. The examination shall be consists of five theory papers and a practical.
2. There shall be a practical course for each group.

The distribution of marks shall be as follows—

Dept. of Physics

Theory papers—

1.	Mathematical Physics.	100 Marks
2.	Electromagnetic Theory & Plasma Physics	1000 Marks
3.	Quantum Mechanics	100 Marks
4.	Atomic & Molecular Spectroscopy	100 Marks
5.	Electronics	100 Marks

Practicals

A candidate has to perform two experiments during examination one from each group. Time alloted for each experiments will be four hours. There will be some sessional work also. The distribution of marks will be as follows—

		Regular Candidate	Ex-Student
1.	Experiment – I (Group A)	60	90
2.	Experiment – II (Group B)	60	90
3.	Viva	50	70
4.	Record	30	
5.	Sessional work	30	
	Total =	250	250

M.Sc. Physics (Previous)

I Paper

MATHEMATICAL PHYSICS

2009-10

UNIT-I:

Numerical Analysis:—

Interpolation: Finite differences, operators, Interpolation with equal and unequal intervals of arguments, Central difference interpolation formula, Inverse interpolation formula

Numerical Differentation:—

Derivatives using Newton's forward interpolation formula, Derivative using Newton's Backward interpolation formula, Derivative using stirling formula.

Numerical Integration:—

General quadrature formula for equidistant ordinates, Trapezoidal rule, Simpson- one third and ~~three~~ one eight rule. Euler- Maclaurin summation formula.

Numerical Solution of ordinary differential equations:—

By Taylor's series method; by Euler's method & by Runge- Kutta method.

~~Solution of Algebraic & transcendental equations:—~~

~~Newton-Raphson or Newton iteration method,~~

~~Regula-falsi method~~

(3)

Integral Transform, Laplace transform; first and second shifting ~~harmonics~~ theorems. Inverse LT by poo-part -cial functions; L.T. of derivative and integral of function; Fourier series; F.S. of arbitrary period; Half wave expansions; Partial sums; Fourier integral and transformation; FT of delta functions.

UNIT-II :- COMPLEX VARIABLES;

General function of complex variables Cauchy by — Riemann Condition differential eqn. Analytic conformal mapping (translation, rotation, inversion) Cauchy's integral formula, Taylor's & Laurent series, Singularity poles, Residue theorem, Evaluation of definite integral (around unit circle, semicircle using jordan's lemma with poles lying on real axis & integration involving multiple valued function — branch point.)

UNIT- III :—

Introduction to Computer languages fortran constants & variables, arithmatical expression, input - output statements control statements, Do statements Subscripted variables, Format specifications logical expressions, function & Subroutines Declaration, Common Equivalence and double

precision. ~~Introduction to C language.~~

Text and Reference Books—

1. Mathematical methods for Physics by Murphy & Morgan
2. Special functions by ED. Rainville
3. Special Functions by WW Bell
4. Mathematical for physicists by Mary L Boas
5. Mathematical Physics B.S. Rajput – Pragati Prakashan Meerut.

M.Sc. (Previous) [5]

Paper-II

Electromagnetic theory and Plasma Physics.

UNIT-I: Electromagnetic theory:

(i) Maxwell Equations: Microscopic & Macroscopic fields Macroscopic Maxwell equations; fields; D & H Dielectric tensor, Principal dielectric axes.

(ii) Potential and Gauges: Scalar & vector potentials, Gauge transformation, Lorentz gauge and Transverse gauge, Maxwell equations in terms of electromagnetic Potentials.

(iii). Four Dimensional formulation: Minkowski space, Intervals, Proper time lorentz transformation, Transformation of velocities, relativistic doppler effect, Four vectors, four Tensor, Principle of least action, Four-momentum of a free particle.

(iv). Propagation of Electromagnetic Waves: Propagation of electromagnetic waves in free space, conducting and non-conducting medium, Propagation of Electromagnetic waves in guided media: Transmission lines, wave guide, modes of vibration in a rectangular wave guide, cavity Resonator.

UNIT-II Plasma Physics:

(i) Plasma State & its properties: Elementry idea of Plasma state of matter, Motion of charge particle in uniform E & B fields, non-uniform fields, drifting motion, electrostatic and magnetostatic lenses; Time varying E & B fields, Adiabatic invariants, Plasma Confinements (Pinch effect, Mirror confinement, Van Allen Belt), Elementry idea of fusion technology.

(ii). Hydrodynamical Description of Plasma:— Hydrodynamical description, Equation of magneto hydrodynamics, High frequency plasma oscillation Short wavelength limit and Debye-Screening distance.

(iii) Kinetic theory of Plasma: Boltzmann Vlasov equation, landau damping, Collision damping.

References—

1. The Classical Theory of Fields by L.D. landau & E.M. Lifshitz (Pergmon press, Oxford)

2. Foundation of Electromagnetic dynamics by J.D. Jackson (Wiley Eeast, Ltd. Delhi)

M.Sc. (Previous)

Paper III

Quantum Mechanics

UNIT- I : Bra and Ket Notation:

Dirac's bra and ket notations, vector representation of states, bra & ket vectors, projection and projection operators; Linear operator eigenvalue equation, orthonormality and completeness relation, relation between kets and wave function, concept of Hilbert space.

UNIT-II : Matrix formulation and theory of angular momentum —

Matrix form of wave function, Matrix representation of observable, Change of basis. Equation of motion in matrix form, Schrodinger, Heisenberg and interaction representation. Matrix theory of linear harmonic oscillator and general proof of uncertainity principle in matrix mechanics, total angular momentum operators, commutation relation of total angular momentum ladder operators, addition of angular momenta, Clebsch gordan coefficients pauli ~~princip~~ matrices, bra & ket notation.

UNIT-III - Approximation methods—

Perturbation theory of degenerate case and its application to Zeeman effect, Varification method and its application to normal He-atom and one dimensional harmonic oscillator of unit mass, Time dependent perturbation theory, Transition Probability, fermi Golden rule, application to semiclassical theory of radiation, Selection rules, WKB method, Application to potential barrier penetration problem (alpha decay).

UNIT-IV- Scattering Theory-

Scattering cross section, quantum mechanical description, Expansion of plane wave in spherical harmonics (partial wave analysis), Scattering by spherical symmetrical-ic potentials, Born approximation, validity of Born's approximation Scattering from three dimensional square well and Coulomb potential.

UNIT-V Identical Particles-

Indistinguishability of identical particles and exchange ~~theory~~ energy, permutation symmetry and Symmetrization postulates, Self consistent field approximation (Hartee method), Slater determinat, Hartee-fock method; Application of quantum mechanics to two electron systems e.g. hydrogen molecule and He-atom.

UNIT- VI KLEING- GORDEN & DIRAC. EQUATION :-

K.G. Equation, Plane wave solution of Dirac equation, Negative energy states and production of positron, Spin and Intrinsic magnetic moment of Dirac electron

References-

1. Quantum Mechanics by L. I. Schiff.
2. Quantum Mechanics by Pauling & Wilson
3. Quantum Mechanics by B. K. Agrawal
4. Quantum Mechanics by Msrt.
5. Quantum Mechanics by Ghatak & Lokanathan
6. Quantum Mechanics by Satya Prakash.

M.Sc. Previous

Paper IV

Atomic & Molecular Spectroscopy

UNIT-I Atomic Spectroscopy :- Quantum states of one electron atoms :- Atomic orbitals - Hydrogen atom- Pauli's principle & non- equivalent electrons, normal & anomalus zeeman effect, Paschen-Back effect, Stark effect, Two electron system, interaction energy in LS & JJ coupling, Hyperfine Structre. (Qualitative), line-broad mechanism (general ideas)

UNIT II :- X-ray Spectra, Regular lines, effect of nuclear properties on spectral lines, seqnences, Auto-ionisation, photo electron spectra, Angular process.

UNIT-IV Polarization of light in Raman effect, rotational Raman effect, vibrational Raman effect Raman & IR spectra as tool of structre determin-ation, Laser Raman Spectroscopy technique & its application.

UNIT-V Electronic spectra of diatomic molecule, vibrational structre of electronic bands progression seqnence, Deslandor Table, Vibrational constants Isotopic displacement & proof of existance of zero point energy, Rotational structre of electronic

bands. Brouches of a band, fortrato diagram, head formation & Shading of bands, Rotational constants, Frank - Condon Principle.

Books —

1. Atomic Spectra — H.E. White
2. Molecular Spectra & Molecular Structre — G. Herzberg
3. Fundamentals of Molecular Spectroscopy — C.B. Banwell.

30/8/19

(i) Power Devices: SCR, Basic Structres., I-V Characteristics and two transistor model, DIAC & TRIAC, Basic structre, operation & equivalent ckt, I-V. characteristics, TRIAC as high power switch, DIAC as triggering devices of TRIAC, UJT in over voltage protection, Saw tooth wave generation using UJT.

(ii) Regulator Circuits: Load and line regulation, Stabilization ratio, Internal impedance & Temperature coefficient of voltage regulation Linear voltage regulator circuit.

References—

1. Principle of electronics by — V.K Mehta
2. Switch Mode Power Conversion Basic theory and Design by — Kitsum (Marcel Dekkar, Nexo York).
3. Power Electronics by — P.C. Sen (Tata Mc Graw hill)
4. Electronic devices & circuits: Millman & Halkias.
5. Functional Electronics — Raja Raman
6. Functional Electronics : Raja Raman.

M.Sc (Previous) (2009-2010)

Paper-IV

ELECTRONICS

UNIT-I :- Op-amp :- Introduction to operational amplifier, Basic parameters, Applicability of Op-amp in Analog computational, op-amp as voltage follower, Adder, Substractor, Integrator, Differentiator, log amplifier, antilog amplifier, Analog multiplier & Divider circuit, Op-amp as low pass filter, high pass filter, band pass filter and band elimination filter

UNIT-II Transistor Oscillators — Oscillators as positive feedback amplifier, Condition of sustained oscillations, Phase shift, & Wien bridge oscillator, Hartley & Colipits circuit, Negative resistance oscillator, fequency stability & distortion in oscillators, Miller circuit.

UNIT-IV Non Sinusodial Generators:— Multi vibrators, Bistable, Mono stable & astable multivib -rator, Saw tooth wave generator, Pulse generator Clipping & clamping circuits.

UNIT-V Power electronics :

SESSION 2010-2011
M. Sc. FINAL EXAMINATION
PHYSICS

The examination shall consist of five theory papers and practical. First three papers are compulsory and others are special papers.

Compulsory theory papers

Paper I	Nuclear and particle physics	100 marks
Paper II	Condense matter physics	100 marks
Paper III	Electrodynamics and instrumentation	100 marks

Special theory papers (electronics)

Paper IV	Communication electronics	100 marks
Paper V	Digital electronics and microprocessor	100 marks

Practicals

A candidate has to perform two experiments during examination, one from each group. Time allotted for each experiment will be of five hours. There will be some sessional work also. The distribution of marks is given as under:

	Regular students	**Ex- students**
1. Experiment –I (group A)	75	75
2 .Experiment-II (group B)	75	75
3. Viva	30+30	50+50
4. Record and	10+10	-
5. Sessional work (seminar and project)	10+10	-
Total	250	250

M.Sc. Final

Paper I: NUCLEAR AND PARTICLE PHYSICS

Binding energy:

Basic properties of nuclei, nuclear stability, nuclear size by electron scattering.

Nuclear Forces:

Ground state of deuteron, n-p scattering, analysis by method of partial wave, effective range theory, p-p scattering, charge independence and charge symmetry.

Non central forces, exchange forces, isospin and charge independence, Pion theory of nucleon forces (elementary treatment)

Nuclear Models:

Liquid-drop model, single particle model of nucleus, shell model, magic numbers, magnetic moments and Schmidt lines, collective model (qualitative discussion)

Nuclear Reactions:

Concept of scattering and absorption cross sections, partial wave analysis, optical theorem, compound nucleus, Breit-Wigner formula, direct reaction, kinematics of nuclear reactions.

Nuclear decay:

α-decay-Geiger- Muller law, Gammow's theory, β-decay-parity violation, selection rules, Fermi theory, Fermi-Curie plots, comparative half life, γ-decay-multipole radiation, selection rules, photo disintegration of deutron.

Particle Physics:

Concept of elementary particles, basic idea of fundamental interactions in nature, classification, conservative laws, Invariance associated production, strange particles, Quark model, Gell-Mann- Nishijima formula, symmetry transformation.

Books:-

1. Atomic & Nuclear Physics---------- S.N.Ghoshal
2. Nuclear Physics ---------- D.C.Tayal
3. Nuclear Physics ---------- Roy & Nigam
4. Nuclear Physics---------- Berkhum
5. Nuclear & Particle Physics---------- E.B.Paul

M.Sc. (Final)

Paper-II- Condensed Matter Physics

Lattice Dynamics:

Central and non central forces, generalized force constants, Harmonic approximation, three dimensional lattice. Dielectric constants, source of polarizability and Clausius-Mossotti relation, introduction to liquid crystals-sematic and nematic, principle uses of liquid crystals (qualitative)

Mossbauer Effect:

Recoil energy in an isolated atom, recoil less emission and absorption, conditions for the absorption of Mossbauer Effect, experimental set up, principle uses of Mossbauer Effect.

Electron Band Theory:

Bloch theorem, one electron band theories, plane wave like localized wave functions, nearly free electron approximation, linear combination of atomic orbitals (LCAO) method, tight binding approximation.

Semiconductor:

Extrinsic semiconductors, variation of Fermi energy, concept of degeneracy, many-valley semiconductors.

Super conductivity:

Persistent currents, Meissner effect, isotopic effect, type-I and type-II super conductors, electronic specific heat, London's equation, simple ideas about screened coulombic interaction.

Cooper pairs, elementary ideas about BCS theory, ground state energy, super conducting tunneling, Josephson effect.

Magnetism:

Paramagnetism, molecular field theory of ferromagnetism, exchange interaction between spins, ferromagnetic and anti-ferromagnetic order, neutron diffraction method to obtain magnetic order in ferrimagnetic and anti-ferromagnetic order, neutron diffraction method to obtain magnetic order in ferrimagnetic and anti-ferromagnetic cases of ferroelectricity.

Lattice defect:

Point defect, Frenkel and Schottky defects, colour centers, number of defects (vacancies) in equilibrium, dislocation: edge and screw, Burger vector, role of dislocation in material strength and crystal growth.

BOOKS:

1. solid state physics----------C.Kittel
2. Quantum theory of solids----------C.Kittel
3. Theoretical solid state physics------Wuang
4. Solid state physics----------S.O. Pillai
5. Mossbauer effect and its application—V.G.Bhinde
6. Semiconductor physics---------S.M.Sze

M.Sc. Final

III Paper:- Electrodynamics and Instrumentation

Unit I:- Electrodynamics

Electromagnetic potentials, Maxwell's field equation in terms of electromagnetic potentials, Lorentz gauge, retarded and advanced potentials, calculation of electromagnetic fields using electromagnetic potentials.

Retarded potentials Lienard Wichert potentials, electromagnetic field due to uniformly moving point charge, Four vector potential, invariance of Maxwell's field equation under relativistic transformation, covariance and tensor form of Maxwell's field equation, electromagnetic field tensor, covariant form of electric and magnetic field equations, transformation relation for electric and magnetic field vectors

Unit II:- Instrumentation and control system analysis

1. Amplified D.C. meter, AC Voltmeter using rectifiers, electronic multimeter, analog voltmeter, differential voltmeter, digital voltmeter, component measuring instruments, Q- Meter, vector impedance meter.
2. Sine wave generators, frequency synthesized signal generator, sweep frequency generator, pulse and square wave generator, function generator, audio frequency signal generator.
3. Wave analyzer, harmonic distortion analyzer, spectrum analyzer, frequency counter.
4. Classification of transducers, selecting a transducer, strain Gages, displacement transducers, temperature measurement, photo sensitive device.

BOOKS:

1. Classical electrodynamics by J.D. Jacson
2. Classical theory of fields by J.D.Landau and EM Lifshitz
3. Electronic instrumentation and measurement-techniques By WD Cooper and AD Helfrick
4. Numerical analysis by Harper

M.Sc. (Final)

Paper-IV- Electronics Special Paper

(Communication Electronics)

UNIT-I Analog and digital communication:

Different types of modulation, amplitude modulation, depth of modulation, frequency spectrum, square law modulation, balanced modulator, DSBSC modulation, SSB modulation, frequency modulation, reactance tube modulation, detection of AM and FM waves, linear diode detector, Foster-Shelley discriminator, and ratio detector.

Fundamentals of PAM, PWM & PPM.

UNIT-II Microwave Devices:

Klystron, Reflex-Klystron, principle of operations of magnetron, traveling wave tubes, Gunn diode.

UNIT-III Microwave Communication:

Advantages and disadvantages of microwave transmission lines in free space, propagation of microwaves, atmospheric effects on propagation, antennas used in microwave communication.

UNIT-IV Radio and Television Receivers:

TRF and super heterodyne receiver, block diagram of B&W T.V., transmitter and receiver.

UNIT-V Satellite Communication:

Fundamental principles of satellite communication, communication satellite link design, satellite orbit inclination.

Basic elements of RADAR system.

UNIT-VI-Optical Communication:-Introduction to optical fiber, ray transmission, step index, grounded index, single mode and multi mode, fundamentals of LED optical propagation theory, basic idea of optical detectors.

BOOKS

1. Principle of communication----------Taub&Shelling
2. Communication System----------S.Haykins
3. Communication System----------Kennedy
4. Satellite Communication----------D.C.Agrawal
5. Microwave Devices----------Liao
6. Optical Fiber Communication---------- G.Keiser
7. Fiber optic communication-principles & practice------- J.M.Senior

M.Sc. (Final)

Paper-V- Electronics Special Paper

(Digital Electronics & Microprocessor)

UNIT-I

Number system, code(Gray code, ASCII code and BCD code), basic logic gates, DTL, RTL, TTL and ECL logic circuits, analysis and synthesis of combinational logic circuits, Karnaugh map, Pairs, Quad & Octets.

UNIT-II

Arithmetic logic circuits, controlled inverter and adder substractor circuits, data processing circuits, multiplexer, demultiplexer, encoder and decoder (1 to 16 decoder, BCD decoder and LED decoder).

UNIT-III

Introduction to FF, R-S, D, T, J-K Maser Slave FF, synchronous and asynchronous counters, mod counters, ring counter, serial and parallel shift registers.

Introduction to semiconductor memories, RAM, ROM, EPROM and their addressing techniques, A\D and D\A converter, 555timer and its application as monostable astable and multivibrater.

UNIT-IV Microprocessor Architecture and Programming:

Introduction to microprocessor, architecture of 8085 system components, control signal of 8085 system, timing diagram, memory R/W cycle, introduction set of 8085, addressing modes, elementary programming, concept of 8085 m.p.

UNIT V Data Transfer Scheme and Memory Interfacing:

Data transfer scheme in microprocessors, memory mapped I/O and I/O mapped I/O scheme synchronous, asynchronous and interrupt driven schemes, hardware and software interrupts of 8085, concept of memory and I/O interfacing of DMA controller.

BOOKS

1. Digital principle and application by Malvino Leach
2. Modern digital electronics by R P Jain
3. Microprocessors by Gaonkar
4. Microprocessor and Interfacing by Douglas Hall (TMII)

M.Sc. Final (PRACTICALS)

General (Group-A)

1. Linear characteristic of op-amp.
2. Non-linear characteristic of op-amp.
3. Active filters using op-amp.
4. Sampling theorem.
5. PAM and demodulation
6. Study of clamping circuits
7. Study of integrated circuit regulators.
8. GM counter
9. IC 555 timer
10. Computer aided circuit design and analysis.

Special (Group B)

1. Register and counter.
2. Boolean algebra
3. Half and Full adder.
4. Flip Flops.
5. A/D converter.
6. D/A converter.
7. Encoder and Decoder.
8. Multiplexer.
9. Microprocessor application circuits.
10. Microprocessor programming (8085)