M. Sc (Phy) SEMESTER I

PAPER-I: CLASSICAL MECHANICS PC 22-1071

Note: 100 marks assigned to theory papers are distributed in following manner

Continuous Evaluation	*30 Marks*
Term End Main Examination	*70 Marks*

Max. Marks: 70 *Duration: 3 Hrs.*

Note: In all five questions are to be set. Four questions will be out of the four units taking one question from every unit with 100% internal choice. Fifth question will be of short answer type covering entire course with no choice. The candidates will be required to attempt all the five questions.

UNIT - I

Constrains, Holonomic and non-holonomic constraints, Generalized Coordinates: D'Alembert's Principle, Lgrangian, Lagrange's Equation and its applications, velocity dependent potentials in lagrangian formulation, generalized momentum, Legendre transformation, Hamiltonian, Hamilton's Canonical Equations of Motion, Hamiltonian Formulation of Relativistic Mechanics

UNIT - II

Calculus of Variations, Derivation of Lagrange's Equation from Hamilton's principle: Derivation of Hamilton's canonical Equation from Hamilton's variational principle. Principle of least action, Extension of Hamilton's Principle for non-conservative and non-holonomic systems, Method of Lagrange's multipliers, Conservation theorems and Symmetry Properties, Noether's theorem. Conservation of energy, linear momentum and angular momentum as a consequence of homogeneity of time and space and isotropy of space.

UNIT – III

Canonical transformation, integral invariant of Poincare: Lagrange's and Poisson brackets as canonical invariants, equation of motion in Poisson bracket formulation. Infinitesimal contact transformation and generators of symmetry, Liouvilee's theorem, Hamilton-Jacobi equation and its application.

UNIT – IV

Action angle variable adiabatic invariance of action variable: The Kepler problem in action angle variables, theory of small oscillation in Lagrangian formulation, normal coordinates and its applications. Orthogonal transformation, Euler's theorem, Eigenvalues of the inertia tensor, Euler equations, force free motion of a rigid body.

Reference Books:

(1) Goldstein - Classical Mechanics

(2) Landau and Lifshitz - Classical Mechanics

(3) A. Raychoudhary – Classical Mechanics

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M. Sc (Phy) SEMESTER I

PAPER-II: CLASSICAL ELECTRODYNAMICS - I PC 22-1072

Note: 100 marks assigned to theory papers are distributed in following manner

Continuous Evaluation	*30 Marks*
Term End Main Examination	*70 Marks*

Max. Marks: 70 *Duration: 3 Hrs.*

Note: In all five questions are to be set. Four questions will be out of the four units taking one question from every unit with 100% internal choice. Fifth question will be of short answer type covering entire course with no choice. The candidates will be required to attempt all the five questions.

UNIT - I

Electrostatics: Electric field, Gauss Law, Differential form of Gaussian law. Another equation of electrostatics and the scalar potential, surface distribution of charges and dipoles and discontinuities in the electric field and potential, Poisson and Laplace equations, Green's Theorem, Uniqueness of the solution with the Dirichlet or Neumann boundary Conditions, Formal Solutions of electrostatic Boundary value problem with Green's function, Electrostatic potential energy and energy density, capacitance. Boundary Value Problems in Electrostatics: Methods of Images, Point charge in the presence of a grounded conducting sphere, point charge in the presence of a charged insulated conducting sphere, point charge near a conducting sphere at a fixed potential, conducting sphere in a uniform electric field by method of images, Green function for the sphere, General solution for the potential, conducting sphere wit hemispheres at a different potentials, orthogonal functions and expansion.

UNIT - II

Multipoles, electrostatics of Macroscopic Media Dielectric: Multipole expansion, multipole expansion of the energy of a charge distribution in an external field, Elementary treatment of electrostatics with permeable media. Boundary value problems with dielectrics. Molar polarizability and electric susceptibility. Models for molecular polarizability, electrostatic energy in dielectric media.

UNIT - III

Magnetostatics: Introduction and definition, Biot and Savart Law, the differential equations of magnetostatics and Ampere's law, Vector potential and magnetic induction for a current loop, Magnetic fields of a localized current distribution, Magnetic moment, Force and torque on and energy of a localized current distribution in an external induction, Macroscopic equations, Boundary conditions on B and H Methods of solving Boundary value Problems in magnetostatics, Uniformly magnetized sphere, magnetized sphere in an external fields, permanent magnets, magnetic shielding, spherical shell of permeable material in an uniform field.

UNIT - IV

Time varying fields, Maxwell's equations conservation laws: Energy in a magnetic field, vector and scalar potentials, Gauge transformations, Lorentz gauge, coloumb gauge, Green function for the wave equation, Derivation of the equations of Macroscopic Electromagnetism, Poynting's Theorem and conservation of energy and momentum for a system of charged particles and EM fields. Conservation laws for macroscopic media.

Electromagnetic field tensor, transformation of four potentials and four currents, tensor dissipation of Maxwell's equations.

Reference Books:

1. J.D. Jackson: Classical Electrodynamics
2. Panofsky & Phillip: Classical electrodynamics and magnetism
3. Griffith: Introduction to Electrodynamics
4. Landau & Lifshitz: Classical Theory of Electrodynamics
5. Landau & Lifshitz: Electrodynamics of continuous media

M.Sc. (Physics) Semester - I

Paper-III: QUANTUM MECHANICS **PC 22-1073**

Note:- 100 marks assigned to theory papers are distributed in following manner

Continuous Evaluation	30 Marks
Term End Main Examination	70 Marks

Max. Marks: 70 **Duration 3 Hrs.**

Note: *In all five questions are to be set. Four questions will be out of the four units taking one question from every unit with 100% internal choice. Fifth question will be of short answer type covering entire course with no choice. The candidates will be required to attempt all the five questions.*

UNIT – 1

(a) States, Amplitude and Operators: states of a quantum mechanical system, representation of quantum-mechanical states, properties of quantum mechanical amplitude, operators and change of a state, a complete set of basis states, products of linear operators, language of quantum mechanics, postulates, essential definitions and commutation relations.

(b) Observables and Description of Quantum system: Process of measurement, expectation values, time dependence of quantum mechanical amplitude, observable with no classical analogue, spin dependence of quantum mechanical amplitude on position, the wave function, superposition of amplitudes, identical particles.

UNIT – 2

Hamiltonian matrix and the time evolution of Quantum mechanical States: Hermiticity of the Hamiltonian matrix, time independent perturbation of an arbitrary system, simple matrix examples of time independent perturbation, energy eigen states of a two state system, diagonalizing of energy matrix, time independent perturbation of two state system the perturbative solution: Weak field and Strong field cases, general description of two state system, Pauli matrices, Ammonia molecule as an example of two state system.

UNIT – 3

Transition between stationary States: Transitions in a two state system, time dependent perturbations – The Golden Rule, Phase space, emission and absorption of radiation, induced dipole transition and spontaneous emission of radiation energy width of a quasi stationary state.

The co- ordinate Representation: Compatible observables, quantum conditions and uncertainty relation, Coordinate representation of operators, position, momentum and angular momentum, time dependence of expectation values, The Ehernfest Theorem, the time evolution of wave function, the Schroodinger equation, energy quantization, periodic potential as an example.

UNIT – 4

Symmetries and Angular Momentum:

a. Compatible observables and constants of motion, symmetry transformation and conservation laws, invariance under space and time translations and space rotation and conservation of momentum, energy and angular momentum.

b. Angular momentum operators and their Eigen values, matrix representations of the angular momentum operators and their eigen states, coordinate representations of the orbital angular momentum operators and their eigen state (Spherical Harmonics), composition of angular momenta, Clebsch-Gordon Coefficients, tensor operators and Wigner Eckart theorem, commutation relations of J_x, J_y, J_z with reduced tensor operator, matrix elements of vector operators, time reversal invariance and vanishing of static electric dipole moment of stationary state.

Reference Books:

1. Ashok Das and A.C.Milissiones: Quantum mechanics - A Modern Approach (Garden and Breach
Science Publishers).
2. Eugen Merzbacher: Quantum Mechanics, Second Edition (John Wiley and Sons).
3. Bjorken and Drell: Relativistic Quantum Mechanics (McGraw Hill).
4. J.J. Sakurai: Advanced Quantum Mechanics (John Wiley)

M. Sc (Phy) SEMESTER I
PAPER -IV : ELECTRONICS PC 22-1074

Note :- 100 marks assigned to theory papers are distributed in following manner.

Continuous evaluation	30 Marks
Term End Main Examination	70 Marks

Max Marks : 70
Duration 3 Hrs.

Note : *In all five questions are to be set. Four questions will be out of the four units taking one question from every unit with 100 % internal choice. Fifth question will be of short answer type covering entire course with no choice. The candidates will be required to attempt all the five questions.*

Unit-I

Operational Amplifiers:

Differential Amplifier – circuit configurations, dual input balanced output differential amplifier, DC Analysis, AC Analysis, Inverting and non inverting inputs, CMRR, constant current bias, level translator.

Block diagram of typical OP-AMP analysis, Open loop configuration, inverting and non inverting amplifiers, OP-AMP with negative feedback, voltage series feedback, effect of feedback on closed loop gain, input resistance, output resistance, bandwidth and output offset voltage, voltage follower.

Practical OP-AMP, input offset voltage, input bias current, input offset current, total output offset voltage, CMRR, frequency response, DC and AC amplifier, Integrator and Differentiator.

Unit-II

Oscillators and wave shaping circuits:

Oscillator Principle – Oscillator types, Frequency stability response, phase shift oscillator, Wein bridge oscillator, LC tunable oscillators, Multivibrators- Monostable and Astable, Comparators, Square wave and triangle wave generation, clamping and clipping.

Voltage regulators – Fixed regulators, adjustable voltage regulators, switching regulators.

Unit-III

Digital Electronics: Combinational Logic: Boolan Algebra, De-Morgan Theorem, Adder, Subtractor, Comparator, Multiplexer/Data selector, Demultiplexer/data distributor, Decoders, encoders.

Sequential Logic: Flip-flops: one-bit memory, RS flip-flop, JK and JK master slave flip flops, T and D type flip flops, shift registers, synchronous and asynchronous counters, Binary counter, Decade counter.

Basic concepts about fabrication and characteristics of integrated circuits.

Unit-IV

Microprocessors: Introduction to microcomputers, Memory, input/output, interfacing device 8085, CPU Architecture, Bus timings, Demultiplexing the address bus generating control signals, Instruction set, addressing modes, Illustrative programmes, writing assembly language programmes, looping, counting and indexing, counter and timing delays, stack and subroutine.

Text and Reference Books:-

1. “Electronic Devices and Circuit Theory” by Robert Boylested and Louis Nashdsky. PHI, New Delhi
2. “OP-AMP and Linear Intergrated Circuits” by Ramakanth, A. Gayakwad, PHI New Delhi.
3. “ Digital Principles and Applications” by A.P. Malvino and Donald P. Leach Goutam Saha, Tata McGraw education Pvt. Ltd., New Delhi.
4. “Modern Digital Electronics” by R.P. Jain, Tata McGraw Education, New Delhi.
5. “Digital Circuits and Design" by S. Salivahanan and S. Arivazhagan, Vikas Publishing house, New Delhi.
6. "Handbook of electronics" by S.L. Gupta and V. Kumar, Pragati Prakashan Meerut.
7. “Microprocessors Architecture, Programming and Applications with 8085” by Ramesh Gaonkar, Penram International Publishing (India) Pvt. Ltd., Mumbai.
8. “Modern Digital Electronics” by R.P. Jain, McGraw Hill Education.
9. “Digital Principles and Design” by Arivazagan, and salivahanan, vikash Publishing house, New Delhi.

M. Sc (Phy) SEMESTER II

PAPER -I: MATHEMATICAL METHOD IN PHYSICS PC 22-2071

Note: 100 marks assigned to theory papers are distributed in following manner

Continuous Evaluation	*30 Marks*
Term End Main Examination	*70 Marks*

Max. Marks: 70 *Duration: 3 Hrs.*

Note: In all five questions are to be set. Four questions will be out of the four units taking one question from every unit with 100% internal choice. Fifth question will be of short answer type covering entire course with no choice. The candidates will be required to attempt all the five questions.

UNIT – I

Coordinates Transformation in N - dimensional space: Contravariant and covarianttensor, Jacobian. Relative tensor, pseudo tensors (Example: charge density, angular momentum) Algebra of tensors, Metric tensor, Associated tensors, Riemann space (Example: Euclidean space and 4D Minkowski space), Christoffel symbols, transformation of Christoffel symbols, covariant differentiation,Ricci's theorem, divergence, Curl and Laplacian tensor form, Stress and strain tensors, Hook's law in tensor form. Lorentz covariance of Maxwell equation, Klein Gordon and Dirac Equation, Test of covariance of Schrödinger equation.

UNIT – II

Group of Transformation: (Example: Symmetry transformation of square) Generators of a finite group, Normal subgroup, Direct product of groups, Isomorphism and Homomorphism. Representation theorem of finite groups, Invariants subspace and reducible representations, irreducible representation, crystallographic point groups, Irreducible representation of C4V. Translation group and the reciprocal lattice.

UNIT – III

Fourier Transforms: Development of the Fourier integral from the Fourier series, Fourier and inverse Fourier transform: Simple Applications: Finite wave train, Wave train with Gaussian amplitude, Fourier transform of derivatives, solution of wave equation as an application. Convolution theorem. Intensity in terms of spectral density for quasi monochromic EM Waves, Momentum representation, Application of Fourier transform to diffraction theory: diffraction pattern of one and two slits.

UNIT – IV

Laplace transforms and their properties: Laplace transform of derivatives and integrals, Derivatives and integral of Laplace transform. Convolution theorem. Impulsive function, Application of Laplace transform in solving linear, differential equations with constant coefficient with variable coefficient and linear partial differential equation.

Reference books:

1. Mathematical Methods for Physicists: George Arfken (Academic Press)
2. Applied Mathematics for Engineers and Physicists: L. A. Pipe (McGraw Hill)
3. Mathematical Methods - Potter and Goldberg (Prentice Hall of India)
4. Elements of Group Theory for Physicists: A.W. Joshi (Wiley Eastern Ltd.)
5. Vector Analysis (Schaum Series) (McGraw Hill)

M. Sc (Phy) SEMESTER II

PAPER-II: CLASSICAL ELECTRODYNAMICS –II PC 22-2072

Note: 100 marks assigned to theory papers are distributed in following manner

Continuous Evaluation	*30 Marks*
Term End Main Examination	*70 Marks*

Max. Marks: 70 *Duration: 3 Hrs.*

Note: In all five questions are to be set. Four questions will be out of the four units taking one question from every unit with 100% internal choice. Fifth question will be of short answer type covering entire course with no choice. The candidates will be required to attempt all the five questions.

UNIT – I

Plane Electromagnetic Waves and Wave Equation: Plane wave in a nonconducting medium. Frequency dispersion characteristics of dielectrics, conductors and plasma, waves in a conducting dissipative medium, superposition of waves in one dimension, group velocity, casualty connection between D and E. Kramers-Kroning relation.

UNIT – III

Magnetohydrodynamics and Plasma Physics: Introduction and definitions, MHD equations, Magnetic diffusion, viscosity and pressure, Pinch effect, instabilities in pinched plasma column, Magneto hydrodynamics waves, Plasma oscillations, short wave length limit of plasma oscillations and Debye shielding distance.

UNIT – III

Covariant Form of Electrodynamic Equations: Mathematical properties of the space- time special relativity, Invariance of electric charge covariance of electrodynamics. Transformation of electromagnetic field. Radiation by moving charges: Lienard-Wiechert Potential for a point charge, Total power radiated by an accelerated charge: Larmour's formula and its relativistic generalization, Angular distribution of radiation emitted by an accelerated charge, Radiation emitted by a charge in arbitrary extremely relativistic motion. Distribution in frequency and angle of energy radiated by accelerated charges, Thomson scattering and radiation, Scattering by quasifree charges, coherent and incoherent scattering, Cherenkov radiation.

UNIT - IV

Radiation damping, self-fields of a particle, scattering and absorption of radiation by a bound system: Introductory considerations, Radiative reaction force from conservation of energy, Abraham Lorentz evaluation of the self-force, difficulties with Abraham Lorentz model, Integro-differential equation of motion including radiation damping, Line Breadth and level shift of an oscillator, Scattering and absorption of radiation by an oscillator, Energy transfer to a harmonically bound charge.

Reference Books:

1. Classical Electrodynamics: Jackson
2. Classical Electricity and Magnetism: Panofsky and Philips.
3. Introduction to Electrodynamics: Griffiths.
4. Classical Theory of Field: Landan and Lifshitz.
5. Electrodynamics of Continuous Media: Landau and Lifshitz.

M.Sc. (Physics) Semester - II

Paper-III: ATOMIC AND MOLECULAR PHYSICS PC 22-2073

Note:- 100 marks assigned to theory papers are distributed in following manner

Continuous Evaluation	30 Marks
Term End Main Examination	70 Marks

Max. Marks: 70 **Duration 3 Hrs.**

Note: *In all five questions are to be set. Four questions will be out of the four units taking one question from every unit with 100% internal choice. Fifth question will be of short answer type covering entire course with no choice. The candidates will be required to attempt all the five questions.*

UNIT - 1

Hydrogen Atom: Gross structure energy spectrum, probability distribution of radial and angular (I=1,2) wave functions (no derivation), effect of spin, relativistic correction to energy levels and fine structure, magnetic dipole interaction and hyperfine structure, the Lamb shift (only a qualitative description).

UNIT - 2

Interaction with External Fields: Non degenerate first order stationary perturbation method, atom in a weak uniform external electric field and first and second order Stark effect, calculation of the polarizability of the ground state of H-atom and of an isotropic harmonic oscillator, Degenerate stationary perturbation theory. Atom in a uniform external strong and weak magnetic field-Zeeman effect (Normal & Anomalous), calculation of interaction energy.

UNIT - 3

Systems with Identical Particles: Indistinguishability and exchange symmetry, many particle wave functions and Pauli's exclusion principle, spectroscopic terms for atoms. The Helium atom, Variation method and its use in the calculation of ground state and excited state energy of Helium atom. The Hydrogen molecule, Heitler-London theory of H_2 molecule, WKB method for on dimensional problem, application to bound states (Bohr Sommerfield quantization) and the barrier penetration (alpha decay)problems.

UNIT - 4

Spectroscopy (Qualitative): General features of the spectra of one and two electron system-singlet, doublet and triplet characters of emission spectra, general features of alkali spectra, rotation and vibration band spectrum of molecule, P,Q and R branches, Raman spectra for rotational and vibrational transitions, comparison with infra red spectra, general features of electronic spectra, Frank and Condon's principle.

Reference Books:

1. Ashok Das and A.C.Milissiones: Quantum mechanics - A Modern Approach (Garden and Breach
Science Publishers).
2. Eugen Merzbacher: Quantum Mechanics, Second Edition (John Wiley and Sons).
3. Bjorken and Drell: Relativistic Quantum Mechanics (McGraw Hill).
4. J.J. Sakurai: Advanced Quantum Mechanics (John Wiley)

M. Sc (Phy) SEMESTER II
PAPER-IV : NUMERICAL METHODS AND COMPUTER PROGRAMMING

PC 22-2074

Note :- 100 marks assigned to theory papers are distributed in following manner.

Continuous evaluation	30 Marks
Term End Main Examination	70 Marks

Max Marks : 70
Duration 3 Hrs.

Note : *In all five questions are to be set. Four questions will be out of the four units taking one question from every unit with 100 % internal choice. Fifth question will be of short answer type covering entire course with no choice. The candidates will be required to attempt all the five questions.*

Unit-I

Errors in Numerical Analysis: Sources of errors, Errors and their Computation, General error formula, Error in a series approximation, the method of undetermined coefficients, Use of interpolation formula, Newton's interpolation formula, Iterated interpolation, inverse interpolation, lagrange's interpolation, Hermite interpolation and spline interpolation.
Solution of linear equations: Direct and iterative methods, calculation of eigenvalues and eigenvectors for symmetric matrices.

Unit-II

Solution of nonlinear equations: Bisection method, Newton's method, modified Newton's method, method of iteration, Newton's method and method of iteration for a system of causation, Newton's method for the case of complex roots.

Unit-III

Integration of a function : Trapezoidal and Simpson's rules, Gaussian quadrature formula, Singular integrals, double integration
Integration of Ordinary differential equations: Predictor-corrector methods, Runga-Kutta method, Simultaneous and higher order equations.
Numerical Integration and Differentiation of Data, Least Squares Approximations, Fast Fourier Transform.

Unit-IV

Some elementary information about Computer: CPU, memory, Input/output devices, Super, mini and micro systems, MS-DOS operating system, High level Languages, Interpreter and Compiler.
FORTRAN 77: Variables, Expressions, Jumping, Branching and Looping statements, Input/Output statement, Statement for handling input/output files, Subroutine, external function, Special statements: COMMON, ENTRY, FORMAT, PAUSE, EQUIVALENCE, Programming of simple problems involving use of interpolation, differentiation, integration matrix inversion and least square analysis.

References Books :-

1. "A First Course in Nemerical Analysis" by A Ralston and P. Rabinowitz, McGraw Hill
2. "Introductory Methods of Nemerical Analysis" by S.S. Sastry, prentice- Hall of India, New Delhi.
3. "Programming with FORTRAN 77" by Ram Kumar, Tata McGraw Edu. Pub. company, New Delhi.
4. "Computer Fundamentals Concepts, Systems and applications" by P.K. Sinha and Priti Sinha, BPB Publications, New Delhi.
5. "Numerical methods for scientific and engineering computation" by M.K. Jain, S.R.K. Iyengar, R.K. Jain, New Age International Pvt. Ltd. Publishers, New Delhi.

LABORATORY (PRACTICAL) WORK

Scheme: The laboratory work will involve performance of experiments by the students. Each student will be required to perform atleast 8 experiments per semester. The examination will be conducted for two days, 6 hrs. each day. The distribution of the marks will be as follows :

Marks	Two experiments	120
	Viva	40
	Record	40
	Total	200
	Minimum Pass Marks	72

LIST OF EXPERIMENTS FOR M.Sc. PREVIOUS SEMESTER I & II

1. To study Zener regulated power supply with different loads.
2. To plot V-I characteristics of a given Uni-Junction Transistor.
3. To determine ripple factor of a power supply using L and π- section filters for different loads.
4. To study the frequency response of R-C coupled transistor amplifier.
5. To study active-filters (low-pass, high-pass, band-pass and notch filter).
6. To study low-pass filter using passive elements.
7. To study high-pass filter using passive elements.
8. To study the V-I characteristics of given MOS-FET.
9. To study Encoder and Decoder.
10. To study the V-I characteristic of S.C.R.(Silicon Controlled Rectifier).
11. To study the different types of Multiplexer and De-multiplexer.
12. To study different configurations of operational amplifier.
13. To study Analog to Digital converter.
14. To study Digital to Analog converter.
15. To determine the hybrid parameter of transistor.
16. To study Clipping circuits using diodes.
17. To determine the leakage current of a given transistor.
18. To determine Brewster's angle for a glass surface and hence to determine refractive index of glass.
19. To draw normal dispersion curve by using a spectrometer and determine the Cauchy's constants.
20. To study prismatic spectrum using Hartmann's relation and to determine the wavelength of mercury light.

30/3/22

21. To determine the wavelength of light using Bi-prism and to determine the thickness of mica-sheet.
22. To determine Planck's constant using filter.
23. To study the characteristics of different Opto-electronic devices.
24. To determine the wavelength of light using Michelson's Interferometer.
25. To study Fresnel's laws of polarization.
26. To find the spacing of the etalon.
27. To study diffraction pattern of slit using laser beam.
28. To study 4 bit shift register
29. To study various flip flops

30/3/22