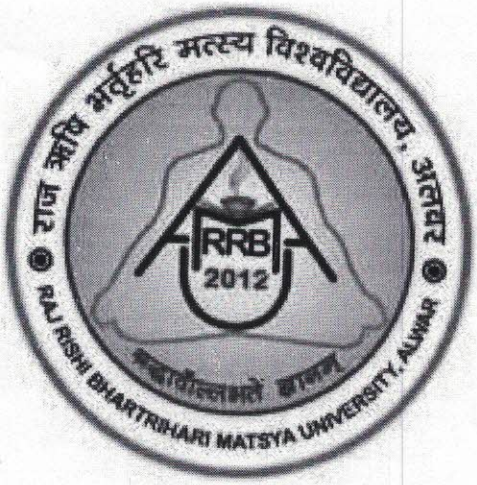

RAJ RISHI BHARATRIHARI UNIVERSITY

ALWAR

SYLLABUS

ANNUAL SCHEME

M.Sc. (Previous) PHYSICS

2017-18

M.Sc. (Previous) Physics

PAPER - I: CLASSICAL MECHANICS AND MATHEMATICAL METHODS IN PHYSICS

Max.Marks :100 Duration : 3hrs.

Note: Five question are to be set. Question first will consist of ten short answer type questions and is compulsory. Remaining four questions will be from four units one from each unit (each question will have an internal choice). Student will attempt all the five question 40% weightage will be given to problems and numericals.

Unit - I

Constraints, holonomic and non -holonomic constraints: D-Alembert's Principle and Lagrange 's equation, Velocity dependant: potentials, simple applications of Lagrange formulation. Hamilton Principle, . Calculus of variations, Derivation of Lagrange Equation from Hamilton's principle. 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

Generalized momentum , Legendre transformation and the Hamilton's equation of motion, simple applications of Hamiltonian formulation, cyclic coordinates, Routh procedure, Hamiltonian formulation of relativistic mechanics, derivation of Hamilton's canonical equation from Hamilton's variational principle. The principle of least action.

Unit - II

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

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, Eulerian angles, Euler theorem, Eigen values of the inertia tensor, Euler equations. Force free moti on of a rigid body.

UNIT-III

Coordinate transformation in N-dimensional space: Contravariant and covariant tensor, Jacobian. Relative tensor, pseudo tensors (Example: change density, angu1ar momentum) Algebra of tensors, Metric theorem, Associated tensors, Reimannian space (Example: Euclidian space and 4-D Minkowski space), Christoffelas symbols, transformation of Christoffelas symbols, Covariant differentiation. Ricci's theorem, Divergence, Curl and Laplacian in 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 Schrodinger equation.

प्रभारी अधिकारी
अकादमिक--प्रथम

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 C_{4V}. Translation group and the reciprocal lattice.

UNIT-IV

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, Convoluation theorem, intensity in term of spectral density for quasi-monochromatic EM waves, momentum representation. Application of Hydrogen Atom and Harmonic Oscillator problems. Application of Fourier Transform to Diffraction Theory; Diffraction pattern of one two slits.

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

Reference Books:

1. Goldstein - Classical Mechanics.
2. Landau.and Lifshitz - Classical Mechanics.
3. A. Raychoudhary - Classical Mechanics.
4. Mathematical Methods for Physicists: George Arkfen (AcademicPress). .
5. Applied Mathematics for Engineers and Physicists: L. A. Pipe (McGraw Hill)
6. MathematicalMethods-Potter and Goldberg (Prentice Hall of fudia).
7. Elements of Group Theory for Physicists: A. W. Joshi (Wiley Eastern Ltd.)
8. VectorAnalysis (Schaum Series) (Mc Graw Hill).

PAPER -II CLASSICAL ELECTRODYNAMICS AND ELECTROMAGNETIC THEORY

Max.Marks :100 Duration : 3hrs.

Note: Five questions are to be set. Question first will consist of ten short answer type questions and is compulsory. Remaining four questions will be from four units one from each unit (each question will have an internal choice). Student will attempt all the five question 40% weightage will be given to problems and numericals.

प्रभारी अधिकारी
अकादमिक प्रथम

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.

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 - II

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.

प्रभारी अधिकारी
अकादमिक–प्रथम

Time varying fields, Maxwell's equations conservation laws: Energy in a magnetic field, vector and scalar potentials, Gauge transformations, Lorentz gauge, coulomb 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.

Unit – III

Plane Electromagnetic Waves and Wave Equation : Plane wave in a nonconducting medium. Frequency dispersion characteristics of dielectrics, conductors and plasmas, waves in a conducting or dissipative medium, superposition of waves in one dimension, group velocity, casualty connection
between D and E. Kramers-Kroning relation.
Covariant Form of Electrodynamics Equations : Mathematical properties of the space-time special relativity, Invariance of electric charge covariance of electrodynamics, Transformation of electromagnetic fields.
Radiation by moving. charges : Lienard-wiechert Potentials 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 quasi free charges, coherent and incoherent scattering, Cherenkov radiation.

Unit - IV

Magneto-hydrodynamics and Plasma Physics : Introduction and definitions, MHD equations Magnetic diffusion viscosity and pressure; Pinch effect. instabilities in a pinched plasma column. Magneto-hydrodynamic waves; Plasma oscillations, short wave length limit of plasma oscillations and Debye shielding distance.
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, Abtaham 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. J.D. Jackson-.-Classical Electrodynamics
2. Panofsky and Philips Classical Electricity and Magnetism'

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RAJ RISHI BHARITRIHARI MATSYA UNIVERSITY ALWAR
PROPOSED SYLLABUS FOR M. Sc (Physics) (2021 and onwards)

M.Sc. (Physics)-III: QUANTUM MECHANICS, ATOMIC AND MOLECULAR PHYSICS

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

Max. Marks: 100 **Duration 3 Hrs.**

Note: *In all five questions are to be set. First question will be of short answer type covering entire course with no choice. Remaining four questions will be out of the four units taking one question from every unit with 100% internal choice. The candidates will be required to attempt all the five questions. 40% weightage will be given to problems and numerical.*

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.

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 – 2

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 Schrodinger equation, energy quantization, periodic potential as an example.

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.

UNIT - 3

Hydrogen Atom: Gross structure energy spectrum, probability distribution of radial and angular (l=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).

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. Linear Stark effect for H-atom levels, inclusion of spin orbit and week magnetic field. Zeeman effect, strong magnetic field and calculation of interaction energy.

UNIT - 4

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 one dimensional problem, application to bound states (Bohr Sommerfield quantization) and the barrier penetration (alpha decay) problems.

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.

Pauli's exclusion principle, spectroscopic terms for atoms. The Helium atom, Variational method and its use in the calculation of ground state and excited state energy, Helium atom. The Hydrogen molecule, Heitler-London method for molecule, WKB method for one dimensional problem, application to bound states (Bohr-Sommerfield quantization) and the barrier penetration (alpha decay, problems).
Hydrogen Atom : Gross structure energy spectrum, probability distribution of radial and angular (l=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 an qualitative description)
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 a molecule, PQ and R branches, Raman spectra for rotational and vibrational transitions, comparison with infra red spectra. General features of electronic spectra. Frankand Condon's principle.

ReferenceBooks:

1. Ashok Das and A.C. Melissionos. Quantum Mechanics-A modern Approach (Gordon and Breach
Science Publishers).
2. P.A.M.Dirac, Quantum Mechanics.
3. E. Merzbaker, Quantum Mechanics, Second Edition (John Willey and Sons).
4. L.P.Landau aridH.M. Lifshitz, Quantum Mechanics-Non relativistic theory (pergamon Press)
5. A..Ghatak and S. Lobnathan.- Quantum Mechanics: Theory and , Applications,Third Edition(Mac
Millan India Ltd.) ,
6. G. K. Woodgate,ElementaryAtomic Structure, Second Edition Clarendon Press, Oxford.
7. T.A. Littlefield- Atomic and Molecular Physics.
8. Eistanberg and Rasmik-QuantumPhysicsof Atoms. Molecules, Solids and Nuclear Particles.
9. White - Atomic Spectra.
10. Herzberg- Molecular Spectra.

PAPER. IV: ELECTRONICS, NUMERICAL METHOD AND COMPUTER PROGRAMMING

Max.Marks :100 Duration : 3hrs.

Note: Five questions are to be set. Question first will consist of ten short answer type questions and is compulsory. Remaining four questions will be from four units one from each unit (each question will have an internal choice). Student will attempt all the five question 40% weightage will be given to problems and numericals.

प्रभारी अधिकारी
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UNIT- I

1. 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 a 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, summing, scaling and averaging amplifiers, instrumentation amplifier, integrator and differentiator.

Oscillators and Wave Shaping Circuits: Oscillator Principle- Oscillator types, Frequency stability, response, The Phase shift oscillator, Wein bridge Oscillator, LC tunable oscillators,

UNIT – II

Multivibrators - Monostable and Astable, Comparators, Square wave and Triangle wave generation, Clamping and Clipping. Voltage regulators- fixed regulators, Adjustable voltage regulators, Switching regulators.

Digital Electronics: Combinational Logic :The transistor as a switch; circuit Realisation of OR,AND,NOT, NOR and NAND gates, Exclusive OR gate, Boolean algebra - De Morgan's theorems Adder, Subtractor, Comperator, Decoder / Demultiplexer ,Data selector/ multiplexer -Encoder. Sequential Logic: Flip -Flops: one-bit memory; The RS Flip-flop, JK Flip- Flop, JK master slave Flip -Flops, T Flip - Flop, D Flip- Flop, Shift resisters - synchronous and asynchronous counters-cascade counters, Binary counter, Decade counter. Basic concepts about fabrication and characteristics of integrated circuits.

UNIT - III

Errors in numerical analysis: Source of error, Round off error, Computer Arithmetic, Error Analysis, Condition and stability, Approximation, Functional and Error analysis, the method of, Undetermined Coefficients. Use of interpolation formula, Iterated interpolation. Inverse interpolation, Hermite interpolation and Spline interpolation, Solution of Linear equations , Direct and Iterative methods, Calculation of eigen value and eigen vectors for symmetric matrices. Solution of Nonliner equation: 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.

Integration of a function: Trapezoidal and Simpson's rules. Gaussian quadrature formula, Singular integrals, Double integration.

UNIT-IV

Integration of Ordinary differential equation: Predictor - corrector methods, Runga-Kutta method, Simultaneous and Higher order equations Numerical Integration and Differentiation of Data, Least-Squares Approximations, Fast Fourier Transform.

Elementary probability theory, random variable, binomial, Poisson and normal distributions.

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Some elementary information about Computer: CPU, Memory, Input/ Output devices, Super, Miniand Micro systems, MS-DOS operating system, High Level Languages, Interpreter and Compiler. Programming: Algorithm and Flowchart.

Fortran 77: Variable, Expression, jumping. Bracching an looping statement ,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.

Reference Book

1. Ryder-Electronic Fundamentals and applications.
2. Millman and Thub-Pulse, Digital and Switching waveforms.
3. Millman and Helkias-Integrated Electronics.
4. Ryder-network Lines and Fields.
5 Bapat-Electronics Devices and Circuitrs.
6. A Ralston and P. Rabinowitz, A First Course in Numberical analysis Mc Graw Hill (1985)
7. S.S. Sastry, Introductory Methods of Numerical Analysis. Prentice hall of India (1979).
8. Ram Kumar, Programming with Fortran 77, McGraw-Hill (1986).
9. "Electronic 'Devices and circuit theory by Robert Boylested and Louis Nashdsky PHI, New Delhi.
1100001, 1991 .
10."OPAmps& Linear integratedcircuits, by Ramakanth A. Gayakwad PHI, Second Edition, 1991.
11. Digital principles and Applications by A.P. Malvino and Donald P.Leach, Tata Megraw - Hill
company, New Delhi, 1993.
12. Microprocessor Architecture, Programming and applications with 8085/8086 by Ramesh S.
Gaonkar,Wiley - Eastern Ltd., 1987.

LIST OF EXPERIMENTS FOR M.Sc. PREVIOUS

Scheme:

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 (any eighteen) :

1. To design a single stage amplifier of a given voltage gain and lower cut of frequencies.

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2. To determine Lo. Co. and Rf of a given coil and to study the variations of RF with frequency.
3. To design a RC coupled two stage amplifier of a given gain and the cut off frequencies.
4. To study Hartley oscillator.
5. To Study Transistor bias Stability.
6. To design a Multivibrator of given frequency and study its wave shape.
7. To study the characteristics of FET and use it 0 design an relaxation oscillator and measure its frequency.
8. To study the characteristics of an operational amplifier.
9. To study the characteristics of a UJT and use it to design a relaxation oscillator and measure its frequency.
10. To study the addition, integration and differentiation properties of an operational amplifier.
11. Determine Planck constant using solar Cell.
12. To determine Planck constant and work function by a photo-cell.
13. To study regulated power supply using (A) Zener diode only (b) Zener diode with a series transistor (c) Zener diode with a shunt transistor.
14. To verify Fresnel's formula;
15. To study the percentage regulation and variation of Ripple factor, with load for a full wave rectifier.
16. To study analog to digital and digital to analog conversion.
17. To study a driven mechanical oscillator.
18.To verify Hartmann's formula using constant deviation spectrograph.
19. To find e/m of electron using Zeeman effect.
20. To find Dissociation energy to I.
21. Study of CH Bands.
22. Salt Analysis / Raman effect (Atomic).
23. Design and study of pass filters.
24. Michelson Interferometer.
25. Fabry-parot Interferometer.
26. Determination of velocity of Ultrasonic waves.
27. Study of Elliptically polarized light by Babinet Compensator.
28. Verification of Cauchy's Dispersion relation.
29. Study of DC gate control characteristics and Anode current characteristics of SCR.

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