Syllabus
University of Rajasthan, Jaipur
B.Sc. Part II
Physics

Session: 2024-25

Work Load: 2 hrs. Lecture/week **Examination Duration: 3 Hrs.**

Scheme of Examination: First question will be of nine marks comprising six parts of short answer type with answer not exceeding half a page. Remaining four questions will be set with one from each of the units and will be of six marks each. Second to fifth questions will have two parts namely (A) and (B) of second to fifth questions shall be compulsory and part (B) of these questions will have internal choice.

Paper-1: Thermodynamics and Statistical Physics

Unit-I

Thermal and adiabatic interactions: Thermal interaction, Zeroth law of thermodynamics, System in thermal contact with a heat reservoir (canonical distribution), Energy fluctuations, Entropy of system in a heat bath, Helmholtz free energy, Adiabatic interaction and enthalpy, General interaction and first law of thermodynamics, Infinitesimal general instruction, Gibbs free energy, Phase transitions, Clausius Clapeyron equation, Vapour pressure curve, Heat engine and efficiency of engine, Carnot's cycle, Thermodynamic scale as an absolute scale, Maxwell relations and their applications.

Unit-II

Productions of low temperatures and applications: Joule Thomson expansion and JT coefficients for ideal as well as Vander's waal's gas, porous plug experiment, temperature inversion, Regenerative cooling by adiabatic expansion and demagnetization, Liquid Helium, He I and He II, superfluidity, Refrigeration through Helium dilution, Quest for absolute zero, Nernst heat theorem.

The distribution of molecular velocities: Distribution law of molecular velocities, most probable, average and r.m.s. Velocities, Energy distribution function, Effusion and molecular beam, Experimental verification of Maxwell's velocity distribution, The principle for equi-partition of energy.

Transport phenomena: Mean free path, Distribution of free paths, coefficients of viscosity, thermal conductivity, diffusion and their interaction.

Unit-III

Classical Statistics: Validity of Classical approximation, Phase space, micro and macro states, Thermodynamics probability, relation between entropy and thermodynamic probability, Monatomic ideal gas, Barometric equation, Specific heat capacity of diatomic gas, Heat capacity of solids.

Unit-IV

Quantum Statistics: Black body radiation and failure of classical statistics, Postulates of quantum statistics, Indistinguishability , wave function and exchange degeneracy, a priority provability, Bose-Einstein statistics and its distribution function, contact potential, Thermionic emission, Specific heat anomaly of metals, Nuclear spin statistics(para and ortho hydrogen)

Paper-II : Mathematical Physics and Special Theory of Relativity

Unit-I

Orthogonal and curvilinear coordinate system, scale factors, expression for gradient divergence, curl and their application to cartesian, circular cylindrical and spherical polar coordinates. Coordinate transformation and Jacobian, transformation of covariant, contra variant and mixed tensor, Addition, multiplication and contraction of tensors, Metric tensor and its use in transformation of tensors.

Unit-II

Lorentz transformation, length contraction, time dilation, mass variation, rotation in space time like and space like vector, macro-causality. Four vector formulation, energy momentum four vector, relativistic equation of motion, invariance of rest mass, orthogonality of four force and four velocity. Lorentz force as an example of four force, transformation of four frequency vectors, longitudinal and transverse Doppler's effect.

Transformation between laboratory and center of mass system, four momentum conservation, kinematics of decay products of unstable particles and reaction thresholds, Pair production, inelastic collision of two particles, Compton effect.

Unit-III

(a) Transformation of electric and magnetic fields between two inertial frames, Electric field measured in moving frames, Electric field of a point charge moving with constant velocity.

(b)The second order linear differential equation with variable coefficients and singular points, series solution method and its application to the Hermite's Legendra and Lauguerre's differential equation, Basic Property like orthogonality, recurrence relation, graphical representation and generating function of Hermite, Lagendre and Laguerre function (simple applications)

Unit-IV

Techniques of separation of variables and its applications to following boundary value problems : (i) Laplace equation in three dimensional Cartesian coordinate system-line charge between two earthed parallel plates (ii) Helmholtz equation in circular cylindrical coordinates, cylindrical resonant cavity, (iii) Wave equation in spherical polar coordinates the vibrations of a circular membrane, (iv) Diffusion equation in two dimensions Cartesian coordinate system heat conduction in a thin rectangular plate (v) Laplace equation in spherical coordinate system electric potential around a spherical surface.

Paper-III : Electronics and Solid State Devices

Unit-I

Circuit analysis: Networks- some important definitions, loop and nodal equation based on D.C. and A.C. circuits (Kirchhoff's Laws). Four terminal network : Ampere volt conventions, open, close and hybrid parameters of any four terminal network, Input, output and mutual impedance for an active four terminal network, Various circuits theorems : Superposition, Thevenin, Norton, reciprocity, compensation, maximum power transfer and Miler theorems.

PN junction: Charge densities in N and P materials, Conduction by drift and diffusion of charge carriers, PN diode equation, capacitance effects.

Unit-II

Rectifiers: Half wave, Full wave and bridge rectifier: calculation of ripple factor, efficiency and regulation, Filter : series inductor, shunt capacitor, L section and π section filters. Voltage regulation: Voltage regulation and voltage stabilization by zener diode, voltage multiplier.

Transistors: Notations and volt ampere characteristics for bipolar junction transistor, Concept of load line and operating point Hybrid parameters, CB,CE,CC configuration. Junction field effect transistor (JEFT) and metal oxide semiconductor field effect transistor (MOSFET). Circuit symbols, biasing and volt-ampere characteristics, source follower operation of FET as variable voltage resistor

.Unit-III

Transistor biasing: Need of bias and stability of Q-point, Stability factors and various types of bias circuits for thermal bias stability, fixed bias, collector to base feedback and bias and four resistor bias.

Amplifiers: Analysis of transistor amplifiers using hybrid parameters and its gain frequency response, Cascade amplifiers, Basis idea of direct coupled and RC coupled amplifiers, Differential amplifiers,

Amplifiers with feedback : concept of feedback, positive and negative feedback, voltage and current feedback circuits. Advantages of negative feedback: Stabilization of gain, effect of negative feedback on output and input resistance, reduction of nonlinear distortion, effect on gain - frequency response.

Unit-IV

Oscillators : Criteria for self-excited and self sustained oscillation, circuit requirement for build up of oscillation, Basic transistor oscillator circuits and its analysis, Colpitts and Hartley oscillators, crystals oscillators and its advantages.

Logic circuits: Logic fundamentals : AND, OR, NOT, NAND, XOR gates, Boolean algebra, De Morgan’s theorem, positive and negative logic, logic gates circuits realization using DTL and TTL logic, Simplification of Boolean expressions.

Practical

Teaching: 4Hrs./week
Practical One-Paper **Duration : 5Hrs.**
Min. Pass Marks : 18 **Max. Marks : 50**

Note : Total no. of experiments to be performed by the students during the session should be 16 selecting 8 from each section.

Section-A

1. Study of independence of velocity of wave propagation of line parameter using torsional wave apparatus.
2. Study of variation of reflection coefficients of nature of terminations using torsional wave apparatus.
3. Using a platinum resistance thermometer, find the melting point of a given substance.
4. Determine wavelength of sodium light by Newton's rings.
5. Using a michelson interferometer, find out the wavelength of a monochromatic source(Sodium light).
6. Determine dispersive power (ω) of a prism.
7. Determine the wavelength of sodium light with the help of plane diffraction grating.
8. Determine the wavelength of a monochromatic source of light with the help of Fresnel's biprism
9. Determine the thermodynamic constant $r = \frac{C_p}{C_v}$ using clement-desormes method.
10. To determine thermal conductivity of a bad conductor by Lee's Method.
11. Determine Ballistic constant of Ballistic Galvanometer.
12. Study the Variation of Total thermal radiation with temperature.

Section-B

1. Plot thermo emf versus temperature graph and find the neutral temperature (Sand Bath).
2. Study of power supply using two diodes/bridge rectifiers with various filter circuits.
3. Study of a Half wave Rectifier using a single diode without any filter and with L and π section filters.
4. Study of a Full wave Rectifier using Two diodes without any filter and with L and π section filters.
5. Study the Input and Output characteristics of a PNP and NPN Transistor (Common base , Common emitter & Common collector configurations).
6. Determine the band gap in a semiconductor using a P-N junction diode.
7. Determination of a power factor(cosθ) of a given coil using CRO.
8. Determine e/m ratio of cathode rays.
9. Compare the capacities of two capacitors by De Sauty's bridge, using a headphone and an audio frequency oscillator.
10. Determine the self inductance (L) of a given coil, by Anderson's bridge method using alternating current.