Assignments

Q 1: What are fundamental ideals of thermodynamics?

Q 2: Discuss continuum model of thermodynamics.

Q3: Define the following: (a) system (b) state (c) equilibrium (d) process

Q4: Why does the temperature of a gas drop when it is subjected to adiabatic expansion? Explain.

Q5. State the zeroth law of thermodynamics. How is mercury in thermometer able to find temperature of a body using the zeroth law of thermodynamics?

Q6. State the first law of thermodynamics. Show that for a cyclic process the heat supplied to a system equal to the workdone by the system.

Q7. State the first law of thermodynamics and use it to derive a relation between the volume and temperature of a perfect gas undergoing an adiabatic change.

Q8. Between two given temperatures no ordinary engine can be more efficient than the Carnot engine and all Carnot's engines are equally efficient. Prove the statement.

Q9. What is the absolute scale to temperature and how has it been derived? Explain clearly why the scale is called absolute and why the zero of this scale is considered to the lowest temperature possible?

Q10. Prove that the efficiency of a Carnot's engine depends only upon the two temperature between which it works.

Waves and Oscillations

Q1. What is meant by plane progressive wave? Distinguish between a traverse and longitudinal wave and obtain an expression for a plane progressive wave in general.

Q2. Write down the three dimensional wave equations and obtain its solution.

Q3. Describe complete theory of oscillations of LC circuit. Find out the expression for the time period and frequency for LC cicuit.

Q4. What is a harmonic oscillator? Show that for a harmonic oscillator the total mechanical energy is constant. Further show that the average potential energy is equal to the average kinetic energy.

Q5. Set up the equation of motion in differential form for a harmonic oscillator driven by a sinusoidal force.

Q6. Show that the particle velocity $\frac{dy}{dt}$ in the case of plane progressive wave is given by $\frac{dy}{dt} = -v\frac{dy}{dx}$. Hence, derive differential equation of a wave motion.

Q7. State the conditions that must be prevail for the formation of stationary waves.

Q8. What fraction of total energy is kinetic and what fraction is potential, when the displacement is one half of the amplitude?

Q9. How can you differentiate free and forced vibrations?

Q10. What are the three main effects of superposition of waves?

Q11. Sound can be heard over longer distance on a summer-rainy day. Why?

Introduction to Electromagnetic Theory

Q1. Illustrate mathematically how and under what conditions does Ampere's circuital law fail? How did Maxwell modify Ampere's law to make it consistent under all conditions? Give the mathematical justification to prove its consistency.

Q2. Give the equation of continuity of E.M. theory. Explain the inconsistency of Ampere's law for transient currents. How was the law modified in its generalized form to overcome the inconsistency?

Q3. Enumerate Maxwell's equations and show that they predict the existence of electromagnetic waves.

Q4. Write the physical significance of Maxwell's equations. Hence derive wave equation in vacuum.

Q5. State and prove Poynting theorem. Give its interpretation. What is Poynting vector?

Q6. In what way the displacement current is different from the conduction current?

Q7. Show that Ampere's circuital law is inconsistent in time varying fields and hence, deduce the modified form of Ampere's law.

Q8. State Gauss's law in magnetostatics. Write its integral form and mention its physical interpretation.

Q9. Discuss the propagation of monochromatic plane electromagnetic wave in a conducting medium. What do you understand by the term skin depth.

Q10. Discuss the propagation of E.M. waves in dielectric. Derive an expression for phase velocity and show that it is less than the speed of light. Also find wave impedance in dielectric media.

Q11. For electromagnetic waves travelling in free space:

(1) Show that E and H are perpendicular to direction of propagation wave vector k.
(2) Show that field vectors E and H are always in phase.

Interference

Q 1: Explain briefly why the fringes in Newton's ring arrangement are circular in shape?

Q 2: State giving reason what change do you expect in Newton's ring, if the distance between the lens and the plate is increased.

Q 3: Why do you require a convex lens of large radius of curvature in Newton's ring experiment?

Q 4: What is the difference between biprism fringe and those obtained with Newton's rings?

Q 5: Why colours are not observed in reflected light from a thick film?

Q 6: Why does an excessively thin film appears to be dark in the reflected light?

Q 7: Two optically plane glass strips of length 10 cm are placed one over the other. A thin foil of thickness 0.010 mm is introduced between the plates at one end from an air film, if the light used has wavelength 590 nm find the separation between consecutive bright fringes?

Q 8: White light is used in Young' double slit experiment, find the minimum order of the violet fringe of wavelength 400 nm which overlaps with red fringe of wavelength 700 nm.

Q 9: Light of wavelength 600 nm falls normally on thin wedge shaped film of refractive index 1.4 forming fringes that are 2 mm apart, find the angle of wedge in seconds.

Q 10: What will happen if a little water is introduced between the lens and the glass plate of Newton's ring experiment?

Diffraction

Q 1: What is the effect on fringes if

(a) the slit width is increased?

(b) the slit separation is increased?

(c) the wavelength of the light used is increased?

Q 2: 2 plane diffraction gratings A & B have same width of ruled surface but A has more number of lines than B. Compare

(a) intensity of fringes.

(b) width of principal maxima

(c) Dispersive power

(d) Resolving power

Q 3 : Differentiate between prism spectra and grating spectra.

Q 4 : A diffraction grating is just able to resolve 2 lines of wavelengths 5140.34 Å & 5140.85 Å in the first order. Will it resolve the lines 8037.2 Å & 8037.5 Å in second order.

Q 5: Sound wave can undergo diffraction at the corner of a building but not light wave. Why?

Q 6: A lens whose focal length is 40 cm forms a Fraunhoffer diffraction pattern of a slit 0.3 mm width. Calculate the distances of first dark band and of the next bright band from the axis. (λ= 5890 Å)

Q 7: Monochromatic light of $\lambda = 6560 \times 10^{-8}$ m falls normally on a grating 2 cm wide. The first order spectrum is produced at an angle 18^0 14' from the normal. What is the total number of lines on the grating?

Q 8: There are 15,000 LPI in a grating, what is the maximum number of orders obtained by using light of λ = 6000 Å?

Q 9: Calculate the least width that a grating must have to resolve the components of sodium D-lines in the second order, the grating having 1000 lines per cm. Two wavelengths of sodium light are 5896 Å and 5890 Å, respectively.

Q 10: The spectral lines of λ_1 = 5890 Å & λ_2 = 5896 Å are observed through a diffraction grating of 2 cm width having 425 lines/cm. Find out whether the 2 lines can be resolved in (a) first order (b) second order.

Polarisation

Q 1: If unpolarised light falls on a system of two cross polarised sheets, no light is transmitted. If thin polarising sheet is placed between them will light be transmitted? Explain.

Q 2: Why do we use monochromatic light for Laurent half shade polarimeter?

Q 3: Why there should be no air bubble in the polarimeter tube?

Q 4: If the plane of vibration of incident beam makes an angle of 30^0 with the optic axis compare the intensities of extraordinary ray and ordinary ray.

Q 5: Differentiate between

(a) e-ray and o-ray

(b) Positive and negative uniaxial crystal

(c) Polarised and unpolarised light

Q 6: A half wave plate is constructed for a wavelength of 600 nm. For what wavelength does it work as quarter wave plate?

Q 7: Calculate the thickness of half wave plate for sodium light of wavelength 589.3 nm. If refractive index of o-ray is 1.54 and ratio of velocities of o-ray and e-ray is 1.007. Is this crystal positive or negative?

Q 8: A 200 mm long tube and containing 48 cm^3 of sugar solution produces an optical rotation of 11^0 when placed in Lorentz half shade polarimeter. If the specific rotation of sugar solution is 66^0, calculate the quantity of sugar contained in the tube in the form of a solution.

Q 9: The value of refractive index of e-ray and o-ray for quartz are 1.5508 and 1.5418 respectively. Calculate the phase retardation for wavelength 500 nm and when the plate thickness is 0.032 mm.

Q 10: What is the use of canada balsam in Nicol prism?

Laser

Q 1: Differentiate between spontaneous and stimulated emission.

Q 2: Differentiate between three levels and four level lasers. Which is more preferable?

Q 3: Population inversion is not possible in two level lasers, State reason.

Q 4: What are the basic conditions for the laser action to take place?

Q 5: What are metastable states? What is the role played by them in working of a laser?

Q 6: LASER action is sometimes called "Inverted absorption". Explain, in what situation may A_{21}/B_{21} be small enough for laser beam.

Q 7: What is the role of He in He-Ne laser?

Q 8: What is population inversion and how is it achieved? Explain, why laser action cannot be achieved without population inversion?

Q 9: Describe qualitatively 4-level laser scheme. Do you think energy conservation is violated in lasing action?

Q 10: State the important characteristics and uses of laser beam.

The Special Theory of relativity

Q1. According to the postulates of the special theory of relativity, laws of physics are same in all inertial frame. What about non- inertial frames? Why they can't be same in non-inertial frame?

Q2. No signal can travel faster than light, Justify.

Q3. If photons have zero rest mass, how they have momentum?

Q4. Show the invariance of space time interval in Lorentz transformation and explain, why it is taken as y=y' and z=z'?

Q5. At what speed the mass of a particle shall be double its rest mass?

Q6. What was the aim and the conclusions of Michelson Morley experiment?

Q7. Why we do not observe Time dilation in day to day phenomena?

Q8. Moving clock ticks slow, explain.

Q9. No two velocities can be added to a value greater than the velocity of light, Justify.

Q10. In a laboratory two particles are observed to travel in opposite directions with speed 2.8×10^{10} cm/s. Deduce the relative speed of the particles.

Q11. An electron is moving with the speed 1.4×10^{8} m/s. How much additional energy must be imparted to double the speed?

Q12. Calculate the velocity of an electron if kinetic energy is equal to twice its rest mass energy.

Q13. The length of a rocket is measured to 2/3 of its proper length. What is the speed of the rocket with respect ground observer and the time dilation?