Time: 3 hour Maximum Marks: 100

Note:

(i) All the questions are compulsory.
(ii) Answer any two sub questions from a, b and c in each main question.
(iii) Total marks for each question is 20 (twenty).
(iv) Each sub-question carries 10 marks.

Q1. (2X10=20 Marks)

a. What is the interference of light? How will you determine the wavelength of light using Fresnel's biprism? (CO1)

b. Newton's rings are observed normally in reflected light of wavelength 6000 Å. The diameter of the 10^{th} dark is 0.50 cm. Find the radius of curvature of the lens and the thickness of the film. (CO1)

c. Define resolving power and dispersive power of a grating. Obtain expressions for these in the case of plane transmission grating. (CO1)

Q2. (2X10=20 Marks)

a. Explain the construction and working of a He-Ne laser with essential components. (CO2)

b. Define quarter wave plate and half wave plate. Calculate the thickness of doubly refracting plane capable of producing a path difference of quarter of the wavelength between ordinary and extra ordinary rays with light of wavelength 5890 Å. The refractive indices for ordinary and extra ordinary. (CO2)
rays are 1.533 and 1.544

c. A glass clad fibre is made with core glass of refractive index 1.5 and the cladding is doped to give an index difference of 0.0005. Determine (a) the cladding refractive index, (b) the critical reflection angle, (c) the critical acceptance angle (d) acceptance cone and (e) the numerical aperture. (CO2)

Q3. (2X10=20 Marks)

a. Define inertial and non-inertial frame of reference. Discuss the Galilean transformation equations and prove that the Newton's law of force remains invariant in all inertial frame of reference. (CO3)

b. State the postulates of special theory of relativity. Show that if (x, y, z, t) and (x', y', z', t') are the coordinates of one event in S and the corresponding event in S'-frames respectively, then the expression $(ds)^2 = dx^2 + dy^2 + dz^2 - c^2dt^2$ is invariant under Lorentz transformation. (CO3)

c. Give the qualitative and quantitative description of Michelson Morley experiment and illustrate its negative results. (CO3)

Q4. (2X10=20 Marks)

a. Discuss the Schrodinger time dependent wave equation. Discuss the physical significance of wave function Ψ. (CO4)

b. State Heisenberg's uncertainty principle and by applying uncertainty principle explain non-existence of electron in nucleus. (CO4)

c. Discuss the application of Schrodinger wave equation for the case of the particle in a box. Compute the associated energy eigenvalue and wave function. (CO4)

Q5. (2X10=20 Marks)

a. What is superconductivity? Explain the distinction between Type-I and type-II superconductors. Give the main properties of a superconductor? (CO5)

b. What are Maxwell's Equations? Derive Maxwell's equation in differential form (CO5)

c. What is nanotechnology? Explain its significance in modern science and engineering. Briefly describe what is meant by fabrication and characterization techniques in the context of nanotechnology. (CO5)