Time: 2 Hours **Marks: 60**

N.B. 1)Question no 1 is compulsory.

2)Attempt any three questions from the remaining questions.

3)Assume suitable data and symbols if required.

4)Figures on the right indicate full marks.

Q.1) Attempt any five

a) Why are Newton's rings circular & why is the centre of interference pattern dark? (3)

b) If the number of lines on the grating surface is increased, what will happen to its resolving power? Explain with necessary formula. (3)

c) Compare stimulated emission with spontaneous emission. (3)

d) Proton is 1836 times heavier than that of electron. If the kinetic energy of the proton is 8.19×10^{-14} J find the de-Broglie wavelength associated with that of proton. (3)

e) The critical field of niobium is 10^5 A/m at 8 K and 2×10^5 A/m at 0K. Calculate critical temperature of the element. (3)

f) How is an electron microscope different from optical microscope. (3)

g) How will you measure of frequency of AC signal using cathode ray oscilloscope? (3)

Q.2) a) What is antireflection coating? Derive amplitude and phase condition for it.

The diameter of a bright ring in Newton's rings experiment was observed to decrease from 2.3 cm to 2.0 cm when air was replaced by liquid in the gap between curved surface of plano convex lens and glass plate. Determine the RI of the liquid. (8)

b) What is index profile in optical fibre? How will you classify optical fibres based on it? The numerical aperture of an optical fibre is 0.2 when surrounded by air. Determine the RI of its core given the RI of cladding as 1.59. Also find the acceptance angle when it is in a medium of RI 1.33. (7)

Q.3) a) Draw energy level diagram of Nd-YAG laser. Explain the working of it by mentioning the active centres, metastable states, type of pumping, the wavelengths emitted out in this laser. Why is the diameter of a tube made elliptical? (8)

b) Show that in wedge shape film the fringe width $\beta = \lambda/2\mu\theta$ where θ is the angle of wedge. White light falls normally on a soap film of thickness $4x10^{-5}$ cm and of refractive index 1.33. Which wavelength in the visible region will be reflected most strongly? (7)

Q.4 a) Calculate the angular separation between the first order minima on either side of central maxima when slit is $6x10^{-4}$ cm wide and $\lambda = 6000$ A°. (5)

b) Explain single slit electron diffraction experiment to verify uncertainty principle. (5)

c) Explain the terms critical temperature, critical magnetic field and critical current in superconductivity. (5)

Q.5 a) A diffraction grating which has 4000 lines per cm is used at normal incidence. Calculate the dispersive power of the grating in the third order spectrum in the wavelength region 5000 A.U. (5)

b) What do you mean by a particle in a box? What are its boundary conditions? Show that the energy of an electron in the box varies as the square of natural number. (5)

c) With Schematic diagram of Scanning Electron Microscope, explain its principle and working. (5)

Q.6 a) The position and momentum of 0.5 KeV electron are simultaneously determined. If its position is located within 0.2nm, what is the percentage uncertainty in its momentum? (5)

b) Explain the working of CRO with block diagram. (5)

c) What are the nanomaterials? Explain any two methods of preparation of nanomaterials. (5)