**Time: 2 Hrs** **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.** (15)

a) What is Rayleigh's criterion of resolution? Define resolving power of grating.
b) A superconductor has a critical temperature $3.7^0$ K. At $0^0$K the critical magnetic field is 0.0306 Tesla. What is the critical magnetic field at temperature $2.0^0$K?
c) An electron is bound in a one dimensional potential well of width 2 $A^0$ but of infinite height. Find its energy values in the ground state and first excited state?
d) What are the advantages of use of optical fibre in communication system?
e) Explain measurement of frequency of AC signal using CRO.
f) What is acronym of 'LASER'? How are they different than ordinary rays?
g) What do you understand by a thin film? Comment on the colours in thin film in sunlight.

Q.2 a) Prove that the diameter of $n^{th}$ dark ring is proportional to square root of natural number in case of reflected system. What will be the order of the dark ring which will have double the diameter of the $40^{th}$ dark ring? (8)
b) A multimode step index optical fibre has core radius of 3 μm and its core refractive index is 1.45. Calculate i) refractive index of cladding ii) acceptanceangle iii) the number of modes propagating through fibre when wavelength of light is 1μm. (7)

Q.3 a) With neat energy level diagram explain principle, construction & working of He-Ne laser? (8)
b) Derive the condition for a thin transparent film of constant thickness to appear bright and dark when viewed in reflected light. (7)

Q.4 a) What is the highest order spectrum which can be seen with monochromatic light of wavelength 6000 $A^0$ by means of diffraction grating with 5000 lines/cm. (5)
b) Derive Schrodinger's time dependent wave equation for matter waves. (5)
c) Distinguish between Type I and Type II superconductors? (5)

Q.5 a) Show that electron cannot exist inside the nucleus using Heisenberg's uncertainty principle. (5)
b) A plane transmission grating having 6000 lines/cm is used to obtain a spectrum of light from a sodium lamp in the second order. Calculate the angular separation between the two sodium lines whose wavelengths are 5890 $A^0$& 5896 $A^0$? (5)
c) With neat diagram explain construction & working of Scanning Electron Microscope. (5)

Q.6 a) What are carbon nano tubes & what are their properties? (5)
b) Derive Bethe's law for electron refraction? (5)
c) The electron which is at rest is accelerated through a potential difference of 200V. Calculate i) the velocity of electron ii) De-Broglie wavelength (5)

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