Time: 2 Hours Marks: 60

N.B.

1. Question **No.1** is Compulsory.
2. Attempt **any three** questions from the remaining questions Nos. 2 to 6
3. Assume suitable data wherever required.
4. Figures to the right indicate marks.

Q.1. Attempt **any Five**

a) Find the divergence of vector function $\vec{A} = x^2\hat{\imath} + x^2y^2\hat{\jmath} + 24x^2y^2z^3\hat{k}$ 03

b) What is antireflection coating? What should be the refractive index and minimum thickness of the coating? 03

c) A glass material A with which an optical fibre is made has a refractive Index of 1.55.This material is clad with another material whose refractive index is 1.51. The light in the fibre is launched from air. Calculate the numerical aperture of the fibre. 03

d) What is the difference between Bottom up approach and Top down approach with respect to nanotechnology? 03

e) Write the difference between LED and Laser Diode. 03

f) How is Lissajous figures used to measure unknown frequency? 03

g) A parallel beam of light of wavelength 5890 Å is incident on a glass plate having refractive index $\mu = 1.5$ such that the angle of refraction in the plate is 60^0.Calculate the smallest thickness of the glass plate which will appear dark by reflected light. 03

Q.2 a) With the help of a proper diagram and necessary expression, explain how Newton's ring experiment is useful to determine the radius of curvature of a plano convex lens. In a Newton ring's experiment the diameter of 5^{th} dark ring is 0.336 cm and the diameter of 15^{th} dark ring is 0.590cm.Find the radius of curvature of a plano convex lens, if the wavelength of light used is 5890Å . 08

b) What is monomode and multimode fibre? Explain the term V-number. Calculate the number of modes a step index optical fibre of diameter 40μm will transmit as its core and cladding refractive indices are 1.5 and 1.46 respectively. Wavelength of light used is 1.5 μm. 07

Q.3 a) With a neat energy level diagram describe the construction and working of He-Ne laser. What are its merits and demerits? 08

b) What is diffraction grating and grating element? Explain the experimental method to determine the wavelength of the spectral line using diffraction grating? 07

Q.4 a) With a neat diagram explain the construction and working of scanning electron microscope 05

b) Derive the Bethe law for electron refraction. 05

c) Derive the condition for absent spectra in grating. 05

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Q.5 a) Draw the block diagram of an optical fibre communication system and explain the function of each block. 05

b) Derive Maxwell's third equation. 05

c) An electron enters a uniform magnetic field B=0.23 X 10^{-2} Wb/m^2 at 45^0 angle to B. Determine radius and the pitch of helical path. Assume electron speed to be 3 x 10^7m/s 05

Q.6 a) If $\vec{A} = x^2 z\hat{\imath} - 2y^2 z^2 \hat{\jmath} + xy^2 z\hat{k}$. Find $\nabla . \vec{A}$ at point (1,-1,1). 05

b) A Newton's rings set up is used with a source emitting two wavelengths λ_1 = 6000Å and λ_2 = 4500Å. It is found that n^{th} dark ring due to 6000Å coincides with $(n+2)^{th}$ dark ring due to 4500Å. If the radius of curvature of the lens is 90 cm, find the diameter of n^{th} dark ring for 6000Å 05

c) Differentiate between stimulated and spontaneous emission. 05

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