19-12-202

FE Sem-I (All branches) NEP 2020

Duration: 1 ½ hours **[Max Marks:45]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any two questions out of the remaining four.
(3) Assume suitable data, if required and state it clearly.

1 Attempt any FIVE [15]

(a) What is metastable state? What is the role of metastable state in LASER?

(b) An optical fiber has an acceptance angle of 30° and core refractive index of 1.4 calculate refractive index of cladding?

(c) Explain why an excessively thin film appears black in reflected light?

(d) Show that the divergence of a curl of a vector is zero.

(e) State the properties of matter waves.

(f) An electron is bound in an 1D potential well of width 2 A° but of infinite height. Find its energy values in the ground state and in first excited state. (Given: Planck constant is 6.634×10^{-34} J-Sec)

(g) Write Fermi Dirac distribution function and explain the terms involved in it

2 (a) With the neat energy level diagram, explain the construction and working of He Ne Gas laser. [05]

(b) Derive an expression for numerical aperture of a step index optical fiber. [05]

(c) In a Newton's ring arrangement, a drop of liquid of refractive index 1.33 is placed in between the lens and plate. The diameter of 9^{th} dark ring is found to be 0.58 cm. Obtain the radius of curvature, if the wavelength of light is 6000 A°. [05]

3 (a) What is gradient? If $\emptyset = 3(x^2y - y^2x)$, find $\nabla\emptyset$ at the point (1, -2,-1). [05]

(b) Prove that electron cannot reside inside the nucleus of an atom. [05]

(c) Predict the effect on the electrical properties of a silicon at room temperature if every millionth silicon atom is replaced by an atom of indium. [05]
Given: Concentration of silicon atoms are 5×10^{28} /m^3
intrinsic conductivity of silicon is 4.4×10^{-4} /Ω-m
mobility of holes is 0.048 m^2 / volt-sec.

X524X1C84FFX524X1C84FFX524X1C84FFX524X1C84FF

4 (a) Show that for an intrinsic semiconductor, fermi level lies midway of conduction band and valence band. [05]

(b) With the experimental set up of Newton's ring, explain the determination of refractive index of a liquid. [05]

(c) An electron and a photon each have a wavelength of 2A°. What are their momentum and energies? [05]

5 (a) Compare Step Index fiber and Graded Index Fiber. [05]

(b) State and explain Maxwell's fourth equation. [05]

(c) What is Lidar technology and how does it work? [05]
