05/06/2025 FE ALL BRANCHES SEM-I (NEP-2020) AP-I QP CODE: 10082947

Duration: 1.5 hours   **[MaxMarks: 45]**

N.B.:
1. Question No. 1 is compulsory.
2. Attempt any two questions from Q.2 to Q.5.
3. Assume suitable data wherever required.
4. Figures to the right indicate marks.

1	Attempt **any FIVE**	**[15]**
	(a) What is metastable state? What is the role of metastable state in LASER?	
	(b) Define the terms: Critical angle, Acceptance angle and Attenuation.	
	(c) What is antireflection coating? What should be the refractive index and minimum thickness of the coating?	
	(d) Show that the divergence of the curl of a vector is zero.	
	(e) Calculate the wavelength of de-Broglie waves associated with mass 1 kg moving with a speed of 10^3 m/sec.	
	(f) Explain the de Broglie hypothesis of mater waves.	
	(g) Write Fermi- Dirac distribution function and explain the terms in it.	
2	(a) What is resonant cavity? Explain its use in the generation of Laser beams.	**[05]**
	(b) Derive an expression for numerical aperture of a step index optical fibre.Give its physical significance.	**[05]**
	(c) In Newton's rings experiment the diameter of 5th ring was 0.336 cm and the diameter of 15th ring was 0.590 cm. Find the radius of curvature of plano convex lens if the wavelength of light used is 5890 Å.	**[05]**
3	(a) Determine the curl of these vector fields. (1) $\bar{A} = \hat{a}_y (2x^2+ y^2)+ \hat{a}_y (xy - y^2)$ (2) $\bar{A} = yz\,\hat{a}_x + 4\,xy\,\hat{a}_y + y\,\hat{a}_z$	**[05]**
	(b) Derive Schrodinger's Time Independent wave equation for matter waves.	**[05]**
	(c) Explain mobility of electrons. The resistivity of Cu is 1.72×10^{-8} ohm-m. Calculate the mobility of electrons in Cu given that number of electrons per unit volume is 10.41×10^{28} m^{-3}.	**[05]**
4	(a) Derive an expression for Fermi level for an intrinsic semiconductor.	**[05]**
	(b) Obtain the condition for maxima and minima of the light reflected from a thin transparent film of uniform thickness.	**[05]**
	(c) An electron has a speed of 400 m/sec with uncertainty of 0.01%. Find the accuracy in its position.	**[05]**
5	(a) The refractive indices of core and cladding materials of a step index fibre are 1.48 and 1.45 respectively. Calculate (1) Numerical Aperture, (2) acceptance angle, (3) the critical angle at the core cladding interface, (4) fractional refractive indices change.	**[05]**
	(b) State Ampere's Circuital law. Derive Maxwell's fourth equation in differential form.	**[05]**
	(c) With a neat energy level diagram, describe the construction and working of He-Ne Laser.	**[05]**