QP Code: PH1T01A-3 **(Pages: 3)**

Reg No : ..... Name : .....

MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM

(Govt. Aided Autonomous Institution)

First Semester B.Tech. Degree (SAY) Examination, February, 2026

(EC, CS, DS, AI Branches)

Course Code: B24PH1T01A

Course Name: ENGINEERING PHYSICS (A)

Max. Marks: 100 Duration: 3 Hours

PART - A: 30 Marks (10 Qns x 3 Marks)

Answer all questions

1. The pulse width of a laser beam of wavelength 3.39μm is 30ms. If the average output is 0.5W, what is the energy released per pulse?
2. Discuss active medium in laser and the criterion for selecting them.
3. State the general form of the uncertainty principle.
4. What is the relationship between a particle's momentum and its de Broglie wavelength?
5. Write the expression for the Fermi level in an intrinsic semiconductor.
6. State the law of mass action. Write the expression for the intrinsic carrier concentration.
7. Explain the variation of Fermi level with temperature in an n type semiconductor.
8. What is doping in semiconductors?
9. What is the role of the depletion region in a p-n junction?
10. List three applications of photonic devices.

PART - B: 70 Marks (5 Qns x 14 Marks)

Answer any One full question from each module.

Module 1

11. a. Establish the relation between Einstein's coefficients. (10 Marks)

b. A semiconductor diode laser has a peak emission wavelength of 1.55μm. What is its band gap in eV? (4 Marks)

OR

12. a. What is fiber acceptance angle? Derive an expression for acceptance angle of an optical fiber. (10 Marks)

b. If $n_1 = 1.56$ & $n_2 = 1.48$ calculate numerical aperture, critical angle and fiber acceptance angle. (4 Marks)

Module 2

13. a. Derive Schrodinger's time dependent equation. (10 Marks)

b. An electron remains in an excited state for $10^{-10} sec$. Find the uncertainty in energy. Given $\hbar = 1.054 \times 10^{-34} Js$. (4 Marks)

OR

14. a. Write the time independent Schrodinger wave equation for a particle in a one dimensional infinite square well potential, hence obtain the expression for the energy levels. (10 Marks)

b. Find the lowest energy of an electron moving in one dimension in an infinitely high potential box of width 0.1mm. (4 Marks)

Module 3

15. a. Discuss the factors that influence the density of electrons in the conduction band of an intrinsic semiconductor. (10 Marks)

b. Find the temperature at which the intrinsic carrier concentration in Silicon is $1.5 \times 10^{12}\ cm^{-3}$. Given $N_C = N_V = 2.8 \times 10^{19}\ cm^{-3}$ and $E_g = 1.12\ eV$. (4 Marks)

OR

16. a. Show that the density of holes in the valance band of an intrinsic semiconductor depends on its effective mass. (10 Marks)

b. Calculate the intrinsic carrier concentration for Germanium at 300K. Given $N_C = 1.02 \times 10^{19}\ cm^{-3}$, $N_V = 0.6 \times 10^{19}\ cm^{-3}$ and $E_g = 0.66\ eV$. (4 Marks)

Module 4

17. a. Derive the relationship between hole concentration and acceptor concentration in a p type semiconductor. (10 Marks)

b. Find the Fermi level at 300K for a p type semiconductor, relative to its initial value (at T = 0K). Given $N_a = 10^{16} cm^{-3}$, $N_v = 1.04 \times 10^{19} cm^{-3}$. (4 Marks)

OR

18. a. Derive the expression for the Fermi level in an n type semiconductor as a function of temperature. (10 Marks)

b. In an n type semiconductor the Fermi level is $0.3eV$ below the conduction band at $300K$. What would be the new position of Fermi level when the temperature is raised to $330K$ (neglect changes in N_c). (4 Marks)

Module 5

19. a. Describe the construction and working mechanism of photodiode. (10 Marks)

b. Write four applications of photodiode. (4 Marks)

OR

20. a. Explain the mechanism of charge flow in a p-n junction under forward bias and reverse bias condition. (10 Marks)

b. How does temperature affect forward and reverse biasing of a p-n junction? (4 Marks)

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