PART – I

Answer all questions:

1. Discuss the detection process in Avalanche photodiode.

2. Explain the terms, conversion efficiency and fill factor of a solar cell.

3. Explain stokes shift in optical transitions.

4. Calculate the value of $\alpha$ for the transitions in GaAs at a photon energy $h\nu = 1.52$ eV. Assume $E_g = 1.5$ eV at 0°K.

5. Briefly explain the line broadening mechanism in LASERs.

6. Explain the working of an acousto-optic modulator.

7. What are the parameters that determine the reliability factor of LEDs?

8. Calculate the ratio of the spontaneous to stimulated emission rates in a tungsten lamp that radiates at an average frequency of $5 \times 10^{14}$ Hz at an operating temperature of 1300°K.

9. Explain the electron-beam pumping techniques in LASERs.

10. What are axial modes in a LASER? 

    \[ (10\times4=40 \text{ Marks}) \]
PART – II

Answer any two questions from each Module:

Module – I

11. Describe the absorption in quantum wells and quantum confined stark effect. 10
12. Explain different techniques commonly used for measuring high speed response of photodetectors. 10
13. Explain the process of Auger recombination and deep level transitions in detail. 10

Module – II

14. A solar cell has a $I_{ph} = 3.5$ mA, $I_s = 5 \times 10^{-11}$ A, area = 2 cm$^2$. Determine open circuit voltage and power delivered by the cell if the fill factor is 80%. 10
15. With neat diagrams, explain the principle of surface emitting LEDs and compare its feature with edge emitting LEDs. 10
16. a) Derive an expression for the spectral response of a photovoltaic cell. 5
   b) Differentiate electrical bandwidth, optical bandwidth and modulation bandwidth of an LED. 5

Module – III

17. Derive Einstein relationship connecting absorption, stimulated emission and spontaneous emission coefficients. 10
18. a) Derive the threshold condition for laser action. 6
   b) On what factors does the gain coefficient of a semiconductor laser depend. 4
19. With layer structure and schematics, explain the principle and operation of heterojunction lasers. 10

$(6 \times 10 = 60$ Marks)