

**M.TECH DEGREE EXAMINATION DECEMBER 2007  
OPTOELECTRONICS AND LASER TECHNOLOGY**

**ISP 6103 OPTOELECTRONICS**

Time 3 Hrs  
Marks 40



Answer *All* questions

(5x8 = 40)

I Write down and explain the expressions for lifetime and diffusion length for minority carriers in a pn junction. Calculate the intrinsic carrier concentration in a semiconductor GaAs at room temperature from the following data.  $m_e=0.07m$ ,  $m_h = 0.56m$ ,  $E_g = 1.43$  eV, where  $m$  is the mass of the electron in free space.

OR

b) What are direct and indirect band gap materials? Discuss the basic physics of processes involving photons and electrons in a semiconductor, on which the operation of photo detectors and emitters are based.

II a) Explain in detail the process of injection luminescence in LEDs. Find the expressions for internal and external quantum efficiencies of an LED  
Calculate the injection efficiency of a GaAs diode in which  $N_a=10^{23} \text{ m}^{-3}$  and  $N_d=10^{21} \text{ m}^{-3}$ . Assume that  $RT=300\text{K}$ ,  $\mu_e=0.85 \text{ m}^2\text{V}^{-1}\text{s}^{-1}$ ,  $\mu_h=0.04\text{m}^2\text{V}^{-1}\text{s}^{-1}$ ,  $k=1.38\times 10^{-23}\text{JK}^{-1}$  and  $L_e=L_h$

OR

b) Explain the working of the double heterojunction laser diodes  
A GaAs laser operating at 900 nm has cavity length of 600  $\mu\text{m}$ . Its refractive index is 3.7. What are the values of frequency spacing and wavelength spacing? If at the half power point,  $\lambda-\lambda_0 = 3\text{nm}$ , what is the spectral width of the gain.

III. a) Explain longitudinal electro optic effect? How can this effect be used to modulate the phase of an optical signal?  
Calculate the thickness of the quarter wave plate made of quartz to be used with sodium light,  $\lambda=589.3$  nm. It is given that the principal refractive indices  $n_e$  and  $n_o$  for quartz are 1.553 and 1.554 respectively.

OR

b) Discuss various types of acousto optic modulators, giving basic principles construction performance characteristics and applications. Explain how amplitude modulation and frequency modulation are achieved in acousto optic modulators.

IV a) Explain various types of liquid crystals. Explain their use in LCDs, color TV and optical switching.

OR

b). Discuss the working principle of plasma panel display. Explain any two applications

V a) Explain the principle of operation of pin photodiodes and their uses. Compare their performance with that of Avalanche photodiode, with reference to, speed and noise.

OR

b) Discuss and compare various types of Solar cells, their construction, and performance for solar power generation.