Reg. No. : ....

Name : ....

Seventh Semester B.Tech. Degree Examination, November 2013
(2008 Scheme)
08.735 : OPTOELECTRONIC DEVICES (TA)

Time : 3 Hours

Max. Marks : 100

PART – I

Answer **all** questions. **Each** question carries 4 marks.

1. Compute radiative recombination time (τ_r) in GaAs having $n_o = 10^{14}\text{cm}^{-3}$ under high injection of 10^{18}cm^{-3}. Given that $B_r = 7\times10^{-10}\text{cm}^3/\text{s}$.

2. What do you understand by Stark Effect ?

3. Draw the noise equivalent circuit of a photodiode and name the components.

4. Explain 'Avalanche multiplication' and write an expression for Avalanche multiplication coefficient.

5. Explain energy band diagram of a Schottky barrier cell.

6. τ_r and τ_{nr} (Radiative and non radiative life times) of a LED are 60 ns and 100 ns respectively. Compute total recombination life time. Given that peak emission wavelength is 0.87 µm at a drive current of 40 mA.

7. Draw the structure of a planar LED.

8. Write down threshold condition for Laser Oscillation.

9. The total efficiency of an injection laser with a GaAs active region is 18%. Voltage applied to the device is 2.5 V and band gap energy is 1.43 eV. Calculate external power efficiency of the device.

10. Write notes on Rare-Earth Doped Lasers.

PART – II

Answer **any two** questions from **each** Module. **Each** question carries **10** marks.

Module – I

11. Explain different types of absorption of photons in semiconductors (with neat figures). **10**

12. a) Derive the relation between quantum efficiency and responsivity of a photo diode. **5**

    b) A photo diode has a quantum efficiency of 65% when photons of energy 1.5×10^{-19} J are incident on it.

       i) At what wavelength is the photo diode operating ?

       ii) Compute the incident optical power required to obtain a photo current of 2.5 µA at this wavelength. **5**

13. Explain the structure of SAGM APD. How grading improves the performance ? **10**

Module – II

14. a) Define injection efficiency and recombination efficiency of a light emitting diode with sufficient Mathematical support. **3**

    b) Explain the structures of Heterojunction LED and surface emitting LED. **7**

15. a) What is image force lowering effect in MSM photodiode ? Explain with sketches. **5**

    b) What is the effect of bias on barrier heights in a triangular barrier diode ? **5**

16. Describe the principle and operation of Electro-optic and acousto-optic modulators. **10**

Module – III

17. a) Compare the ratio of threshold current densities at 20°C and 80°C for AlGaAs
    injection laser with $T_0 = 180$ K.   4

    b) Write notes on Axial and Transverse Laser Modes.   6

18. a) Derive an expression for gain in a two level lasing medium.   5

    b) Calculate the number of modes of an AlGaAs laser supported by the gain
       spectrum which has a bandwidth of 6nm. Cavity length of the laser is 200 μm
       and emission wavelength is 800 nm.   5

19. Write notes on :

    a) DFB lasers.   5

    b) Quantum well lasers.   5