Course Name – Opto-electronics   **Maximum Marks – 50**
Course Code – PH 708   **Total Time: 3 Hours**

Attempt all the questions

Q.1: Derive the expression of depletion width in p-n junctions starting from the expression of electric field. Also plot the Electric field as a function of distance from the junction.. (5)

Q.2: (a) Explain the non-radiative mechanisms in LED .... (3)
(b) Explain the practical challenges in LED and means to overcome them .... (3)

Q.3: Write four characteristics of a photodetector .... (4)

Q.4: Draw band diagram of metal-semiconductor (n type) junction. Explain the difference between M-S contact and p-n junction based on application....................................... (2)

Q. 5: (a) write down the composition of white and blue LED.................................... (1)
(b) Explain the significance of V_{OC} and I_{SC} in solar cell in terms of solar spectra. In what quadrant of I-V, solar cell works... (3)

Q.6: (a) The band gap of an intrinsic semiconductor is 0.72eV and $m_h^* = 6m_e^*$. What will be Fermi level w.r.t edge of Valence band at room temperature.................................. (3)
(b) At temperature T K, the value of Fermi function at energy 0.5eV above Fermi energy is 0.01. Calculate the value of Temperature? .... (3)
(c) The donor concentration in a sample of n type Si is increased by a factor of 100. What will be the shift in the position of Fermi level at 300 K? .... (3)

Q. 7: (a) Write down four characteristics of LASER .... (2)
(b) If the coefficient of stimulated emission for a particular transition is $2.1 \times 10^{19} \text{m}^3\text{W}^{-1}\text{s}^{-1}$ and the emitted photon is at $\lambda = 3000$Å, Calculate the lifetime of excited state?... (3)

Q.8 (a) Explain the longitudinal modes in LASER .... (2)
(b) The cavity of He-Ne LASER emitting at 632.8 nm, consists of 2 mirrors separated by a distance of 35 cm. If the oscillations in the laser cavity occur at frequency within the gain bandwidth of 1.3GHz, Calculate the no of longitudinal modes allowed in cavity............. (3)

Q.9: On what principle, optical fibers work. Explain its construction and working. Define acceptance cone... (5)

Q.10: Explain single mode and multimode fibers.. (2)

Q.11: A step index fiber has a core index of refraction of =1.425. The cut off angle for light entering the fiber from air is found to be 8.5. Calculate .... (3)
(a) N.A.
(b) Refractive index of cladding.
(c) If the fiber is submerged in water, what would be the new N.A and cut off angle.