Optical Fibre Communications
(EC-404, Dec-2007)

Note: Section A is compulsory. Attempt any four questions from Section-B and any two from Section-C.

Section-A

1. a) What is an optical fibre repeating system?
   b) What are the advantages of cladding on a fibre?
   c) What do you mean by V-parameter? Give the expression for the same.
   d) Explain how a mode coupling can occur?
   e) What are the basic attenuation mechanisms?
   f) What are the direct band gap and indirect band gap semiconductors?
   g) Describe the operation of pn junction diode on physical basis with reference to the formation of barriers potential and depletion layer.
   h) What do you understand by absorption, spontaneous emission and stimulated emission in a two level energy system?
   i) How is the population inversion accomplished in semiconductor and non-semiconductor layer?
   j) What is the difference between connector and splice?

Section-B

2. What do you mean by dispersion? How do we reduce dispersion using dispersion compensating fibre?
3. Explain the operation of Avalanche photodiode with the help of necessary diagram.
4. A graded index fibre has a core with a parabolic refractive profile which has a diameter of 50 μm. The fibre has a numerical aperture of 0.2. Estimate the total number of guided modes propagating in the fibre when it is operating at a wavelength of 1 μm.
5. A photodiode has a quantum efficiency of 65 percent when photons of energy 1.5×10^{-19} J are incident on it.
   (a) Calculate the wavelength at which the photodiode is operating and
   (b) Incident optical power required when the current through the diode is 3μA.
6. Explain the optical receiver with the help of schematic diagram.

Section-C

7. Explain in detail the block diagram of a receiver showing different types of noise generated giving the expression for each type of noise.
8. (a) Calculate the refractive indices of the core and the cladding materials of an optical fibre whose NA = 0.35 and Δ = 0.01.
   (b) Explain in detail WDM systems with suitable diagrams.
9. (a) Calculate for both single mode and multimode fibres, the critical radius of curvature at which large bending losses occur in a step index fibre of core refractive index of 1.45 and relative index difference of 3% at an operating wavelength of 1.5 μm and core radius of 5 μm.
   (b) Explain in detail the operation of small signal modulation.