(3 Hours) [Total Marks : 100

N.B. :(1)Question no.1 is compulsory.
(2)Answer any 4 out of the remaining 6 questions.
(3)Assume any suitable data wherever required but justify the same.

1(a)Describe 3 types of optical fibers. For each type ,give typical core and cladding diameters .Sketch their refractive index profile. 5

(b)Explain the significance of phase and group velocities in a dispersive medium. 5

(c)What are the techniques used to give both electrical and optical confinement in injection lasers.? 5

(d)Derive an expression for the responsivity of an intrinsic photodetector in terms of quantum efficiency and wavelength. 5

2(a)Derive an expression for numerical aperture of optical fiber in terms of refractive indices.A step index fiber has an acceptance angle in air of 20 deg. And a relative refractive index difference of 1%.Estimate the numerical aperture and the critical angle at the core-cladding interface. 10

(b)Discuss the boundary conditions and the mode cutoff in case of optical fiber.What is the significance of 'V' number.Get an expression for it in terms of N.A. 10

3(a)Explain any one fiber fabrication process with a neat diagram. 10

(b)Explain with neat sketches fiber splicing techniques.Enlist the desirable requirements of a good fiber connector. 10

4(a)Describe the intermodal dispersion in a multimode fiber.Show that the total pulse broadening of light pulse δTs due to intermodal dispersion is given by

$$\delta Ts = \frac{L(N.A)^2}{2\eta c}$$

10

(b) Consider an optical link consisting of a 10 km long step index fiber with a core index $\eta_1 = 1.49$ and relative refractive index difference =1%
(i) Find the delay difference at the fiber end between the fastest and the slowest modes
(ii) Find the r.m.s pulse broadening caused by intermodal dispersion.
(iii) Calculate the maximum bit rate B_T that can be transmitted on this fiber.
(iv) Assuming Max bit rate=Bandwidth ,what is the BW distance product of this fiber. 10

5(a)Outline the common LED structures for optical fiber communications,discussing their merits and drawbacks.Compare surface and edge emitting devices. 10

(b)A planar LED is fabricated from GaAs which has r refractive index of 3.5.
(i)Calculate the optical power emitted into air as a percentage of internal optical power for the device when the transmission factor at the crystal air interface is 0.69.
(ii) When the optical power generated internally is 40% of the electrical power supplied,determine the external power efficiency. 10

6(a)Discuss the operation of a silicon RAPD describing how it differs from p-i-n photodiode.Outline the advantages and drawbacks with use of RAPD as a detector. 10

(b)Aphotodiode has a quantum efficiency of 65%.when photons of energy 1.5×10^{-19} joules are incident upon it.
(i) At what wavelength is the photodiode operating.
(ii) Calculate the incident optical power required to obtain a photocurrent of 2.5 microamperes.when the photodiode is operating as above. 10

7.Write Notes on any two:- 20

(a)OTDR
(b)Optical link power budget.
(c) Wavelenght division multiplexing
(d)Linearly polarized modes.