Total No. of Questions : 6]

SEAT No. :

**P89**

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# APR - 18/BE/Insem. - 49

## B.E. (E&TC)

## BROADBAND COMMUNICATION SYSTEMS

## (2012 Course) (Semester - II) (404190)

*Time : 1 Hour]* *[Max. Marks : 30*

***Instructions to the candidates:***

1) ***Answer Que. 1 or Que. 2, Que. 3 or Que. 4, and Que. 5 or Que. 6.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of scientific electronic calculator is allowed.***
5) ***Assume suitable data if necessary.***

***Q1)*** a) A step index fiber has a core refractive index 1.5 and $\Delta = 1.3\%$ with core radius of 100μm. The operating wavelength is 850 nm. Assuming that the fiber is kept in air calculate **[6]**

i) Numerical aperture of fiber and acceptance angle

ii) V number (Normalized Frequency) and number of modes in fiber

iii) What will happen to the number of modes in fiber if

- core refractive index increased
- Wavelength increased

b) Compare and contrast LED and ILD as light source in optical fiber communication. **[4]**

OR

***Q2)*** a) For a single mode fiber with core and cladding refractive indices 1.49 and 1.47 respectively, calculate **[6]**

i) Cut off wavelength if core radius is 2μm

ii) Maximum core diameter for cut off wavelength of 1310 nm

b) Explain micro bending and macro bending with reference to optical fiber. **[4]**

***P.T.O.***

***Q3)*** a) The following parameters are established for a long-haul single-mode optical fiber system operating at a wavelength of 1.3 μm : **[6]**

| | |
|---|---|
| Mean power launched from the laser transmitter | – 3 dBm |
| Cabled fiber loss | 0.4 dB $km^{-1}$ |
| Splice loss | 0.1 dB $km^{-1}$ |
| Connector losses at the transmitter and receiver | 1 dB each |
| Mean power required at the APD receiver: | |
| When operating at 35 Mbit $s^{-1}$(BER $10^{-9}$) | –55 dBm |
| When operating at 400 Mbit $s^{-1}$(BER $10^{-9}$) | –44 dBm |
| Required safety margin | 7 dB |

Estimate:

i) The maximum possible link length without repeaters when operating at 35 Mbit $s^{-1}$(BER $10^{-9}$). It may be assumed that there is no dispersion-equalization penalty at this bit rate.

ii) The maximum possible link length without repeaters when operating at 400Mbit $s^{-1}$(BER $10^{-9}$) and assuming no disperison-equalization penalty.

b) Enlist and explain different fiber misalignment losses. **[4]**

OR

***Q4)*** a) An optical fiber system is to be designed to operate over an 8-km length without repeater. The rise times of the chosen components are: **[6]**

| | |
|---|---|
| Source(LED) | 8 ns |
| Fiber: Intermodal | 5 ns $km^{-1}$ |
| (Pulse broadening) intra-modal | 1 ns $km^{-1}$ |
| Detector (*p-i-n* photodiode) | 6 ns |

From system rise time considerations, estimate the maximum bit rate that may be achieved on the link when using an NRZ format.

b) Explain key system requirements to establish point to point optical fiber link. **[4]**

***Q5)*** a) A 2×2 biconical tapered fiber coupler has an input optical power level of $P_0 = 200\mu W$. The output powers at the other three ports are $P_1 = 95\mu W$, $P_2 = 85\mu W$ and $P_3 = 9.3$ nW.

Calculate coupling ratio, excess loss and insertion loss. **[6]**

b) Explain operational principles of WDM with a suitable schematic diagram. **[4]**

OR

***Q6)*** a) Explain working principle of FBG. Support your answer with suitable diagram. **[6]**

b) Write a short note on EDFA. **[4]**

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