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Total No. of Questions : 12]

SEAT No. :

P1745

[Total No. of Pages :4

[4859]-100
B.E. (E&TC)
OPTICAL FIBER COMMUNICATION
(2008 Course) (Semester - II) (404188)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2,Q3 or Q.4,Q5 or Q.6 from section-I and Q.7 or Q.8,Q9 or Q.10,Q.11 or Q.12 from section-II.***
2) ***Answer to the two sections must be wrtten in separate answer books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to right indicate full marks.***
5) ***Assume suitable data wherever necessary.***

SECTION-I

Q1) a) With reference to mode theory for optical propagation explain the following terms: **[6]**

i) Phase velocity

ii) Group velocity

iii) Group delay

b) Compare: **[6]**

i) Multimode and single mode fibers

ii) Step Index and graded Index fibers.

c) An optical fiber with 25μm core radius has core refractive index 1.48 and relative refractive index difference of 0.01. **[6]**

i) Calculate the value of normalized frequency and the number of modes that can propagate through this fiber, if the wavelength of operation is 1310nm.

ii) Calculate the percentage of optical power flow in the cladding.

iii) If the relative refractive difference is reduced to 0.001, how many modes are supported by the fiber and what fraction of the optical power flows in the cladding?

OR

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Q2) a) A graded index fiber with parabolic index profile supports the propagation of 742 guided modes. The fiber has numerical aperture in air of 0.3 and core diameter of 70 μm. Determine the wavelength of light propagating in the fiber. Also estimate the new maximum core diameter for single mode operation at same wavelength. **[6]**

b) Explain any one fiber fabrication method with a neat diagram. **[6]**

c) Velocity of light in the core of step index fiber is $2x10^8$m/sec and critical angle at core-cladding interface is 80°. Determine numerical aperture and acceptance angle for the fiber in the air, assuming it has core diameter suitable for consideration by ray analysis. **[6]**

Q3) a) Explain the various loss mechanisms in optical fibers in detail. **[8]**

b) A continuous 40 km long optical fiber link in a test setup has a loss 0.4 dB/km. **[8]**

i) What is the minimum optical level that must be launched into the fiber to maintain an optical power level of 2 μW at the receiving end?

ii) What is the required input power if the fiber has a loss 0.6 dB/km?

OR

Q4) a) What is dispersion? Explain the various dispersion mechanisms that are observed in multimode and single mode optical fibers. **[8]**

b) Explain **[8]**

i) DSF

ii) NZDSF

iii) Dispersion flattened fiber and

iv) PM fibers.

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Q5)a) Explain the mechanism of optical feedback to provide oscillation and hence amplification within the laser. **[8]**

The longitudinal modes of GaAs injection laser emitting at a wavelength of 0.87 μm are separated in frequency by 278 GHz. Determine the length of the optical cavity and the number of longitudinal modes emitted. Consider the refractive index of GaAs as 3.6.

b) Explain the various modulation schemes applicable to optical sources.**[8]**

OR

Q6) a) Draw and explain LED drive circuits for digital and analog communication. **[8]**

b) Draw and explain the principle of working and characteristics of LASER.**[8]**

SECTION - II

Q7) a) For the wavelength range 1300 nm < λ < 1600 nm, the quantum efficiency for InGaAs is around 90%. **[6]**

i) Calculate the responsivity at 1300 nm;

ii) Calculate the cutoff wavelength of this detector considering the energy gap of InGaAs as Eg = 0.73 eV.

iii) State the reason for the rapid decrease in responsivity for smaller wavelengths.

b) Explain the principle of working and characteristics of photo transistor.**[6]**

c) Draw and explain the generic front–end amplifier structures in receivers.**[6]**

OR

Q8) a) A silicon based avalanche photo diode has a quantum efficiency of 65% at a wavelength of 900nm. Optical power of 0.5 μW produces a multiplied photocurrent of 10 μA. Calculate. **[6]**

i) Primary photo current and ii) Multiplication factor M.

b) Explain the principle of working and characteristics of avalanche photo diode. **[6]**

c) Write short note on: Noise considerations in p-n, p-i-n and APDs. **[6]**

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Q9) a) Draw the block diagram of optical fiber communication link. Explain the system design considerations in a point-to-point optical fiber communication link. **[8]**

b) Using graphical method calculate the maximum attenuation-limited transmission distance of the following two systems operating at 100Mb/s: **[8]**

System I operating at 850 nm

i) GaAlAs laser diode: 0dBm fiber-coupled power.

ii) Silico APD with -50 dBm sensitivity.

iii) Graded-index fiber: 3.5 dB/ km attenuation at 850 nm.

iv) Connector loss: 1dB/connector.

System II operating at 1300 nm

i) InGaAsP LED diode: 13dBm fiber-coupled power.

ii) InGaAs pin photodiode with -38dBm sensitivity.

iii) Graded-index fiber: 1.5 dB/km attenuation at 1300 nm.

iv) Connector loss: 1dB/connector.

Allow a 6 dB system operating margin in each case. Comment on the result.

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OR

Q10)a) Explain in detail: Multichannel transmission system. **[8]**

b) Explain in detail: Rise time Budget **[8]**

Q11)a) Explain the principle of operation of Erbium Doped Fiber Amplifiers (EDFA) with a neat diagram. Comment on the gain and noise in EDFA. **[8]**

b) Draw a block diagram of a WDM optical system. Explain the technique of wavelength division multiplexing. **[8]**

OR

Q12)a) Write short note on: WDM couplers and their properties. **[8]**

b) Compare between SOA and EDFA. Comment on the selection criteria of such amplifiers. **[8]**

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