Code No: K0421 **R07** **Set No. 1**

IV B.Tech. II Semester Regular Examinations, April, 2011

OPTICAL COMMUNICATIONS

(Electronics & Communication Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. a) Discuss the advantages of optical fibers over conventional copper cables. [8]
   b) A multimode step index fiber has a relative refractive index difference of 1% and a core refractive index of 1.5. The number of modes operating at a wave length of 1.3μ meters is 1500. Determine the diameter of the fiber core. [8]

2. a) Explain the following [8]
      i). Cut off wave length
      ii). Mode field diameter.
   b) Explain the bending losses in the optical fiber. [8]

3. a) Derive the expression for the wave guide dispersion and obtain the relationship between mode number V and β. [8]
   b) Explain about straight sleeve connectors. [8]

4. a) Explain internal quantum efficiency and modulation capability of LED with suitable expressions. [8]
   b) Explain about Mechanical splices with a neat diagrams. [8]

5. a) Explain about lensing schemes for coupling efficiency improvement. [8]
   b) An optical source has a circular emitting area of radius 25 μm and an associated lambertian emission pattern. Determine B_0 if the amount of power coupled from this source in to a graded index fiber with core radius as 20 μm and a parabolic index profile as 0.735. Take n_1 and n_2 as 1.45 and 1.435 respectively. [8]

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6. a) Derive an equation for SNR at the input of an optical receiver and discuss. [10]
   b) Discuss the temperature effect on Avalanche gain. [6]

7. a) Discuss power budget Analysis with an example. [8]
   b) Write short notes on "Overall fiber dispersion in multimode fibers". [8]

8. a) What is the necessity of WDM? How it is different from FDM? Explain. [8]
   b) Write short notes on "Measurement of Dispersion using Frequency domain measurement technique. [8]

Code No: K0421 **R07** **Set No. 2**

IV B.Tech. II Semester Regular Examinations, April, 2011
OPTICAL COMMUNICATIONS
(Electronics & Communication Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions
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****

1. a) Explain the following in brief
   i) Total internal reflection
   ii) Numerical Aperture
   iii) V – number
   iv) Skew Rays [8]
   b) Calculate the number of modes at 820 nm in a graded index fiber having a parabolic index profile 1.90, of a 25 μ meters core radius, $n_1 = 1.48$ and $n_2 = 1.46$. How does it compare to a step index fiber? [8]

2. a) Discuss briefly about radioactive losses in the optical fiber. [8]
   b) Explain effective Refractive index in detail with necessary mathematical expressions. [8]

3. a) For a fiber material dispersion parameter is 58.8 ps/nm/km. The relative spectral width $\delta\lambda/\lambda$ of the source is 0.0015 at the wave length of 820nm. Calculate the RMS pulse broadening per km. [8]
   b) Explain Biconical ferrule connectors with a neat diagram. [8]

4. a) Draw the schematic of Edge emitting double hetero junction LED and explain its working in detail. [8]
   b) A 10 μ m core diameter single mode step index fiber has a normalized frequency of 2.0. A fusion splice at a point along its length exhibits an insertion loss of 0.15dB. Assume only lateral misalignment contributes to the splice insertion loss, estimate the magnitude of lateral misalignment. [8]

5. a) Explain about LED coupling to single mode fibers. [8]
   b) A GaAs optical source with a refractive index of 3.6 is coupled to a silica fiber that has a refractive index of 1.48. If the fiber end and the source are in close physical contact, find the Fresnel reflection at the interface and power loss in dB. [8]

6. a) Explain the principle of operation of PIN photodiode with a neat diagram. [8]
   b) Draw the block diagram of an optical receiver and explain its operation. [8]

7. a) Calculate the rise time limit for the optical fiber system working at 1.3 μm wavelength and 1Gbls bit rate over a single mode fiber with a link length of 50 km. The rise times of the transmitter and receiver are 0.25ns and 0.35ns respectively. The source spectral width is 3nm and the dispersion parameter is 2ps/(km-nm). [8]
   b) Discuss the point to point optical link and its characteristics. [8]

8. Write short notes on
   a) Measurement of "Attenuation using cut back method'' . [8]
   b) Line coding. [8]

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OPTICAL COMMUNICATIONS
(Electronics & Communication Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. a) Compare the step index fiber and graded index fibers with a neat diagram. [8]
   b) A single mode step index fiber has a core diameter of 7 µm and core refractive index of 1.49. Estimate the shortest wavelength of light which allows single mode operation when the relative refractive index difference for the fiber is 1%.

2. a) What is absorption in optical fiber? Explain in brief the different types of mechanism of absorption in the fiber? [8]
   b) Determine the cut off wave length for a single mode optical fiber of 5µ meters core radius having a core refractive index of 1.450. Take Δ= 0.002. [8]

3. a) A butt jointed fiber connection used on a multimode step index fiber with a core refractive index of 1.42 and a relative refractive index difference of 1% has an angular misalignment of $9^{o.}$ There is no longitudinal or lateral misalignment but there is no a small air gap between the fibers in the connection. Estimate the insertion loss of the connector. [8]
   b) Distinguish between material dispersion and wave guide dispersion. [8]

4. a) Discuss the advantages and disadvantages of the fusion splicing and adhesive splicing. [8]
   b) Define the following with respect to LED
      i) Internal Quantum efficiency
      ii) Modulation capability.
      iii) Power band width product [8]

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5. a) Explain about coupling losses from the light source to the fiber. [8]
   b) Explain about lensing schemes for coupling efficiency improvement. [8]

6. a) Draw a simple model of a photo detection receiver and its equivalent circuit. [6]
   b) Compare digital and Analog receivers. [10]

7. a) Discuss the system considerations of optical fiber link. [8]
   b) Write short notes on "Rise time budget Analysis". [8]

8. Write short notes on
   a) Bidirectional WDM [8]
   b) Measurement of Attenuation [8]

Code No: K0421 **R07** **Set No.4**

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OPTICAL COMMUNICATIONS
(Electronics & Communication Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
****

1. a) Briefly explain historical development of optical fiber communications. [8]
   b) Prove that the total number of modes entering the step index fiber is $M = V^2/2$. [8]

2. a) Explain the following [8]
      i) Cut off wave length
      ii) Mode field diameter.
   b) Explain about Rayleigh scattering and Mie scattering [8]

3. a) A single mode fiber operating at the wavelength of 1.3 μ meter is found to have a total material dispersion of 2.81ns and a total waveguide dispersion of 0.495 ns. Determine the received pulse width and approximate bit rate of the fiber if the transmitted pulse has a width of 0.6 ns. [8]
   b) Explain about connector return losses. [8]

4. a) A mechanical splice in a multimode step index fiber has a lateral offset of 16% of the fiber core radius. The fiber core has a refractive index of 1.49 and an index matching fluid with a refractive index of 1.45 is inserted in the splice between the butt Jointed fiber ends. Assuming the longitudinal or angular misalignment, estimate the insertion loss of the splice. [8]
   b) Discuss the reliability of double hetero junction Laser diode and explain how to improve the reliability of the system. [8]

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5. a) Explain about Laser diode to fiber coupling [8]
   b) Write short notes on " Equilibrium Numerical Aperture". [8]

6. a) Explain the principle of operation of an Avalanche photo diode. [8]
   b) Derive an expression for receiver sensitivity. [8]

7. a) Calculate the maximum bit rate that may be achieved on the fiber link length of 50km without repeater and using NRZ format. Transmitter rise time = 4ns, Intermodal rise time = 5ns $km^{-1.}$ Intermodal rise time =1ns km^{-1} and Receiver rise time =2ns. [8]
   b) Discuss the system considerations of optical fiber link. [8]

8. Write short notes on
   a) Dispersion measurement [8]
   b) Unidirectional WDM [8]