Code No: RR410404 **Set No.1**

IV B.Tech. I Semester Regular Examinations, November -2005
OPTICAL COMMUNICATION
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) List out the advantages and disadvantages of optical fiber communication. [5+3]
   (b) Distinguish between optical fiber communication system and conventional communication system. [4+4]
2. (a) Describe the sample characteristics of PMMA and PFP polymer optical fiber
   (b) Give a brief note on plastic optical fibers. [8+8]
3. (a) Two step index fibers one of which is of mono mode type and the other one in the multimode type have the following parameters:
   The mono mode fiber has a core diameter of 8μm and core refractive index of 1.5.
   The relative refractive index difference between the core and cladding is 0.3%
   The operating wavelength is 1.55μm . Calculate the critical radius of curvature at which bending losses occur in the fiber
   (b) With the help of relevant expressions explain material dispersion and waveguide dispersion. [8+8]
4. (a) Draw the schematic of edge emitting double hetro junction LED and explain its working in detail. [3+5]
   (b) If the radiative and non radiative recombination lifetimes of the minority carriers in the active region of an LED are 25ns and 100ns, respectively, find the internal quantum efficiency and the bulk recombination lifetime in the absence of self absorption and recombination at the heterojuntion. [4+4]
5. (a) Describe the different modes available in the laser diode and derive the condition for reaching the lasing threshold optical gain. [5+4]
   (b) A GaAs laser emitting at 800nm has a 400μm long cavity with a refractive index n=3.6. If the gain g exceeds the total loss α_t throughout the range 750nm$< \lambda <$850nm, how many modes will exist in the laser? Also find the frequency separation of the modes. [4+3]
6. (a) What are the requirements of an optical receiver? Using a flow chart explain the receiver design. [4+4]
   (b) Derive an expression for receiver sensitivity. [8]

7. (a) What are the underlying principles of the WDM technique? What are its various advantages? How is it different from FDM technique? [5+3+2]

   (b) Discuss the effect of Rz and NRz coding on bit rate. [3+3]

8. (a) Explain about lensed connector ?

   (b) A fiber has a 50-μm core diameter and an 0.2NA value. The beam is expanded to a 2-mm diameter. Design the lens arrangement and compute the allowable lateral offset for a 0.5-dB loss. [8+8]

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Code No: RR410404 **Set No.2**

IV B.Tech. I Semester Regular Examinations, November -2005
OPTICAL COMMUNICATION
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Compare the advantages and disadvantages of guided optical communication lines with that of Microwave systems. [5+3]
   (b) What are the various elements of an optical communication system? Explain each element in brief. [2+6]
2. (a) Calculate the numerical aperture of a step index fiber having n_1=1.48 and n_2=1.46. What is the maximum entrance angle θ_0 maximum for this fiber of the outer medium is the air with n=1.00? [4+4]
   (b) Consider a dielectric slab having a thickness d=10mm and index of refraction n_1=1.50. Let the medium above and below the slab be air in which n_2=1. Let the wavelength λ be 10mm (equal to the thickness of the wave-guide). What is the critical angle for the slab waveguide? What happens to the number of angles? [4+4]
3. (a) Compare the optical parameters of free space with dispersive & non dispersive mediums. [4+4]
   (b) List the differences between intramodal & intermodal dispersions. [4+4]
4. (a) Write notes on broadening of pulse in the fiber dispersion.
   (b) For a fiber material dispersion parameter is 58.8 ps/nm/km.The relative spectral widthδ_λ/λ of the source is 0.0012 at the wavelength of 850nm.Calculate the R.M.S. pulse broadening per km. [8+8]
5. (a) Explain the detection process in the Avalanche photo diode and compare this device with the P-I-N photodiode [5+4]
   (b) An APD has a quantum efficiency of 45% at 0.85μm. When illuminated with radiation of this wavelength it provides an output photocurrent of 10μA after avalanche gain with a multiplication factor of 250. Calculate the received optical power to the device. How many photons per second does this correspond to? [4+3]
6. (a) What are the requirements of an optical receiver? Using a flow chart explain the receiver design. [4+4]
   (b) Derive an expression for receiver sensitivity. [8]
7. (a) Describe with diagram to explain the operation of a unidirectional WDM system.

(b) Discuss about a bidirectional WDM system. [8+8]

8. (a) Explain intermodal and intramodal dispersion. [4+4]

(b) Compare and contrast the measurement of dispersion using time domain and frequency domain measurement technique [4+4]

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Code No: RR410404 **Set No.3**

IV B.Tech. I Semester Regular Examinations, November -2005
OPTICAL COMMUNICATION
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Give the block diagram of a digital optical fiber communication system and explain the functions of each block. [4+6]
   (b) With respect to band width explain how optical fibers are advantageous over coaxial cables. [6]
2. (a) Explain in detail elliptical and circular propagation of light. [8]
   (b) Describe the quantum nature of light. Explain basic optical laws in detail with relevant mathematical expressions. [3+5]
3. (a) What are the three important mechanisms that are responsible for absorption losses in signal through an optical fiber? Explain in brief the curve for wavelength versus attenuation for different ranges of the signal. [3+4]
   (b) Explain in detail about the Ultraviolet absorption, Infrared absorption and Ion-resonance absorption losses in the pure and doped SiO_2 at various wavelengths [3+3+3]
4. (a) Write notes on broadening of pulse in the fiber dispersion.
   (b) For a fiber material dispersion parameter is 58.8 ps/nm/km.The relative spectral widthδ_λ/λ of the source is 0.0012 at the wavelength of 850nm.Calculate the R.M.S. pulse broadening per km. [8+8]
5. (a) Draw the following characteristics of the photodiode device.
      i. Current Vs Reverse voltage
      ii. Optical power Vs Photocurrent [3+3]
   (b) Draw the curve of a light absorption co-efficient as a function of wavelength for Si, Ge, GaAs and give comment on it. [6]
   (c) Photons of energy 1.53 x 10^{-19}J are incident on a photo diode which has a responsivity of 0.65A/W. If the optical power level is 10μW, Find the photo current generated in the output of the device. [4]
6. (a) Discuss noise and bandwidth considerations for the cases of trans-impedance and high impedance receivers. Comment on their merits and demerits.[4+4+2+2]
   (b) Define BER? What is its significance? [2+2]
7. (a) Discuss about the Point to Point Fiber Optic Link and its characteristics with an example? [5+3]

(b) Explain about the frequency chirping and its effects. [5+3]

8. (a) Explain about an optical attenuation meter? [8]

(b) i. Convert the optical signal powers of 5mw and 20μw to dBm.

ii. Convert optical signal powers of 0.3mw and 80ηw to dBμ. [4+4]

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Code No: RR410404 **Set No.4**

IV B.Tech. I Semester Regular Examinations, November -2005
OPTICAL COMMUNICATION
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) List out the advantages and disadvantages of optical fiber communication. [5+3]
   (b) Distinguish between optical fiber communication system and conventional communication system. [4+4]
2. (a) Calculate the numerical aperture of a step index fiber having n_1=1.48 and n_2=1.46. What is the maximum entrance angle θ_0 maximum for this fiber of the outer medium is the air with n=1.00? [4+4]
   (b) Consider a dielectric slab having a thickness d=10mm and index of refraction n_1=1.50. Let the medium above and below the slab be air in which n_2=1. Let the wavelength λ be 10mm (equal to the thickness of the wave-guide). What is the critical angle for the slab waveguide? What happens to the number of angles? [4+4]
3. (a) Explain the bending losses in the optical fiber.
   (b) What is micro bending and how can it be reduced?
   (c) Explain with diagram how the microbending is minimized and avoided by a compressible jacket. [8+5+3]
4. (a) Write notes on broadening of pulse in the fiber dispersion.
   (b) For a fiber material dispersion parameter is 58.8 ps/nm/km.The relative spectral widthδ_λ/λ of the source is 0.0012 at the wavelength of 850nm.Calculate the R.M.S. pulse broadening per km. [8+8]
5. (a) Obtain lasing threshold condition and from which find the amplitude of modes, resonant frequencies, frequency and wavelength spacing between two consecutive modes. [2+8]
   (b) A Gas injection laser has an optical cavity of length 250μm. At normal operating temperature the gain factor is 2l x $10^{-3}Acm^{-3}$ and the loss coefficient/cm is 10. Determine the threshold current density and hence the threshold current for the device. It maybe assumed that the cleaved mirrors are uncoated and that the current is restricted to the optical cavity. The refractive index of GaAs may be taken as 3.6. [3+3]
6. (a) Discuss noise and bandwidth considerations for the cases of trans-impedance and high impedance receivers. Comment on their merits and demerits.[4+4+2+2]

(b) Define BER? What is its significance? [2+2]

7. (a) Describe with diagram to explain the operation of a unidirectional WDM system.

   (b) Discuss about a bidirectional WDM system. [8+8]

8. (a) Discuss with the aid of suitable diagram the measurement of dispersion in optical fibers using frequency domain measurement technique with pulsed laser source. [3+5]

   (b) Describe what is meant by equilibrium mode distribution and cladding mode stripping with regard to transmission measurements in optical fibers. [4+4]

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