Code :R7420401 **1**

IV B.Tech II Semester(R07) 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) Compare the differences between conventional communication system and optical communication system?
   (b) The core of an optical fiber is made of glass of refractive index 1.55 and in clad with another glass of refractive index 1.0 determine
      i. Numerical aperture
      ii. Acceptance angle
      iii. Critical angle
2. (a) Derive the relation between the effective refractive index and normalized propagation constant
   (b) Optical power of 5 mw coupled into optical fiber reduces to 3.8 mw after propagation through a distance of 10 km. Determine the attenuation coefficient of this fiber in db/km. Determine the power to be coupled into this is 100 μw of power is to be available at a distance of 85km.
3. (a) A GA/AS laser diode has a 600 km cavity length has an effective absorption coefficient of 15^{-1} cm for coated facts, the refractiveness are 0.30 at each end. What is the optical gain at the laser threshold?
   (b) If one end of the laser is coated with a dielectric reflector so that its reflectivity is now 80%. What is the optical gain at the laser threshold.
   (c) If the internal quantum efficiency is 0.6, what is external quantum efficiency in case (a) & (b).
4. Discuss the magnitude of different dispersion in various fibers and also explain how does this dispersion vary with a different operating wavelengths for the fiber in detail.
5. (a) Determine the expressions for the power flow through core and cladding of a step index fiber.
   (b) Calculate the required Δ if a fiber with 8μm core and 125μm cladding is to be a single mode at 1300nm. The core refractive index is 1.5.
6. (a) What is lasing condition.
   (b) Explain the resonating modes of a semiconductors injection laser diode.
7. (a) Write a note on the losses encountered while coupling optical power from an optical fibers into a fiber optic receiver?
   (b) With neat sketches, explain the principle of operation of an avalanche photo diode?
8. (a) What is the importance of power budget analysis and rise time budget analysis in the design of a fiber optic link?
   (b) Write a note on various multiplexing techniques suitable in fiber optic links.

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Code :R7420401 **2**

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

Answer any FIVE questions
All questions carry equal marks

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1. (a) Explain step index fiber structures in detail.
   (b) The core of an optical fiber is made of glass another glass of refractive index 1.55 and clad with another glass of refractive index 1.0. Determine
      i. Numerical Aperture
      ii. Acceptance angle
      iii. Critical angle
2. (a) Explain about "Chalgenide" glass fibers.
   (b) Commonly available single mode fibers have beat lengths in the range 10 cm <LP<2m. what range of refractive index differences does this correspond to for λ=1300nm.
3. Derive the expression for relationship between material dispersion and wavelength of the optical fiber with suitable examples.
4. (a) A laser diode has maximum average output of 1 mw(0dbm). The laser is to be amplitude modulated with a signal x(t) has a D.C component of 0.5 and a periodic component of ± 2.6. if the current input to the optical output relationship is P(t)=$\frac{i(t)}{25}$, find the values of IO and m,if the modulating current is i(t)=IO[(1+mx(t)]
   (b) Obtain the expression for the 3db modulation band width of LED and discuss the importance of radiative recombination life time.
5. Explain the following:
   (a) Receiver sensitivity and S/N ration in a digital fiber optic link.
   (b) Operation and performance of an analog fiber optic receiver.
6. (a) Write expression for power coupled into a step index fiber from an LED source.
   (b) Write about the operation of a quantum laser diode.
7. (a) Describe briefly various multiplexing techniques.
   (b) What are the types of dispersion contributing significantly to overall system rise time in case of single mode fiber? List them.
8. (a) List the conditions under which cut back method of measurement of fiber attenuation yields more accurate values?
   (b) Suggest a non destructive method for measurement of fiber attenuation. Mention the principle behind this method?
   (c) Output of a PIN detector preamplifier of an optical receiver for 1.6 km fiber is 2.26 volts at 820 nm wavelength. The output of PIN amplifier increases to 9.06 volts when this fiber is cut back to 4m length at the same wavelength. Compute the total attenuation and attenuation per unit length (db/km) for the cut-off fiber.

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Code :R7420401 **3**

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

Answer any FIVE questions
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1. (a) Distinguish between step index and graded index fibers?
   (b) Write a note in various modes of propagation in optical fibers?
2. Explain the mechanisms responsible for signal distortion in optical fibers.
3. (a) Explain the following terms:
      i. cut off wave length
      ii. mode field diameters
      iii. effective refractive index
      iv. modal birefringence
   (b) Discuss the requirements for the materials used in the manufacture of optical fibers.
4. (a) Discuss the requirements for the design of good connectors?
   (b) Discuss on cylindrical fersule connector double eccentric connector and biconical ferrule connects.
5. (a) What are the requirements of an optical source to be used in optical communication systems.
   (b) With neat diagram explain an edge emitting LED.
6. Explain the following:
   (a) Equilibrium numerical aperture and power coupling from an LED
   (b) Radiation patterns of a lambastian source with necessary equation.
7. (a) Explain material dispersion? Derive an expression for the relationship between material dispersion and wavelength of the optical fiber.
   (b) A step index multimode fiber has a core of refractive index of 1.5 and a cladding refractive index of 1.49 determine.
      i. The intermodal dispersion factor for the fiber.
      ii. Total dispersion in a 20 km length fiber.
8. (a) Describe the procedure to carry out the rise time budget analysis of a fiber optic link.
   (b) Write a note on various multiplexing techniques suitable in fiber optic links.

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Code :R7420401 4

IV B.Tech II Semester(R07) Regular Examinations, April 2011
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Time: 3 hours **Max Marks: 80**

Answer any FIVE questions
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1. (a) List out the advantages and disadvantages of optical fiber communication.
   (b) Discuss the analog and digital applications of optical fiber.
2. (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 micro bending is minimized and avoided by a compressible jacket.
3. Explain the modulation capability of the laser diode and its temperature effects how to compensate for variations in temperature.
4. (a) Discuss the dependence of equilibrium NA on power coupling from a source into a fiber
   (b) Estimate the losses encountered while coupling power from a source to a fiber due to mismatch in their numerical apertures and surface aseas.
5. Write short notes on the following:
   (a) Radiation patterns of a Lambertian source with necessary equations.
   (b) Radiation from monochromatic source and power coupling into a fiber.
6. (a) Reason out if the two parameters 'Quantum efficiency and Responsively signify the same properties of a detector diode.
   (b) A pin diode is characterized by a quantum efficiency of 72% at a wavelength of 900 nm calculate
      i. Responsivity of the PIN diode at 900 nm
      ii. Received optical power if the mean photo current is 10 mA at 900 nm
      iii. Number of received photons for 1 mA mean photogenerated current.
7. (a) Describe a method to carry out rise time budget analysis for a fiber optic link.
   (b) Explain the procedure to determine the maximum allowable RZ and NRZ data rates from rise time budget analysis.
   (c) Explain the effect of mode mixing factor on modal dispersion induced rise time.
8. Write brief notes on the following:
   (a) Measurement of dispersion in single mode optical fiber
   (b) Requirement and merits of line coding in optical communication system.

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