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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGG

Sem /Year: VII/IV(2013 REGULATION)

Subj. Code/Title: EC6702/Optical Communication & Networking

UNIT-1 (INTRODUCTION)

PART A

1. State Snell's law(Nov -2008)
2. Give refractive index expression for step index fiber (Nov -2008)
3. Give the refractive index expression of a graded index fiber.(Apr-2009)
4. Define Numerical Aperture of a step index fiber.(Apr-2009)
5. What are the major elements of an optical transmission link?(Nov-2009)
6. What are the two principal photo detectors used in a fiber-optic link?(Nov-2009)
7. What's meant by refractive index of a material?(Apr-2010)
8. What are all the advantages offered by multimode fibers than single mode fibers?(Apr-2010)
9. What do you mean by ray congruence?(Nov-2010)
10. What is tunnel effect?(Nov-2010)
11. What are the advantages and disadvantages of the ray optics theory? (Nov-2011)
12. What is a linearly polarised mode ? (Nov.-2011)

PART B

1. (i)What is Numerical Aperture of an optical Fiber? Deduce an expression for the same. (Nov -2008)
(ii)Calculate NA of silica fiber with its core refractive index of 1.48 and Cladding refractive index of 1.46. What should be the new value of n_1 in order to change the NA to 0.23?
2. (i) A graded index fiber has a core with a parabolic refractive index profile which has a diameter of $50\mu\text{m}$. The fiber has a numerical aperture of 0.2. Estimate the number of guided modes propagating in the fiber when it is operating at a Wavelength of $1\mu\text{m}$. (Nov -2008)
(ii)Explain briefly Phase and Group Velocities.

3. (i) Explain the phenomenon of total internal reflection using Snell's law with figures and calculations. (Apr-2009)
(ii) Distinguish Step-index from graded index fibers.
4. (i) Calculate the diameter of the fiber core of relative refractive index difference is 10%, core refractive index $n_1 = 1.5$, No. of modes propagation is 1100 and wavelength of operation is $1.3 \mu\text{m}$. (Apr-2009)
(ii) Determine the cut off wavelength for a step index fiber to exhibit single mode operation, when the core refractive index and radius are 1.46 and $4.5 \mu\text{m}$ respectively with the relative index difference being 0.25% .
5. Draw the block diagram of a fiber optic communications system and describe function of each component. (Nov-2009)
6. (i) Derive the mode equation for a circular fiber using Maxwell's equations.
(ii) With diagram explain Electromagnetic mode theory of optical propagation (Nov-2009)
7. (i) Describe single mode fibers and their modes-field diameter. What are the propagation modes in them? (Apr-2010)
(ii) Consider a fiber with diameter $8\mu\text{m}$, n_1 and $\Delta = 0.92\%$. If this fiber is operated at 1550 nm , how many modes will it have?
8. (i) Define the normalized frequency for an optical fiber and explain its use
(ii) Discuss on the transmission of light through graded index fiber. (Apr-2010)
9. Explain the features of multimode and single mode step index fiber and compare them. (Nov-2010)
10. (i) Draw and explain ray theory transmission in an optical communication.
(ii) With diagram explain acceptance angle numerical aperture and total internal reflection. (Nov-2010)

UNIT-II-TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS

PART A

1. What does signal attenuation determine? (Nov-2008)
2. What's the effect of dispersion in an optical fiber? (Nov-2008)
3. Define signal attenuation. (Nov-2009)
4. How is absorption caused in a fiber? (Nov-2009)
5. What are atomic defects? (Apr-2010)
6. How does intrinsic absorption occur? (Nov -2008)

7. What's Dubach's rule?(**Apr-2010**)
8. Identify the causes of scattering loss. (**Apr-2009**)
9. What are micro bends? How are they caused in the fiber? (**Nov -2008**)
10. How can you minimize micro bending losses? (**Apr-2009**)

PART B

1. (i) What is signal attenuation in an optical fiber? What is the unit of attenuation? (**Nov-2008**)
(ii) With the help of suitable diagrams, explain in detail basic attenuation loss mechanisms. (**Nov -2008**)
2. (i) What do you mean by Dispersion?(**Nov-2013**)
(ii) Explain in detail chromatic dispersion in single mode fibers.
3. **Clearly bring out the differences between intra and inter modal Dispersion with necessary diagrams. (Nov-2009)**
4. Discuss the attenuation encountered in optical fiber communication due to: Bending, Scattering, Absorption (**Apr-2009**)
5. (i) **What is meant by Fiber Splicing? Explain the different types of Splicing Technique (Nov -2008)**
(ii) Explain the different types of Fiber Connector in details.
6. **Describe linear scattering losses in optical fibers with regard to (i) Rayleigh Scattering (ii) Mie scattering. (Nov-2009)**
7. Explain stimulated Brillouin and Raman scattering in optical fibers and indicate the Ways in which they can be avoided in optical fiber communication.(**Apr-2010**)
8. (i) **Derive expression for material dispersion and waveguide dispersion and explain them.(Apr-2010)**
(ii) **Describe various fiber connectors and couplers. (Apr-2009)**
9. (i) What is meant by critical bending radius of optical fibers? Explain (**Apr-2011**)
(ii) Explain the following in single mode fiber: Modal birefringence and beat length.
10. (i) Describe the three types of fiber misalignment that contribute to insertion loss at an optical fiber joint.(**Apr-2009**)
(ii) Outline the major categories of multiport fiber optic coupler.

UNIT III-SOURCES AND DETECTORS

PART A

1. Mention any four required properties of light sources used in the Optical communication.(Nov-2008)
2. What are the laser light properties? How are they produced?(Nov-2008)
3. What is meant by threshold condition for laser oscillation? (Nov-2009)
4. What are direct band gap and indirect band semiconductors? (Nov -2008)
5. Mention the important semiconductors used in laser and LED's. (Nov -2008)
6. What are the drawbacks of homo-junction laser diode? (Nov-2009)
7. Define internal quantum efficiency of a LED.(Apr-2010)
8. Why do we prefer laser diodes over LED's for communication applications?(Apr-2009)
9. Mention any four factors which affect the power launched into the fiber.(Apr-2009)
10. What are the different noises present in the avalanche photodiode?(Apr-2010)

PART B

1. (i) What are direct band gap and indirect band, gap semiconductors?(Nov-2008)
2. (ii) Describe the operation of LED?
3. **Explain surface emitting LED (SLED) and an edge emitting LED (ELED) in detail.(Nov-2008)**
4. Discuss coupled cavity semiconductor lasers and tunable semiconductor Lasers.(Apr-2010)
5. **Briefly explain the different noise sources of a photo detector.(Apr-2009)**
6. **Explain the structure and working of a silicon PIN and Avalanche photo diode.(Apr-2011)**
7. What do you understand by optical wave confinement and current confinement in LASER diode? Explain with suitable structures.(Apr-2009)
8. A double hetro junction In Ga ASP LED emitting as a peal wavelength of 1310 nm has radiative and non-radiative recombination times of 25r and 90 ns respectively.
9. The derive current is 3.5 m A. (Nov-2009)
10. (i) Find the internal quantum efficiency and internal power level. (Nov-2009)
(ii) If the refractive index of the light source material is $n = 3.5$. Find the power emitted from the device.
11. (i)**Describe the operation of a injection laser. (Apr-2010)**
(ii)Compare the optical sources LED and ILD.

12. (i) What are the possible noise sources that contribute the photo detector noise?(Apr-2011)
- (ii) What is meant by detector response time? Explain.

UNIT IV FIBER OPTICAL RECEIVER AND MEASUREMENTS

PART A

1. What are the requirements of an optical receiver? (Nov-2008)
2. What are the requirements for a preamplifier?(Nov-2008)
3. Why do we prefer trans-impedance preamplifier rather than high Impedance preamplifier? (Nov-2011)
4. What are the main advantages of InGaAs photodiodes(Apr-2011)
5. What are the various error sources in the optical receiver?(Apr-2010)
6. Define probability of error. Write an expression for it.(Nov-2011)
7. Define quantum limit. (APR-2011)
8. Define BER.(Nov-2009)
9. What are the advantages of preamplifier?(Apr-2010)
10. What is Inter symbol Interference?(Nov-2009)

PART B

1. Explain the different types of Preamplifiers used in a receiver.(Nov-2008)
2. Define the term Quantum limit and derive a suitable expression for Probability of Error with respect to receiver.(Nov-2008)
3. Explain the various methods used for Fiber attenuation measurements.(Apr-2009)
4. Explain the Time domain Measurement method for fiber dispersion measurements With relevant expressions.(Apr-2009)
5. Explain the Frequency domain Measurement method for fiber dispersion Measurements with relevant expressions.(Nov-2009)
6. Explain the measurement technique used in the case of
 - (i) Numerical aperture (Apr-2010)
 - (ii) Refractive index profile
7. Explain the measurement technique used in the case of
 - (i) Fiber cut-off wave length (Apr-2010)
 - (ii) Fiber diameter.
8. Discuss in detail about (a) Interferometric methods (b) Near field scanning method (c) Refracted near field method. (Nov-2009)

9. Discuss the measurement of fiber scattering loss by describing the use of two common scattering cells. (Apr-2011)
10. Draw the block diagram of fundamental optical receiver. Explain each block. (Apr-2011)

UNIT V- OPTICAL NETWORKS

PART A

1. What are solitons and give its significance? (Nov-2008)
2. What are repeaters?(Nov-2008)
3. What is frequency chirping?(Apr-2009)
4. Why do we use NRZ coding scheme generally?(April-2011)
5. Explain the principle of operation of fiber amplifier(April-2009)
6. List out the benefits of SONET and PDH?(Apr-2011)
7. What is SDH?(Nov-2009)
8. State the concept of WDM. (Apr-2010)
9. Distinguish fundamental and higher order solitons. (Nov-2009)
10. What is EDFA?(APR-2010)

PART- B

1. Explain the SONET frame structures and SONET rings with neat diagrams.(Nov-2008)
2. Write short notes on SDH networks.(Apr-2009)
3. Explain the EDFA configuration in detail.(Nov-2009)
4. Describe Non linear optical effects in detail.(Nov-2009)
5. Write notes on Solitons. (Nov-2008)
6. Explain the following requirements for the design of an optically amplified WDM link.(Apr-2010)
 - a. Amplified WDM link.(Apr-2010)
 - b. (i)Link Band width. (ii)Optical power requirements for a specific BER.
7. Write short notes on(Apr-2010)
 - a. Wavelength routed networks
 - b. Optical CDMA
8. Explain the SA/SA protocol and modified S/SA protocol of Broadcast and select networks.(Apr-2009)
9. Write detail notes on CDMA and its applications.(Apr-2010)
10. Discuss the following(Apr-2010)
 - a. WDM networks
 - b. Ultra high capacity networks.