CBCS SCHEME

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15EC82

Eighth Semester B.E. Degree Examination, July/August 2021
Fiber Optics and Networks

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. Explain with a neat diagram an optical fiber communication system. **(06 Marks)**
b. Derive an equation for numerical aperture for a step index fiber using Snell's law. **(07 Marks)**
c. A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and cladding refractive index of 1.47. Determine:
i) Critical angle at the core – cladding interface
ii) The numerical aperture for the fiber
iii) The acceptance angle in air for the fiber. **(03 Marks)**

2 a. Discuss the advantages of optical fiber communication. **(05 Marks)**
b. Explain photonic crystal fibers. **(07 Marks)**
c. A graded index fiber has core with a parabolic refractive index profile which has a diameter of 50μm. The fiber has a numerical aperture of 0.2 estimate the total number of guided modes propagating in the fiber when it is operating at a wave length of 1μm. **(04 Marks)**

3 a. Explain intrinsic and extrinsic absorption losses. **(06 Marks)**
b. Explain fiber bending losses with the help of neat diagrams. **(06 Marks)**
c. When the mean optical power launched into an 8km length of fiber is 120μw, the mean optical power at the fiber output is 3μw. Determine :
i) The overall signal attenuation or loss in the decibels through the fiber assuming there are no connectors or splices.
ii) The signal attenuation per kilometer for the fiber
iii) The overall signal attenuation for a 10km optical link using the same fiber with splices at 1km intervals, each giving an attenuation of 1dB
iv) The numerical input/output power ration in (iii). **(04 Marks)**

4 a. Derive an expression for r.m.s pulse broadening due to intermodal dispersion in a step index fiber. **(06 Marks)**
b. Explain three types fiber splicing techniques with neat diagrams. **(06 Marks)**
c. An optical fiber has a core refractive index of 1.5. Two lengths of the fiber with smooth and perpendicular (to the core axis) end faces are butted together. Assuming the fiber axis are perfectly aligned, calculate the optical loss in decibels at the joint (due to Fresnel reflection) when there is a small air gap between the fiber end faces. **(04 Marks)**

5 a. With neat sketch, explain GaAs homo-injection LASER Fabry – Perot cavity. **(06 Marks)**
b. Derive an expression for quantum efficiency and LED power. **(06 Marks)**
c. Discuss the operation of PIN photodetector with appropriate diagrams. **(04 Marks)**

6 a. With a neat schematic diagram, explain the working of an optical receiver. **(06 Marks)**
b. Explain the different types of front end amplifiers in an optical receiver. **(06 Marks)**
c. A double – heterojunction In GaAsP LED emitting at a peak wavelength of 1310nm has radiative and nonradiative recombination times of 30 and 100ns, respectively. The drive current is 40mA. Calculate : i) bwk recombination lifetime ii) internal quantum efficiency iii) internal power. **(04 Marks)**

7 a. With the help of neat diagram, explain the operation of WDM (Wavelength Division Multiplexing). **(08 Marks)**
b. Derive an equation for path difference in a 2×2 Mach – Zehnder interferometer. **(08 Marks)**

8 a. Explain the operation of polarization independent isolator. **(06 Marks)**
b. Explain the three possible configurations of an EDFA (Erbium doped Fiber amplifiers). **(10 Marks)**

9 a. Briefly discuss the evolution of optical networks indicate the significant features of the optical network generations. **(06 Marks)**
b. Describe the concept of OXC (Optical Cross Connect) and a ROADM (Reconfigurable optical add/drop multiplexer) outline how they are utilized in the development of large scale wavelength division multiplexed networks. **(06 Marks)**
c. Define what is ATM(Asynchronous Transmission Mode) and its application in optical networks. **(04 Marks)**

10 a. Describe the purpose and the layered structure of Open System Interconnection (OSI) reference model. **(08 Marks)**
b. Outline the main features of the optical transport network and describe its hierarchy as specified by ITU-T. **(08 Marks)**

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