USN

Time: 3 hrs.

Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Outline any light advantages of optical fibers over copper wires or coaxial cables that are used in communication links as transmission media. **(08 Marks)**

   b. Define Numerical Aperture (NA) and what is its significance. With an optical ray diagram and by derivation relate NA and core-cladding refractive indices as well as NA and relative refractive index Δ. **(08 Marks)**

   c. With a simple block diagram, briefly explain the digital optical communication link that employs optical fiber. **(04 Marks)**

OR

2 a. Discuss the refractive index profile and ray transmission in multimode step index and single mode step index fiber. What are advantages and drawbacks of single mode and multimode step index fiber? **(10 Marks)**

   b. In a multimode step-index fiber with a 62.5µm core diameter and a core-cladding index difference of 1.5 percent. If the core refractive index is 1.480, estimate the normalized frequency of the fiber and the total number of modes supported in the fiber at a wavelength of 850nm. **(06 Marks)**

   c. What are the photon energies with 850nm and 1550nm wavelength? **(04 Marks)**

Module-2

3 a. The mean optical power launched into a fiber of length 8kms is 120 µW and the mean optical power at the fiber output end is 3 µW. Find :
   i)   The overall signal attenuation in dB without any connectors or splices.
   ii) The signal attenuation per kilometer for the fiber
   iii) The overall signal attenuation for a 10 km optical link using the same type of fiber with splices at 1 km intervals, each giving an attenuation of 1dB. **(06 Marks)**

   b. Explain the phenomena of : i) material absorption and ii) linear scattering in optical fibers that lead to losses of optical signals. **(10 Marks)**

   c. With a neat diagram, explain the technique of fusion splice for optical fibers. **(04 Marks)**

OR

4 a. Discuss the Intramodal dispersion. **(08 Marks)**

   b. When mean optical power launched in to 8km length of fiber is 12µw, the mean optical power at the output is 3µm. Determine: i) Overall signal attenuation in dB ; ii) The overall signal attenuation for 10km, optical link using the same fiber with splices at 1km intervals, each giving attenuation of 1dB. **(08 Marks)**

   c. Write brief note on Fiber splices. **(04 Marks)**

Module-3

5 a. With a neat schematic explain the structure and features of a high radiance surface emitting LED. **(08 Marks)**

b. Explain briefly the three key photon transition processes involved in laser action. **(03 Marks)**

c. Show the derivation of the mathematical expression that estimates the amount of photon emissions per unit volume, starting from the two rate equations of laser diode. **(09 Marks)**

OR

6 a. Explain Fabry-Perot resonator cavity of laser with a neat diagram. **(10 Marks)**

b. Explain the following:
   i)   Spontaneous emission
   ii) Stimulated emission
   iii) Quantum efficiency. **(06 Marks)**

c. For an alloy $In_{0.74} + Ga_{0.26} \ As_{0.57} \ P_{0.43}$ used in LED find wavelength emitted by the source. **(04 Marks)**

Module-4

7 a. Explain the implementation of WDM networks with various types of optical amplifiers. **(10 Marks)**

b. Explain MZI multiplex with necessary equations. **(10 Marks)**

OR

8 a. Discuss the working of optical isolators and circulators. **(10 Marks)**

b. What are the general applications of optical amplifiers? **(06 Marks)**

c. What are S-matrices? **(04 Marks)**

Module-5

9 a. Discuss in detail about optical networking terminology. Mention the merits and demerits of each. **(10 Marks)**

b. Describe optical networking node elements with a neat diagram. **(10 Marks)**

OR

10 a. What are the four basic functions performed by an optical packet switch? Show the overall structural format of a typical packet used in the optical packet switched network and briefly explain. **(07 Marks)**

b. Show the structure of a metropolitan area network and explain. **(06 Marks)**

c. With a neat block diagram, briefly explain the generic Optical Label Switched (OLS) network configuration. **(07 Marks)**

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