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Roll No.							Total No. of Pages: 0
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B.Tech.(ECE) (Sem.-7,8) OPTICAL FIBER COMMUNICATIONS

Subject Code: EC-404 Paper ID: [A0329]

Time: 3 Hrs. Max. Marks: 60

INSTRUCTION TO CANDIDATES:

- 1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
- 2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
- 3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

SECTION-A

1. Write briefly:

- a) What are the transmission characteristics of various fibers?
- b) What do you mean by link power budget? What is power budget equation?
- c) What are the scattering losses in optical fiber? List.
- d) Describe the process by which light-emitting diodes produce light.
- e) Describe the spectral output of a gallium arsenide laser.
- f) Explain the two primary loss mechanisms in semiconductor lasers.
- g) Define extinction ratio as it applies to an electro-optic modulator.
- h) What does the term transparent window mean? Specify three peak wavelengths for transparent windows in modern optical fibers.
- i) Explain the propagation of light through fiber using Ray model.
- j) Why different modes travel with different speeds in a multimode fiber? Justify your answer.

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SECTION-B

- 2. a. Which of the following detectors would be the best choice for a single mode optical fiber communication system if the optical source is a DFB laser with an emission wavelength of $\lambda = 1.55 \mu m$? Explain your choice.
 - a) a silicon PIN photodiode
 - b) a silicon APD photodiode
 - c) an indium gallium arsenide PIN photodiode (3)
 - b. Write short notes on SONET and SDH. (2)
- 3. You are using a DFB laser as a source for a fiber system. You can choose between single-mode SI, single-mode GRIN, multi-mode SI, and multi-mode GRIN fibers. What is the best choice (assuming that the core diameters and the Δns are the same for the single-mode fibers, and the core diameters and the Δns of the multi-mode fibers are the same)? Briefly explain your choice.
- 4. List various fiber non-linearties. Explain how they degrade the performance of an optical communication system or Network. What is the permissible BER in case of ordinary optical communications and WDM networks? (5)
- 5. Approximately how many modes will an optical fiber with a core diameter of $100 \mu m$ and a cladding diameter of $250 \mu m$ support if the core index is 1.5 and the clad index is 1.48? Assume that the radiation propagating in the fiber has a free space wavelength of $0.98 \mu m$.
- 6. Describe the construction of APD and list the various characteristics of APD. (5)

SECTION-C

- 7. a. A SI fiber has core refractive index of $n_1 = 1.655$, and a cladding index of $n_2 = 1.650$. The normalized frequency V is 2.1 if the source wavelength is $\lambda = 1.55 \,\mu\text{m}$. (5)
 - a) What is the core radius of this fiber?
 - b) What is the numerical aperture (NA) of this fiber?
 - c) What is the spot-size of this fiber?
 - d) How many modes can propagate in this fiber? Briefly explain your answers.
 - b. What are the major methods of fiber preforms? Explain any one in detail. (5)

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- 8. a. Write short note on optical modulators and their applications. What is the impact of chirping on modulator performance? (4)
 - b. What do you understand by bandwidth distance product and what is a bitrate limitation due to GVD? (3)
 - c. Is there any advantage of using hetro junctions in optical devices? Explain. (3)
- 9. a. What is the reason of OH absorption peaks for a typical optical spectrum? (3)
 - b. For a single mode fiber, the V parameter is typically chosen to be between 2 and 2.4.
 - a) Why is the lower limit typically about 2?
 - b) Why is the upper limit about 2.4? (4)
 - c. If the index of refraction of a material is independent of wavelength (the index has the same value at all wavelengths), would
 - a) Material dispersion exist. Briefly explain
 - b) Waveguide dispersion exist. Briefly explain
 - c) Modal distortion exist. Briefly explain (3)

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