



MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : PE-EC801B Fibre Optic Communication

UPID : 008329

Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks.

Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following : [1 x 10 = 10]
- (I) What are the sources used in optical communication?
 - (II) What material is used in electro-optic modulators and switches?
 - (III) The material for making an efficient LED should be-----
 - (IV) Does Self-phase modulation causes modifications to the pulse spectrum?
 - (V) Define Acceptance angle of an optical fiber.
 - (VI) What is the unit of measurement of the optical attenuation per unit length?
 - (VII) Which detector material is most often used in 1550 nm window?
 - (VIII) Which is the most common method for manufacturing couplers?
 - (IX) What are passive components in WDM?
 - (X) In Kerr effect, induced index change has its proportionality with respect to _____
 - (XI) In spontaneous emission, the light source in an excited state undergoes the transition to a state with _____
 - (XII) In the fiber optic link, power transfer from one fiber to another and from fiber to detector must take place with _____ coupling efficiency.

Group-B (Short Answer Type Question)

- Answer any three of the following : [5 x 3 = 15]
2. Discuss the attenuation characteristics of a SMF. What are the three different wavelength windows used in optical fiber communication? [5]
 3. Briefly outline the advantages and drawbacks of the LED in comparison with the injection laser for use as a source in optical fiber communications. [5]
 4. Explain waveguide dispersion. What are dispersion-flattened fibres? [5]
 5. Establish the threshold gain condition for lasing to occur in a fabry-perot resonator based laser diode. [5]
 6. Discuss the impact ionization in avalanche photodiode. [5]

Group-C (Long Answer Type Question)

- Answer any three of the following : [15 x 3 = 45]
7. (a) Draw the block diagram of general communication system and fiber optics communication system? Explain in detail. [10]
 - (b) Explain the advantages of an Optical Communication system. [5]
 8. (a) Explain what is meant by a graded index optical fiber, giving an expression for the possible refractive index profile. Explain the light propagation mechanism in graded index fiber. [7]
 - (b) What is V number of fiber or normalized frequency of fiber? Define cutoff wavelength of the fiber. [4]
 - (c) A multimode step index fiber with a core diameter of 80 μm and a relative index difference of 1.5% is operating at a wavelength of 0.85 μm . If the core refractive index is 1.48, estimate: (i) the normalized frequency for the fiber; (ii) the number of guided modes. [4]
 9. (a) Briefly discuss with the aid of a suitable diagram what is meant by the acceptance angle for an optical fiber. [3]
 - (b) Define Numerical aperture of a step index fiber. Obtain an expression for it. [5]
 - (c) Explain Mode-field diameter. [3]
 - (d) 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 a cladding refractive index of 1.47. Determine: (a) the critical

angle at the core-cladding interface; (b) the NA for the fiber; (c) the acceptance angle in air for the fiber.

10. (a) Discuss with the aid of a suitable diagram one melting method for the preparation of multicomponent glass. [5]
- (b) Briefly describe the major reasons for the cabling of optical fibers which are to be placed in a field environment. [5]
- (c) Explain the working principle of optical time domain reflectometer (OTDR). [5]
11. (a) Mention the criteria for choosing the photo detectors for optical communication. [5]
- (b) Define Responsivity and Quantum efficiency of a photo detector. Derive an expression for the Responsivity of an intrinsic photodiode in terms of Quantum Efficiency and the wavelength of the incident radiation. [7]
- (c) When 3×10^{11} photons each with wavelength $0.85 \mu m$ are incident on a photodiode, on average 1.2×10^{11} electrons are collected at the terminals of the device. Determine the quantum efficiency and responsivity of the photodiode at $0.85 \mu m$. [3]

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