

**ET701M - Fiber Optic Communications**

P. Pages : 2

Time : Three Hours



**GUG/S/23/14247**

Max. Marks : 80

- Notes :
1. All questions carry marks as indicated.
  2. Assume suitable data wherever necessary.
  3. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Derive an expression to determine the modes propagating in step index fiber. **8**
- b) The velocity of light in the core of step index fiber is  $2.01 \times 10^8$  m/s and the critical angle at the core clad interface is  $80^\circ$ . Determine the numerical aperture and the acceptance angle for the fiber in air. **8**

**OR**

2. a) A multimode step index fibre with a core diameter of  $80\mu\text{m}$  and a relative index difference of 1.5% is operating at a wavelength of  $0.85\mu\text{m}$ . If the core refractive index is 1.48, estimate. **8**
- i) The normalized frequency for the fiber
  - ii) The number of guided modes
- b) Define - **8**
1. Refraction
  2. Refraction Index
  3. Absolute refractive index
  4. Relative refractive index also state the significance of refractive index
3. a) What is attenuation? Explain different types of attenuation in fiber optic communication. **8**
- b) An optical fiber is described as follows **8**
- a) Length = 120m
  - b) Optical power provided =  $12\mu\text{W}$
  - c) Output power =  $8\mu\text{W}$
- Find out the loss of the optical fiber a dB/km.

**OR**

4. a) What is splicing. Explain loose tube splicing and V-groove splicing. **8**
- b) An optical fiber system Is provided with the following data. **8**
- a) Optical power fed =  $12\mu\text{W}$
  - b) Optical fiber length = 12km
  - c) Output power =  $6\mu\text{W}$
- Determine
- i) Overall loss per km neglecting the effect of connectors or splices.
  - ii) If the splices are at 1.25km intervals having 1.2dB attenuation for each, find the overall signal attenuation of the same fiber for 25km optical link. Also find out the numerical input output power ratio.

5. a) With the help of a neat diagram explain the construction and working of a surface emitting LED? **8**
- b) What is population inversion? Explain population inversion with three level and four level energy band diagram. **8**

**OR**

6. a) What is optical amplifier? Explain Erbium doped fiber amplifier? **8**
- b) An InGaAsP surface emitter has an activation energy of 1 eV with a constant of proportionality ( $\beta_0$ ) of  $1.84 \times 10^7 \text{ h}^{-1}$ . Estimate the CW operating lifetime for the LED with a constant junction temperature of  $17^\circ\text{C}$ , if it is assumed that the device is no longer useful when its optical output power has diminished to 0.67 of its original value. **8**
7. a) State and explain performance and compatibility requirement for detector. **8**
- b) When  $3 \times 10^{11}$  photons each with a wavelength of  $0.85 \mu\text{m}$  are incident on a photodiode, on average  $1.2 \times 10^{11}$  electrons are collected at the terminals of the device. Determine the quantum efficiency and the responsivity of the photodiode at  $0.85 \mu\text{m}$ . **8**

**OR**

8. a) Draw the structures of APD photo detectors and explain their operations. **8**
- b) A photodiode has a quantum efficiency of 65% when photons of energy  $1.5 \times 10^{-19} \text{ J}$  are incident upon it. **8**
- a) At what wavelength is the photodiode operating?
- b) Calculate the incident optical power required to obtain a photocurrent of  $2.5 \mu\text{A}$  when the photodiode is operating as described above.
9. a) What is DWDM? Explain the architecture of DWDM. **8**
- b) Define STM and state their units with bitrates. Also draw and explain the frame format of STM-1. **8**

**OR**

10. a) With the help of neat block diagram explain elements of GPON. **8**
- b) What is numerical aperture? Explain fiber numerical aperture measurement using a scanning photodetector and a rotating stage. **8**

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