

# AI-108

April-2015

M.Sc., Sem.-IV

**ELE-509 : Electronics & Science**

**(Fiber Optics & Its Applications)**

**Time : 3 Hours]**

**[Max. Marks : 70**

**Instructions :** (1) Attempt **all** questions.

(2) Symbols and terminology have their usual meanings.

(3) Use of scientific calculator may be permitted.

1. (a) Consider an optical fiber as cylindrical wave guide and derive an equation of normalized frequency (V-number). State its importance. 7

**OR**

Explain the following :

(i) Group velocity and group index

(ii) Single mode step index fiber

- (b) What do you mean by linear scattering loss ? Explain (i) Rayleigh scattering and (ii) Cut off wavelength. 7

**OR**

(i) A multimode step index fiber with a core refractive index of 1.500, a relative refractive index difference of 2%. The number of modes propagating at a wavelength of 1.3  $\mu\text{m}$  is 1000. Calculate the diameter of the fiber. 3

(ii) Using neat diagram, explain fiber bend loss. 4

2. (a) Describe the double crucible method of fiber drawing. 7

**OR**

Give schematic illustration of Modified Chemical Vapour Deposition (MCVD) technique of fiber drawing.

- (b) Draw the schematic of longitudinal and angular misalignment of fiber joints. Briefly explain the Fresnel reflection loss mechanism. 7

**OR**

Explain fiber mechanical and fusion splices.

3. (a) What is numerical aperture ? Explain. With the help of block diagram discuss one method for measuring numerical aperture of optical fiber. 7
- OR**
- Explain OTDR with necessary diagrams.
- (b) Name different applications of optical fibers. Discuss any two of them in detail. 7
- OR**
- What is meant by refractive index profile of optical fiber ? Give details of how refractive index profile of optical fiber is measured with necessary diagrams.
4. (a) Draw and explain working of a laser drive circuit used in IM/DD optical fiber communication systems. What is the role of optical feedback in such circuits ? 7
- OR**
- Draw block diagram of generalized coherent optical fiber communication system. Explain clearly the difference between heterodyne and homodyne systems with diagrams of spectra.
- (b) Draw block diagram of optical fiber receiver and explain briefly function of each block. 7
- OR**
- What is heterodyne synchronous detection ? Give block diagram of one method for carrier recovery used in coherent optical PSK receiver. Explain the working of the circuit.
5. Answer all following questions : (Each carry **one** mark) **14**
- (1) Which parameters mostly affect the stability of fiber transmission characteristics ?
  - (2) What is the difference between fiber connector and coupler ?
  - (3) Draw a schematic of biconical ferrule connector.
  - (4) Draw a schematic of Evanescent field.
  - (5) Draw the refractive index profile of graded index fiber.
  - (6) "Graded index fiber is preferred to reduce the intermodal dispersion." Justify.
  - (7) Draw the attenuation spectra of an ultra low loss single mode silica fiber.
  - (8) Define coherence.
  - (9) What is meant IM/DD system ?
  - (10) Give full form of ORL.
  - (11) When light travels from high refractive index medium to another medium of lower refractive index its speed \_\_\_\_\_.
  - (12) Give two main advantages of optical fiber communication over wireless systems.
  - (13) Give two main advantages of optical fiber communication in military applications.
  - (14) What are mode scramblers ?