53 (IE 703) FOLI

2016

FIBER OPTICS & LASER INSTRUMENTS

Paper : IE 703

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer ***any five*** *questions.*

1. *(a)* What are the advantages of optical fibre communication system ? 4

   (b) What is the significance of acceptance angle and numerical aperture ? An optical fibre has a core refractive index 1·5 and cladding refractive index 1·47. Determine acceptance angle and numerical aperture. 5+4=9

(c) With neat diagram show the ray transmission and refractive index profile in step index multimode and single mode fibre. What are the advantages of multimode fibre over single mode fibre ? 4+3=7

2. (a) When the mean optical power launched into an $8km$ length of fibre is $200\mu W$, the mean optical power at the output is $10\mu W$. Determine,

(i) Overall signal attenuation assuming no connectors or splices.

(ii) Signal attenuation per *kilometre.*

(iii) The overall attenuation for a $5km$ optical link using the same fibre with splices at $0{\cdot}5km$ intervals, each giving an attenuation of $2dB$. 6

(b) Silica has an estimated fictive temperature of $1400K$ with an isothermal compressibility of $7 \times 10^{-11} m^2 N^{-1}$. The refractive index and the photoelastic coefficient for silica are 1·46 and 0·286 respectively. Determine the theoretical attenuation in *decibels* per *kilometre* due to the fundamental Rayleigh scattering in silica at optical wavelengths of $0{\cdot}63\mu m$, $1\mu m$, $1{\cdot}3\mu m$. Boltzmann's constant is $1{\cdot}381 \times 10^{-23} JK^{-1}$. 10

(c) Differentiate between stimulated Raman scattering and stimulated Brillouin scattering. 4

3. (a) What is dispersion ? With neat diagram show the effects of dispersion. 5

(b) What are the advantages of LED as a light source for optical fibre communication ? Obtain the expressions for internal efficiency and power of LED. 3+6=9

(c) Draw and explain the block diagram of a fibre optic sensor system. 6

4. (a) How current can be measured by polarization modulation technique ? Explain. 10

(b) What are fibre optic extrinsic sensors ? Explain the fibre optic technique of measurement of displacement and fluid level detection. 10

5. (a) What are the fundamental characteristics of a laser source ? 4

(b) Explain the terms — Population inversion and laser pumping. 8

(c) How laser can be used for measurement of atmospheric effects ? 8

6. (a) State the industrial applications of laser. 4

(b) Explain the theory of holograms. 8

(c) State the characteristics and applications of holography. 8

7. Write short notes on : 10×2=20

(a) Solid state lasers

(b) UV spectrometry.
