2018

FIBER OPTION AND 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. (i) What are skew rays ? $2 \times 10 = 20$

   (ii) Define dark current noise.

   (iii) What is Rayleigh scattering ?

   (iv) What is the function of intrinsic layer in a PIN ?

   (v) What is population inversion ?

   (vi) How the Fresnel loss is compensated in a fiber optic connector ?

(vii) What is the difference between a splice and a connector ?

(viii) Define quantum efficiency.

(ix) Which type of light source would you think is more prevalent in a fiber optic communication ? Why ?

(x) What are the *two* types of losses in an optical fiber ?

2. (a) How would you classify optical fiber based on the variation in the composition of the core material ? 4

(b) What do you understand by 'Numerical Aperture' and 'Acceptance Angle' of a fiber ? Derive the expression for them.
2+6=8

(c) Define the terms : Phase and group velocity. 3

(d) The relative refractive index difference between core and cladding of an optical fiber is 5%. Calculate the NA for the fiber when the core R.I. is 1·50. Also estimate the critical angle at the core cladding interface. 5

3. (a) State the merits and demerits of single mode fiber. 3

(b) Name the *five* different types of intrinsic losses that appear in a fiber joint. 5

(c) A four part directional coupler has 4:1 splitting ratio and excess loss equals to 20dB, directionality equals to 10dB. 6

(i) What fraction of input power goes to each of the port ?

(ii) Compute the throughput loss and excess loss.

(iii) Compute the loss due to radiation and scattering.

(d) Specify the basic components of a LASER. 6

4. (a) What is a LIDAR ? Describe the main components of a LIDAR system. Make a comparison between LIDAR and RADAR. 1+4+3=8

(b) What is the role of Helium in He-Ne LASER ? Explain the operating principle of He-Ne LASER. How this LASER is superior to ruby LASER ? 2+4+2=8

(c) A Faraday current sensor consists of 30 *loops* of a single mode fiber (silica) of radius 62·2μm bent around a circular forma of radius 20cm. What will be the Faraday rotation for a current of 1Amp at 0·633μm ? 4

5. (a) Differentiate between intrinsic and extrinsic fiber optic sensors with examples. 4

(b) Explain the construction, working principle of ruby LASER. 6

(c) Describe with suitable diagram, how a LASER distance meter is advantageous than ultrasonic distance meters. 8

(d) State the applications of directional coupler. 2

6. (a) List out the properties of LASER, which make it different from ordinary light. 4

(b) Differentiate between spontaneous and stimulated emission with suitable diagrams. Which of them is applicable to LASER action and why ? 5

(c) Why we prefer 4-level LASER over 3-level LASER even if its efficiency is low ? 3

(d) State the important features of Nd:YAG LASER compared to ruby LASER. 5

(e) A photon with an associated wavelength of 980nm upon interaction with an atom at a particular energy level E_1 is able to promote that atom to an energy level E_2 ; where $E_2 > E_1$. Estimate the difference between these two energy levels. 3

7. (a) What is the advantage of fiber optic gyroscope over the conventional mechanical gyros ? Explain the principle of operation of fiber optic gyroscope based on sagnac effect. 2+8=10

(b) How does a hologram differs from a photograph ? Are all the holograms same ? Explain the recording and reconstruction process of reflection hologram. 3+1+6=10

8. Write short notes on : *(any four)* 5×4=20
* Fiber optic current sensor
* Mach-Zehnder Interferrometric sensor
* Q-switching
* LASER doppler velocimeter
* Graded-index fiber.

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