Total number of printed pages: 3 **Programme (UG)/6th Semester/Paper Code UIE603**

2024

UIE603: Optical Fiber and Optoelectronics

Full Marks: 100

Time: Three hours

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

*Answer **any five** questions.*

1. a)

i) What does index of refraction measure? 1

ii) On what factors, the NA of a fiber depends? 1

iii) List the characteristics and drawbacks of semiconductor lasers. 2

iv) Explain the difference between dispersion and bandwidth length product. 2

v) State the zero dispersion wavelength of optical fiber. 1

vi) Explain the three mechanisms that causes distortion in the signal sent along communication fiber. 3

b) Fill in the blanks with the correct answer: 5

i) The light sources used in fibre optics communication are _____

(LED's and Lasers/ Phototransistors/ Xenon lights/ Incandescent)

ii) _____is the numerical aperture of the fiber if the angle of acceptance is 16 degree.

(0.50/ 0.36/ 0.20/ 0.27)

iii) The ratio of speed of light in air to the speed of light in another medium is called as _____

(Speed factor/ Dielectric constant/ Reflection index/ Refraction index)

iv) A graded-index fiber has a core with parabolic refractive index profile of diameter of 30μm, NA=0.2, λ=1μm. The normalised frequency will be_____

(19.32/ 18.84/ 16.28/ 17.12)

v) _____fiber is advantageous for lower bandwidth applications.

(Single mode/ Co-axial/ Multi mode/ Photonic crystal)

c) State the advantages and disadvantages of Laser surgery. 5

2. a) Generalize the necessity of cladding for an optical fibre. 2

b) Define the normalized frequency for an optical fiber and explain its use in the determination of the number of guided modes propagating within a step index fiber. 4

c) Discuss absorption losses in optical fibers, comparing and contrasting the intrinsic and extrinsic absorption mechanisms. 6

d) A fiber has 30 mW of light power injected into it. Of this 27.9 mW exits the opposite end of the fiber. This exiting light from the fiber fall upon a detector with a light sensitive area of 5 cm^2. Now determine the irradiance. 4

e) Define the relative refractive index difference for an optical fiber and show how it may be related to the numerical aperture. 4

3. a) State the different advantages of optical fiber over the copper wire system in telecommunication application. 5

b) Describe the distinctions that exist between transmission holograms and reflection holograms. 6

c) What exactly are surface plasmons (SP)? Describe a typical Surface Plasmon Resonance (SPR) sensor arrangement using fiber optics. 7

d) How is stimulated emission different from spontaneous emission? 2

4. a) Define the following parameters of a coupler: 4

- Tap loss
- Throughput loss
- Directionality
- Excess loss.

b) Compute the V-parameter and the no. of modes supported by a fiber having n_1(core) = 1.50 and n_2 (cladding) = 1.46; core radius 35-micrometer and operating wavelength is 1550nm. 4

c) Describe the types of detectors used in optical fiber communications and their working principles. 5

d) Describe the operation of Fiber Bragg grating based sensors 7

5. a) Compare and contrast different types of fiber connectors and couplers. 6

b) Describe the requirements that must be satisfied in order to use reagents in 5

reagent-mediated sensors.

c) What is a Micro bend sensor? Discuss the principle of working of Micro bend sensor. 5

d) Show with a neat diagram, how Laser can be used for measurement of distance 4

6. a) How a PIN detector does differs from APD? Explain. 5

b) Calculate the quantum efficiency of an APD that produces 10 electrons for every one incident photon. 3

c) What are fibre optic extrinsic sensors? Explain the fibre optic technique of measurement of displacement and fluid level detection. 7

d) How does Li-Fi work? Make a comparison with Wi-Fi. 5

7. Write short notes on ***any four*** of the following 5 x 4=20

a) Mach-Zehnder interferometer (MZI)

b) Medical applications of lasers

c) Surface plasmon resonance-based sensors

d) LASER Doppler Velocimetry (LDV)

e) Laser for material processing