2022

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) With the schematic diagram explain the different reagent mediated fiber optic sensor configurations. Also state the conditions for the use of reagent in such sensor configuration.

   5+5=10

   (b) What is surface plasmon resonance (SPR) ? Explain how fiber based sensors can utilize the mechanism of SPR for sensing applications.   2+5=7

   (c) Describe the evanescent wave phenomenon at the interface of two media.   3

2. (a) Explain the working of fiber optic rotation sensor or the fiber optic gyroscope based on the Sagnac effect. 8

(b) State the Bragg Condition as appeared in optical fiber gratings. 4

(c) What is the working principle of FBG sensor ? Derive the condition that demonstrates that Bragg wavelength is dependent on grating period and effective refractive index of FBG. 5+3=8

3. (a) State the Faraday effect as applicable to polarized light. 4

(b) Outline the experimental setup for measuring current in a conductor using the Faraday effect using an appropriate diagram. 7

(c) Discuss how a micro-bend hydrocarbon sensor works. 6

(d) Define the following terms as applicable for description of a photodetector : 3

Responsivity, Quantum Efficiency, Thermal Noise.

4. (a) Explore the merits and special features offered by optical fiber communications over more conventional electrical communications. 7

(b) The data for two LED sources are given. If the sources are to be used in a fiber optic system that requires the following operational parameters, which LED would be the best choice ? 6

System Requirements

Bandwidth = 20 MHz

Output power of $10/\mu W$ after 1.5 km (loss of 3 dB/km)

Electrical power maximum of 1 watt

Fiber Numerical Aperture = 1.2

LED Characteristics

Parameter	LED-1	LED-2
Output power	1mW	2mW
Rise Time	1ns	10ns
NA	1.10	1.70
Supply Voltage	2.3	3.0
Forward Current	10mA	50mA

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(c) Why are heterojunction designs used in optical sources ? 2

(d) List the characteristics, benefits, and drawbacks of semiconductor lasers. 5

5. (a) How holography does differ from ordinary photography ? Describe the different types of holograms. 5+5=10

(b) List the benefits and drawbacks of LASER surgery. 5

(c) Describe how LIDAR differs from RADAR. 5

6. Write short notes on any *two* of the following : 10×2=20

(a) The evanescent field absorption sensors

(b) Mach-Zehnder interferometric sensors

(c) Microbend Fiber Optic Sensor.

7. Differentiate between : 5×4=20

(a) Short-period gratings Vs. Long-period gratings

(b) Intrinsic Vs. Extrinsic fiber optic sensors

(c) WiFi (Wireless Fidelity) Vs. LiFi (Light Fidelity)

d) PIN photodiode Vs. The Aalanche photodiode.