

OPTO ELECTRONICS AND FIBRE OPTICS
(AEIE 3232)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) At which wavelength the Silica fiber has minimum loss and dispersion?
(a) 0.85 μm (b) 1.7 μm (c) 1.1 μm (d) 1.3 μm .
 - (ii) Laser beam machining process can be used for
(a) Conductors (b) Insulators
(c) Metals (d) All of the mentioned.
 - (iii) The core of an optical fiber has a
(a) lower refracted index than air
(b) lower refractive index than the cladding
(c) higher refractive index than the cladding
(d) similar refractive index with the cladding.
 - (iv) Which of the following is an example of a wavelength modulated sensor?
(a) Micro bend sensor (b) Fiber optic gyroscope
(c) A fluorescence temperature sensor (d) All of these.
 - (v) Which of the following are the properties of a laser?
(a) Highly collimated (b) Monochromatic
(c) Coherent light beam (d) All of the mentioned.
 - (vi) What kind of change can be measured by a-fiber interferometer?
(a) Intensity (b) Phase
(c) Wavelength shift (d) All of the above.
 - (vii) What is the wavelength value of CO₂ laser used in Laser beam machining?
(a) 0.16 μm (b) 1.6 μm (c) 10.6 μm (d) 106 μm .
 - (viii) Nd³⁺:YAG laser is
(a) solid state laser (b) a molecular laser
(c) dye laser (d) semiconductor laser.

- (ix) What is the abbreviation of Laser?
(a) Light allowed simple emission of radiation
(b) Light amplification by stimulated emission of radiation
(c) Light amplified simultaneous emission of rays
(d) Light amplified stimulated emanation of rays.
- (x) If two optical fibers with different diameter are to be spliced, which of the following mechanical splices will be most suitable?
(a) Snug tube splice (b) Loose tube splice
(c) Spring groove splice (d) V-groove splice.

Group- B

2. (a) What is an intrinsic and extrinsic semiconductor? [(CO1)(Remember/LOCQ)]
(b) How the LDR can be used for automatic street light control? [(CO1)(Apply/IOCQ)]
(c) Explain why Silicon is not suitable to fabricate LED or Laser diode. [(CO1)(Evaluate/HOCQ)]
3 + 5 + 4 = 12
3. (a) Mention few photo detector materials and their properties. [(CO2)(Remember/LOCQ)]
(b) Explain the working principle of Photomultiplier-tube. [(CO1)(Analyse /IOCQ)]
(c) Differentiate between Photodiode and Solar cell. [(CO2)(Analyse/IOCQ)]
3 + 5 + 4 = 12

Group - C

4. (a) Write short note on edge emitting LED. [(CO2)(Remember/LOCQ)]
(b) Discuss the factors to determine frequency response of an LED. [(CO2)(Analyze/LOCQ)]
(c) Design a circuit of Opto-isolator using LED and Photodiode. [(CO2)(Analyze/IOCQ)]
4 + 4 + 4 = 12
5. (a) Describe with relevant diagram the operation of silicon p-i-n Photodiode. [(CO2)(Remember/LOCQ)]
(b) Compare p-i-n photo diode with p-n junction Photodiode. [(CO2)(Analyse/IOCQ)]
(c) Discuss why is LDR not suitable for optical fiber communication? [(CO1)(Evaluate/HOCQ)]
5 + 4 + 3 = 12

Group - D

6. (a) Explain with necessary diagrams three process of absorption, spontaneous emission and stimulated emission in a two-level energy system. [(CO3)(Analyse/IOCQ)]

- (b) Compare LASER and LED as source in optical fiber communication system. [[CO3](Apply/IOCQ)]
- (c) List the various modes of laser diode. [[CO3](Remember/LOCQ)]
5 + 4 + 3 = 12
7. (a) Describe laser machining with proper diagram. [[CO3](Remember/LOCQ)]
- (b) What applications are best suited for laser machining? [[CO3](Apply/IOCQ)]
- (c) Discuss the advantages and disadvantages of laser machining over other processes. [[CO3](Evaluate/HOCQ)]
5 + 4 + 3 = 12

Group - E

8. (a) Describe the structures of different types of optical fibers with ray paths. What is the approximate diameter of an optical fiber in each case? [[CO4](Remember/LOCQ)]
- (b) The average optical power launched into a 10 km length of fiber is 100 μ W and the average output power is 2.5 μ W. Calculate (i) the signal attenuation in decibels through the fiber. It is assumed that there are no connectors or splices (ii) the signal attenuation per km of the fiber, (iii) overall signal attenuation for the 11 km optical link using the same fiber with 3 splices each having an attenuation of 0.8 Db and (iv) numerical value of the ratio between input and output power. [[CO4](Apply/IOCQ)]
(4 + 2) + (2 + 2 + 1 + 1) = 12
9. (a) What are the three important mechanisms that are responsible for absorption losses in signal through an optical fiber? Explain in brief. [[CO5](Remember/LOCQ)]
- (b) Write short note on any one:
(i) Optical fiber flow sensor
(ii) Optical fiber temperature sensor. [[CO6](Remember /LOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	46.87	42.71	10.42

Course Outcome (CO):

After the completion of the course students will be able to

1. Learn the basic concepts of opto- electronics, properties and industrial applications.
2. Gain the fundamentals of Lasers, properties and industrial applications.
3. Understand the characteristic of optical fibers and their performances, properties and industrial applications industrial.
4. Specify and analyze optoelectronic devices in optical fiber communication.
5. Analyze various types of losses in optical fiber communication.
6. Acquire the knowledge of different types of Optical Fiber sensors and their applications.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question;
HOCQ: Higher Order Cognitive Question.