

**OPTO ELECTRONICS AND FIBRE OPTICS
(AEIE 3232)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) At which wavelength the silica fiber has minimum loss and dispersion
(a) 1.7µm (b) 0.85µm (c) 1.1µm (d) 1.3µm.
- (ii) Which fiber is preferred for long distance communication?
(a) Step index single mode fiber (b) Graded index multimode fiber
(c) Step index multimode fiber (d) Graded index single mode fiber.
- (iii) A photo conducting detector can be constructed from
(a) an intrinsic semiconductor (b) an extrinsic semiconductor
(c) polycrystalline material (d) all of the above.
- (iv) Laser beam machining process can be used for
(a) Conductors (b) Insulators
(c) Metals (d) All of the mentioned.
- (v) The loss in signal power as light travels down a fiber is called
(a) Dispersion (b) Scattering
(c) Absorption (d) Attenuation.
- (vi) 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.
- (vii) What kind of change can be measured by a-fiber interferometer?
(a) Intensity (b) Phase
(c) Wavelength shift (d) All of the above.
- (viii) What is the full form of LBM in advanced machining processes?
(a) Laser Beam Manufacturing (b) Laser Beam Machining
(c) Light Blast Manufacturing (d) Light Beam Machining.

- (ix) 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.
- (x) Which of the following pairs are suitable for making a heterojunction?
 (a) Si and Ge (b) Si and GaAs
 (c) Ge and GaAs (d) GaAs and AlGaAs.

Fill in the blanks with the correct word

- (xi) Multimode graded index fibers are manufactured from materials with _____.
- (xii) Single mode fibers allow single mode propagation; the cladding diameter must be at least _____.
- (xiii) Light incident on fibers of angles _____ the acceptance angle do not propagate into the fiber.
- (xiv) _____ converts the received optical signal into an electrical signal.
- (xv) Mie scattering has in-homogeneities mainly in _____.

Group - B

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

Group - C

4. (a) Write short note on Edge emitting LED. *[[CO4](Remember/LOCQ)]*
 (b) Discuss the factors to determine frequency response of an LED. *[[CO4](Understand/LOCQ)]*
 (c) Design a circuit of Opto-isolator using LED and Photo-diode. *[[CO4](Create/HOCQ)]*
3 + 6 + 3 = 12
5. (a) Describe with relevant diagram the operation of silicon p-i-n Photodiode. *[[CO4](Remember/LOCQ)]*
 (b) Compare p-i-n photo diode with p-n junction photo-diode. *[[CO4](Understand/LOCQ)]*
 (c) Why is phototransistor not suitable for optical fiber communication? *[[CO4](Evaluate/HOCQ)]*
5 + 4 + 3 = 12

Group - D

6. (a) Define LASER. [[CO2](Understand/LOCQ)]
 (b) Discuss the LASER diode principle, modes and threshold conditions. [[CO2](Remember/LOCQ)]
 (c) Explain optical feedback and laser oscillation. [[CO2](Evaluate/HOCQ)]
3 + 4 + (2 + 3) = 12
7. (a) Describe Laser Machining with proper diagram. [[CO2](Remember/LOCQ)]
 (b) What applications are best suited for Laser Machining? [[CO2](Understand/LOCQ)]
 (c) Discuss the advantages and disadvantages of Laser Machining over other processes. [[CO2](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? [[CO3](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. [[CO5](Remember/LOCQ)]
(4 + 2) + (2 + 2 + 1 + 1) = 12
9. (a) If the step index fiber has a core of refractive index 1.5, a cladding of refractive index 1.48 and a core diameter of 100 μ m, calculate
 (i) NA of the fiber
 (ii) Angle α_m , θ_m , φ_c
 (iii) Pulse broadening per unit length due to multipath dispersion. [[CO5](Apply/IOCQ)]
- (b) Write short note on any one:
 (i) Optical fiber flow sensor
 (ii) Optical fiber temperature sensor. [[CO6](Remember/LOCQ)]
(2 + 2 + 2) + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	60.42	15.63	23.96

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.*