

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) Which of the following is not suitable for making an LED?
(a) GaAs (b) Si (c) InGaAsP (d) AlGaAs.
- (ii) At which wavelength the silica fiber has minimum loss and dispersion?
(a) 0.85μm (b) 1.7μm (c) 1.1μm (d) 1.3μm.
- (iii) Snell's law relates _____
(a) light reflection (b) light refraction
(c) light transmission (d) light absorption.
- (iv) Light guided within the core of a step index fiber by
(a) refraction at the core –air interface
(b) total internal reflection at the core cladding interface
(c) total internal reflection at the outer surface of the cladding
(d) change in speed of light within the core.
- (v) The loss in signal power as light travels down a fiber is called
(a) dispersion (b) scattering
(c) absorption (d) attenuation.
- (vi) A photo conducting detector can be constructed from
(a) an intrinsic semiconductor (b) an extrinsic semiconductor
(c) polycrystalline material (d) all of the above.
- (vii) 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.
- (viii) What kind of change can be measured by a-fiber interferometer?
(a) Intensity (b) Phase
(c) Wavelength shift (d) All of the above.

- (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.

Group- B

2. (a) Define direct band gap and indirect band gap semiconductors. Give at least two examples for each. Which of these are suitable for fabricating LEDs?
[[C01](Remember/LOCQ)]
- (b) Write short note on any one of the following:
(i) Photo conducting effect
(ii) Photo transistor.
[[C01](Remember/LOCQ)]
(3 + 2 + 1) + 6 = 12
3. (a) What do you mean by electroluminescence effect? [[C02](Remember/LOCQ)]
(b) Differentiate between Photo-diode and solar cell. [[C01](Analyse/IOCQ)]
(c) Design a circuit for proximity sensor using phototransistor as optical detector.
[[C02](Create/HOCQ)]
3 + 5 + 4 = 12

Group - C

4. (a) Differentiate between Edge Emitting LED and Surface Emitting LED.
[[C02](Remember/LOCQ)]
- (b) What is meant by heterojunction? Write the basic principle of confinement of carriers in heterojunction LED.
[[C02](Analyse/IOCQ)]
- (c) Design a circuit of Opto-isolator using LED and Photo-diode.
[[C02](Analyse/IOCQ)]
4 + 4 + 4 = 12
5. (a) Describe with relevant diagram the operation of silicon Reach-Through Avalanche Photodiode.
[[C02](Remember/LOCQ)]
- (b) Compare p-i-n photo diode with Avalanche photo-diode.
[[C02](Analyse/IOCQ)]
- (c) Why is phototransistor not suitable for optical fiber communication?
[[C01](Evaluate/HOCQ)]
5 + 4 + 3 = 12

Group - D

6. (a) What do you mean by population inversion? [[C03](Remember/LOCQ)]

- (b) List the various modes of Laser diode. [(C03)(Remember/LOCQ)]
- (c) A GaAs injection laser with refractive index 3.6 has a cavity length of 500 μm and the loss coefficient is 20 cm^{-1} . The measured differential quantum efficiency is 45%. Calculate the internal quantum efficiency of semiconductor laser. [(C03)(Apply/IOCQ)]
4 + 3 + 5 = 12
7. (a) Compare LASER and LED as source in optical fiber communication system. [(C03)(Evaluate/HOCQ)]
- (b) A semiconductor diode laser has a peak emission wavelength of 1.55 μm . Find its band gap in eV. (c = velocity of light = 3×10^8 m/s, h = Planck's constant = 6.63×10^{-34} J-S). [(C03)(Apply/IOCQ)]
- (c) A GaAs injection laser with refractive index 3.6 has a cavity length of 500 μm and the loss coefficient is 20 cm^{-1} . The measured differential quantum efficiency is 45%. Calculate the internal quantum efficiency of semiconductor laser. [(C03)(Apply/IOCQ)]
5 + 3 + 4 = 12

Group - E

8. (a) What are step index and graded index fibers? Explain with proper diagram. [(C04)(Remember/LOCQ)]
- (b) Why step index single mode fiber preferred for long distance communication? [(C04)(Evaluate/HOCQ)]
- (c) The average optical power launched into a 10 km length of fiber is 100 μW and the average output power is 2.5 μW . 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. [(C04)(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. [(C05)(Remember/LOCQ)]
- (b) Write short note on any one of the following:
 (i) Optical fiber flow sensor
 (ii) Optical fiber temperature sensor. [(C06)(Remember/LOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	48.96	36.46	14.58

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