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CS/B.TECH (EIE-N)/SEM-6/EI-602/2011

2011 OPTO-ELECTRONICS & OPTICAL INSTRUMENTATION

Time Allotted: 3 Hours Full Marks: 70

The figures in the margin indicate full marks.

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

GROUP – A (Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following : $10 \times 1 = 10$

- i) Which of the following materials is not suitable for making an LED?
 - a) GaAs

- b) Silicon
- c) InGaAsP
- d) GaAIAs.
- ii) Attenuation in optical fibre is represented in
 - a) dB/km
- b) dB/hr

c) kdB/fr

- d) dB/m.
- iii) Laser is not used in
 - a) Optical communications
 - b) Entertainment electronics
 - c) Illumination purposes
 - d) Bloodless surgery.

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The Dark current in the photodiode is actually the iv)

- Forward current through the junction a)
 - Reverse saturation current b)
 - Basically a output radiation c)
 - None of these. d)
- Which one is the coherent source? v)
 - LED a)

- b) LASER
- Photodiode c)
- d) Both (a) & (b).
- For a single spherical surface, Newton's formula is vi)
 - $(x_1 x_2)^2 = (f_1 f_2)^2$
- b) $x_1 + x_2 = f_1 + f_2$
- $x_1^2 + x_2^2 = (f_1 + f_2)^2$ d) $x_1^2 + x_2^2 = f_1^2 + f_2^2$.
- vii) Which of the following photodetectors exhibits internal gain?
 - p-n photodiode a)
- APD b)
- p i n photodiode
- d) none of these.
- viii) The measurement of optical radiation by the principle of radiometry is possible over the frequency range of
 - visible range a)
 - only entire the IR range b)
 - UV, visible & IR range c)
 - none of these.
- ix) Hologram is the
 - 2-D view on 2-D photo plate a)
 - b) 3-D view on 2-D photo plate
 - 2-D view on 3-D photo plate c)
 - 3-D view on 3-D photo plate. d)
- Carbon dioxide laser is a x)
 - Molecular laser a)
- Ionic laser b)
- Atomic laser c)
- None of these. d)



- xi) What is the maximum wavelength that can be absorbed by Germenium (Ge) detector of bandgap of 0.67 eV?
 - a) 7080 nm
- b) 4560 nm
- c) 1850 nm
- d) 1100 nm.
- xii) Optical fibre operates between refractive index of the core
 - a) < cladding
- b) = cladding
- c) > cladding
- d) none of these.

GROUP - B

(Short Answer Type Questions)

Answer any three of the following.

 $3 \times 5 = 15$

- 2. State Huygen's principle of wavefront. Explain the phenomenon of reflection and refraction on its basis. 2 + 3
- What are fiber sensors? Discuss the principle of operation of Intensity Modulated senor.2 + 3
- 4. What is population inversion in LASER? Why is three-level or four-level system used instead of two-level system? 2 + 3
- 5. By the Corpuscular theory prove that its obey the Snell's law.
- 6. What is optocoupler? Describe briefly its operation and utility?

GROUP - C

(Long Answer Type Questions)

Answer any three of the following.

 $3 \times 15 = 45$

- 7. a) What are the direct bandgap and indirect bandgap semiconductors? Illustrate with suitable diagrams.
 - b) Describe the structure of SLED with its proper diagram.

3 + 7 + 5

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- 8. a) Discuss the principle of operation of PIN photodiode.

 Draw equivalent circuit of it.
 - b) Define Responsivity and overall efficiency of PIN photodiode.
 - c) A Si p-i-n photodiode with 8 μm receives light of wavelength $0.87~\mu m$ and power of $0.5~W/cm^2$. Calculate the photocurrent density. Assume that the top illuminated surface is coated with antireflection coating such that there is no reflection. Absorption coefficient $\alpha = 600~cm^{-1}$. 6 + 4 + 5
- 9. a) Differentiate between CW Laser output, Pulsed Laser output and Q-switched Laser output.
 - b) What is Q-factor of a Laser Cavity?
 - c) What is cavity oscillation and how does it influence laser operation?
 - d) Write a short note on He-Ne Laser.
 - e) What are the vibrational modes in a CO₂ Laser?

2 + 2 + 4 + 5 + 2

- 10. Explain the Principle of holography. Discuss the holographic technique invented by Gabor. Find out the Gaussian formula for single surface.5 + 5 + 5
- 11. Write short notes on any three of the following:

 3×5

- a) Ouantum Well Laser
- b) LDR
- c) Camera mechanism
- d) Refractometer
- e) Optoisolator
- f) Spectrometero.