



Printed Pages : 3

TIC011

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0316

Roll No.

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B.Tech

**(SEM VII)-ODD SEMESTER THEORY EXAMINATION 2009-10
OPTO ELECTRONICS**

*Time : 3 Hours]**[Total Marks : 100*

- Note :**
- (i) *Attempt all questions.*
 - (ii) *All question carries equal marks.*
 - (iii) *Be precise in your answers.*

- 1** Attempt any **four** parts of the following : **5×4=20**
- (a) Explain with relevant diagrams the different modes of an electromagnetic wave in an optical fiber. What do you mean by hybrid mode ? Use ray diagram to explain.
 - (b) Distinguish between symmetric, asymmetric slab wave guides. What is a channel waveguide and explain its operating principle.
 - (c) A fiber has a core of radius 30mm. The core and cladding refractive indices are 1.50 and 1.49 respectively. The operating wavelength is 0.85 μm . Determine :
 - (i) the value of total number of guided modes and
 - (ii) the ratio of power flow in the core and cladding.
 - (d) Compare the differences in performance characteristics between conventional LED used in fiber communications and super luminescent LED.
 - (e) A DH surface emitter which has an emission area diameter of 50 μm , is butt jointed to 80 μm core step-index fiber with a NA of 0.15. The device has a radiance of 30 watts $\text{Sr}^{-1}\text{cm}^{-2}$ at a constant

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operating drive current. Estimate the optical power coupled into the fiber. It is assumed that the Fresnel reflection coefficient at the index matched fiber surface is 0.01.

- (f) What do you mean by population inversion ? How is the population inversion accomplished in semiconductor and non-semiconductor lasers ?

2 Attempt any **four** parts of the following : $5 \times 4 = 20$

- (a) Discuss the importance of crystal-cut and electrode placement in choosing a substrate material for an electro-optic modulator. Specify two configurations that utilize the maximum electro-optic effect in case of lithium niobate.
- (b) Outline the procedure for fabricating an electro-optic phase modulator in lithium niobate.
- (c) An electro-optic phase modulator is made of z-cut LiNbO_3 with a $3 \mu\text{m}$ wide waveguide and electrode each of length 8 mm. Find the voltage required for using the device as a BPSK modulator if the gap between the electrodes is $4 \mu\text{m}$ and if the electrodes are placed on either side of the waveguide. Assuming an overlap factor of 0.4, calculate the voltage product.
- (d) Explain the principle and operation of integrated optic spectrum analyzer.
- (e) What are non-linear effects of optical fibers ? Explain Pockel's effect, harmonic generation, solitons and self phase modulation with reference to non-linear effects.
- (f) How is parametric amplification obtained through non-linear effects of optical fibers ?

3 Attempt any **two** of the following : $10 \times 2 = 20$

- (a) How is phase transformation of thin lens obtained ? - Explain. Also describe Fourier transforming property and image forming property of lens.

- (b) Explain the principle of Holography. What is On axis and Off Axis Holography ? Also explain how real time holographic interferometry can be useful ?
- (c) What is a speckle phenomenon ? Explain the operation of a Laser Interferometer.

4 Attempt any **two** of the following : $10 \times 2 = 20$

- (a) What are Current sensors, Magnetic sensors and Single mode FO sensors ? Explain electric current measurement by use of a single mode optical fiber sensor.
- (b) What are active multimode FO sensors ? Describe a fiber optic Gyroscope.
- (c) Explain the principle of Micro-bend optical fiber sensors. By means of a configuration, show how a micro-bending fiber sensor could be used for monitoring structural deformation.

5 Attempt any **four** of the following : $5 \times 4 = 20$

- (a) Using examples, explain how Averaging, Differentiation and Integration can be achieved in optical processing ?
- (b) With reference to optical computing, explain threshold devices and Theta Modulation devices.
- (c) Distinguish between linear and non-linear optical processing citing examples.
- (d) What is phase matching condition ? Explain by means of an example and application.
- (e) What are spatial light modulators ? Give an application which uses it.
- (f) Explain halftone processing with reference to optical signal processing. How can this technique be applied to images ?