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

PAPER ID : 0316 Roll No.

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 luminent 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 $Sr^{-1}cm^{-2}$ at a constant

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 : **5×4=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 unitize 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 μm 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 μm 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, solitans 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 : **10×2=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 : **10×2=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 : **5×4=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 ?