PG/IIS/ELC-201/11

M.Sc. 2nd Semester Examination, 2011

ELECTRONICS

(Applied Optics and Optoelectronics)

PAPER—ELC-201

(Theory)

Full Marks : 40

Time : 2 hours

Answer **Q. No. 1** and any **three** from the rest

The figures in the right-hand margin indicate marks

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

Illustrate the answers wherever necessary

1. Answer any *five* questions :   2 × 5

   (a) Why is it difficult to construct blue laser in comparison to red laser ?

(b) Why four level laser system is more advantageous over three level laser system ?

(c) What are the significances of numerical aperture ?

(d) What is volumn hologram ?

(e) Why $1\cdot33$ μm and $1\cdot55$ μm are important for choosing wavelengths of propagating light signal through optical fiber ?

(f) Why nonlinearity in refractive index occurs at highly intense electric fields when the same material is linear in low fields ?

2. (a) Explain clearly why optical fiber is advantageous in optical communication in terms of increasing the information carrying capacity in comparison to radio and microwave propagation.

(b) Explain the refractive index distribution

$$n^2(r) = n_1^2 \left[1 - 2\delta \left(\frac{r}{a}\right)^q\right], \ r < a$$
$$= n_1^2 \left[1 - 2\delta\right], \ r > a$$

for a graded index fiber with reference to symbols. Sketch and names the profiles with justification for $q = 1, 2$ and ∞. $4 + (3 + 3)$

3. How light emission is obtained from a LED ? What is the basis for the selection of material for a particular LED ? Discuss how impurity-related transitions enhance the external quantum efficiency of a LED. $5 + 2 + 3$

4. What are the different modes of vibration in CO_2 ? What does the role plays N_2 molecules in CO_2 laser ? Explain the mechanism of population inversion in CO_2 laser. $4 + 2 + 4$

5. (a) What is *p-i-n* photodiode ? Derive the expression for photo-current, quantum efficiency and responsivity of a photodiode.

   (b) A photodiode has a quantum efficiency of 65 percent when photons of energy $1 \cdot 5 \times 10^{-19}$ J are incident on it. (*i*) Calculate the wavelength at which the photodiode is operating and (*ii*) incident optical power required when the current through the diode is $3 \mu A$. $(1 + 2 + 2 + 2) + (1 + 2)$

(*Turn Over*)

6. Write short notes on any *two* of the following topics : 5×2

   (*i*) Material dispersion in optical fiber

   (*ii*) Basic holographic equation

   (*iii*) Light Dependent Resistor (LDR)

   (*iv*) Passive and acousto-optic Q-switching.

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