2017

M.Sc. Part–II Examination

PHYSICS

PAPER—X

Full Marks : 75

Time : 3 Hours

The figures in the right-hand *margin indicate full marks.*

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

Illustrate the answers wherever necessary.

(Use separate scripts for Group–A and Group–B)

Group—A

1. Answer any *five* of the following :   5×2

    (a) A binary number is expressed as 1001. Convert it in modified tristate number system.

    (b) Define quality factor of a laser resonator.

    (c) Give the names of any two tunable lasers.

    (d) Why does phase matching condition required in second harmonic generation?

(e) Write the expression of dielectric polarization of a Kerr type of non-linear material identifying its different terms.

(f) Write the difference between single and multimode fibers.

(g) What do you mean by temporal Coherence of a laser light?

2. Answer any *two* questions : 2×3

(a) Describe the method of opto-electronic Q-switching.

(b) Show that the refractive index of a non-linear material depends on the intensity of the incident laser light.

(c) What is 'Basic Module'? How tristate input signal can be generated by using Basic Module?

3. Answer any *one* question : 1×4

(a) Discuss the method of generation of frequency subtraction of light signal using a proper non-linear material.

(b) Discuss the method of reconstruction of real and Virtual wave fronts in holography.

4. Answer any *two* questions : 2×10

(a) Why does a four level laser system more advantageous over a three level one? Derive the expression of

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'population inversion' of a four-level laser system. Hence obtain the expression of threshold power of this type of laser. Write the example of two four level laser system. 2+4+3

(b) Obtain the expressions of TE symmetric and anti-symmetric waves in a planar optical wave guide. What is a single mode wave guide? 8+2

(c) What do you mean by multi-path dispersion in optical fiber? Derive its expression.

Write a short note on classification of solid lasers. Discuss the method of 'q-switching' by electro-optic method. (1+3)+2+4

Group—B

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

1. Answer any *two* bits : $2×2\frac{1}{2}$

(a) Show the probability of occupancy of the state of energy E above E_F by an electron in a semiconductor is the same as the probability of occupancy of a state of energy E below E_F by a hole.

(b) Derive electrical nutrality condition when a semiconductor is doped with donor and acceptor impurity.

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(c) Prove that Fermi level remain invariant in a p-n junction under equiliberium condition.

2. Find an expression of density of states in the Valence band of a semiconductor and hence find expression of density of Holes for a non-degenerate semiconductor.

4+6

3. What is meant by abrupt junction. Find an expression of junction capacitance.

2+8

4. (a) Explain what is meant by Photoconductivity.

(b) Find an expression of growth of carrier in a seminconductor when light is incident on it.

(c) How can you measure relaxation time experimentally.

2+6+2

5. Assume Boltzman tansport equation and hence find an expression conductivity in non-digenerate semiconductor.

10

6. (a) Device Einstien relation for electron and Holes in a p-n junction under equilibrium condition.

(b) Derive diode equation assuming a p-n junction.

5+5

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TB—325