2016

M.Sc. 4th Seme. Examination

PHYSICS

PAPER—PHS-403

Full Marks : 40

Time : 2 Hours

The figures in the 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 Answer-scripts for Group-A & Group-B

Group-A

[Marks : 20]

Answer Q. No. *1* & *2* and any *one* from the rest.

1. Answer any *two* questions :

(a) What is the principle of Photodetection using a photodiode ? 2

(b) Describe the band structure of the material which leads to Gunn Effect oscillation. Why mobility varies with application of field in such material ? 1+1

(c) Find the surface potential ϕ_F corresponding to inversion in a MOC_3 capacitor on p-type Si with $N_a = 10^{15}$ cm^{-3} at room temperature and $n_i = 1.5 \times 10^{10}$ cm^{-3}. 2

2. Answer any *two* questions : 2×3

(a) Explain how drift mobility of minority carriers can be exprimentally determined by Haynes Schokley Experiment. 3

(b) What is meant by Quantum Hall effect ? 3

(c) Show the variation of mobility with temperature for a non-degenerate semiconductor in the low and high temperature region. 3

3. (a) Describe the device operation of p-n-p-n Diode and hence find an expression of current i through the device using two transistor analogy.

(b) What is a bilateral p-n-p-n diode configuration & show its i-v characteristic. 7+3

4. (a) Describe the I-V characteristics of Tunnel Diode using the band diagrams.

(b) What is volume component of thermo emf ? 8+2

Group-B

[Marks : 20]

Answer Q. No. *1* & *2* and any *one* from the rest.

1. Answer any *two* bits : 2×2

(a) Why is the use of coherent light important in holographic recording ?

(b) Write the expressons of refractive indices of a Pockels and Kerr types of materials. Give one example for each type.

(c) Compare focusing by a convex lens with the self focusing by a non-linear material.

(d) Construct a tristate NOT gate.

2. Answer any *two* bits : 3×2

(a) Discuss the method of adding two different frequencies using a non-linear material.

(b) What is a single mode optical fiber ? Write the advantages of single mode fiber in digital communication over a multimode one.

(c) With supporting diagram and truth table discuss the operation of optical or opto-electronic Ex-OR logic gate.

(d) In a step index fibre the refractive indices of the core and the cladding are 1.4746 and 1.4600 respectively. Find the intermodal delay for an impulse passing through such a fibre of length 10 km.

3. Starting from Maxwell's equation derive the expressions of TE symmetric and anti-symmetric modes of electromagnetic waves in a planar wave guide. Derive also the expression of power of any single mode of wave passing through the fiber. 7+3

4. Why a material becomes optically non-linear and what are the characteristics of a non-linear optical material ? How these materials are used in medical sciences ? Give two examples of organic non-linear optical crystal.

Construct an opto-electronic half adder circuit.

How phase matching condition is satisfied in 2nd harmonic generation ? 1+2+1+1+3+2
