2017

M.Sc.

4th Semester Examination

PHYSICS

PAPER – PGS-403 (Gr. – A + B)

Full Marks : 50

Time : 2 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.

(Gr. A –Semiconductor Devices)
Answer Q1 and Q2 and any one from Q3 and Q4.

1. Answer any five bits: 5 X 2 = 10

(i) Why degenerate semiconductors are essential for the fabrication of semiconductor laser?

(ii) Prove that when lattice scattering is involved, mobility of a nondegenerate semiconductor can be shown as $\mu_e \propto T^{-\frac{3}{2}}$

(iii) What is SCR and how it is different from normal rectifier?

(iv) Explain how a bipolar transistor can be converted to a phototransistor.

(v) The resistivity of a semiconductor was known to be 0.00893Ωm at room temperature. The flux density B_z is 0.5 Weber/m^2. Calculate the Hall angle for a Hall coefficient of $3.66 \times 10^{-4}\ m^3/c$.

(vi) Explain how drift mobility can be experimentally determined through Hayne's Shockley experiment.

(Turn Over)

(vii) An n-channel Si JFET has $N_D = 10^{21} m^{-3}$ and a channel width 4μm. If ε=11.8, estimate the value of pinch-off voltage. Also calculate $(I_D)_{sat}$ $for\ V_{GS} = -2V$ and $I_{DSS} = 12mA$ in this case.

(viii) For an intrinsic semiconductor, the resistivity at 20^0C is 4.5 Ωm and at 32^0C is 2.0 Ωm. Find out the band gap energy for this semiconductor.

2. Explain the origin of negative differential mobility in a Gunn diode and hence find a relation between electron temperature and lattice temperature. What are the essential conditions required for a material to show Gunn effect oscillation? (4+4+2)

3.a) Using Boltzman transport equation, show that the Hall-coefficient of a non-degenerate semiconductor is $R_H = \frac{1}{ne}\frac{<\tau^2>}{<\tau>^2}$ where τ represent relaxation time.
b) Using Boltzman transport equation, find out the expression for thermoelectric power of a couple consisting non-degenerate semiconductor. (5+5)

(Gr. B – *Applied Optics*)

1. Answer any five bits: 5 X 2 = 10

(i) What are single mode and multimode optical fiber?

(ii) What do you mean by second harmonic generation?

(iii) Using simple derivation show that the refractive index of a nonlinear medium depends on the intensity of incident radiation.

(iv) Using any optical switching mechanism draw the ray diagram of optical AND, NOT and EXOR gate.

(v) What is hologram?

(vi) A LED at 850nm has δλ=30nm. What is its coherence length?

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(vii) A step-index optical fiber has core refractive index 1.5 and cladding refractive index 1.4. Calculate its acceptance angle.

(viii) Write the expression of phase matching condition for addition of two frequencies in a non-linear material.

2. What is pulse dispersion in optical fiber? Obtain the expression of multipath dispersion in an optical fiber having length L. Consider L=1Km, n(core)=1.45, n(cladding)=1.44, f=1MHz. Can you send a pulse train having duty cycle 0.5 through the fiber? Obtain the ray path for a graded index fiber. (1+4+3+2)

3. Write down the Maxwell equation in inhomogenous medium. Obtain the wave equation, solve it for n=n(x) only. Discuss TE mode for planar wave guide. (1+3+3+3)

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(Internal Assessment – 10)