

2017

**M.Sc. 4th Semester 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 &amp; 2 and any one from the rest.

1. Answer any *two* questions : 2×2
- (a) Explain the region of negative slope of I-V characteristics of a tunnel diode with a neat band diagram.
- (b) Find the maximum width of the depletion region for an ideal MOS capacitor on p-type Si with  $N_a = 10^{15} \text{ cm}^{-3}$ . The relative dielectric constant of silicon is 11.8. Intrinsic carrier concentration  $1.5 \times 10^{10} / \text{cm}^3$ .
- (c) Find a relation between Hall mobility and drift mobility. What is hot probe method ? 1+1

*(Turn Over)*

2. Answer any *two* questions : 2×3
- (a) Assuming drain voltage is small, find an expression of channel conductance of a FET. 3
- (b) Considering a bipolar transistor (pnp) under Common Base Configuration find an expression of injection efficiency ( $\gamma$ ). What conclusion can be drawn from the result. 3
- (c) If  $(n_l, v_l)$  and  $(n_u, v_u)$  are the electron densities and drift velocities respectively in the lower and upper valley. Find an expression of average drift velocity and electron temperature in GaAs. 2+1
3. (a) Explain with neat band diagram the ideal MOS capacitor and effects of applied voltage on it.
- (b) Explain the capacitance-voltage characteristics for the ideal n channel (p substrate) MOS capacitor at high measurement frequency. 8+2
4. (a) Find an expression of deviation from equilibrium distribution function introducing relaxation time in Boltzmann transport equation ? 3+5
- (b) Apply this deviation to find the thermoelectric power of a nondegenerate semiconductor.
- (c) What is quantum Hall effect ?
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**Group-B**

[ Marks : 20 ]

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

1. Answer any *two* bits : 2×2
- (a) What are the different types of impairments for optical fiber alignment ?
  - (b) Write the advantages of an all optical logic gate over electronic and opto-electronic logic gate.
  - (c) What is holography ? Make a comparison between ordinary photography and a holography.
2. Answer any *two* bits : 3×2
- (a) Give the examples of two inorganic and two semi-organic non-linear optical crystals. What is the advantage of semi-organic non-linear crystals over inorganic non-linear crystals ?
  - (b) Construct an opto-electronic full adder circuit.
  - (c) Show that the refractive index of a non-linear material depends on the intensity of light falls on it.
3. Describe the working principle of an optical fibre and explain the necessity of cladding in it.  
What do you mean by attenuation in an optical fibre ? Derive the expression for attenuation in an optical fibre.

If 15% the power fed at the launching end of a 500 m fibre is lost during propagation, calculate the attenuation in dB/Km.

Give the expression for the numerical aperture (NA) of an optical fibre and show that it is related to the fractional index change  $\Delta$ , by the equation

$$NA = n_1 \sqrt{2\Delta}$$

where  $n_1$  is the refractive index of the core.

2+1+1+2+2+2

4. How the non-linearity of a medium can be used for achieving second harmonic generation ?

Discuss the process of self-focussing by exploitation of non-linear phenomenon of a dielectric medium.

What is the advantage of tri-state logic system over binary system ?

How the tri-state logic system is achieved in practice ?

Construct an opto-electronic XOR gate. 2+3+1+2+2