

2023**M.Sc.****4th Semester Examination****PHYSICS****PAPER : PHS-403.1 & 403.2***Full Marks : 40**Time : 2 hours*

*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.*

SECTION—I**(SEMICONDUCTOR DEVICE)****PHS-403.1**

1. Answer *any two* questions from the following : 2×2=4
- (a) Find an expression of hall mobility in a non-degenerate semiconductor.
- (b) Find an expression of transport coefficient in a bipolar transistor (*pnp*) under common base configuration.

(2)

- (c) What are the criteria for obtaining -ve differential mobility region in the v_d vs ϵ curve of Gunn effect oscillator.
- (d) Explain how the channel can be opened in a MOSFET.

2. Answer *any two* questions from the following :

4×2=8

- (a) Describe in detail, the I - V curve of a tunnel diode.
- (b) Prove that for a non-degenerate semiconductor mobility vary as $T^{-3/2}$ in the high temperature region.
- (c) Explain in detail, the operation of MODFET.
- (d) Describe in detail, how drift mobility of a carrier in a semiconductor can be determined experimentally.

3. Answer *any one* question from the following :

8×1=8

- (a) Explain what is Gunn effect oscillator and hence find an expression of electron temperature.
- (b) Assuming Boltzmann transport equation, find an expression of conductivity in a non-degenerate semiconductor.

(3)

SECTION—II

(APPLIED OPTICS)

PHS-403.2

1. Answer *any two* questions from the following :

2×2=4

- (a) Why does crosstalk happen for copper wire communication?
- (b) Calculate the carrier frequency and energy in eV for an optical communication system operating at $\lambda = 1.55 \mu\text{m}$.
- (c) Write down the truth table of the tri-state AND gate.
- (d) What is the difference between ordinary photography and holography?

2. Answer *any two* questions from the following :

4×2=8

- (a) A $\lambda = 1.3 \mu\text{m}$ optical transmitter is used to obtain a digital bit stream at a bit rate of 2 Gb/s. Calculate the number of photons N_{Ph} contained in a single 1 bit when the average power emitted by the transmitter is $P = 4 \text{ mW}$. Assume that the 0 bit carry no energy. 1+3
- (b) What is self-focusing? Determine the expression for self-focusing length. 1+3

(4)

- (c) Define the photosensitivity and the photo-responsivity of a photodetector. 2+2
- (d) How is holography recording done? 4

3. Answer *any one* question from the following :
8×1=8

(a) (i) Why does a material become optically non-linear and what are the characteristics of a non-linear optical material? How these materials are used in material sciences?

(ii) What is the advantage of a tri-state system over a binary system? How is optically tri-state generated?

(2+1+2)+(1+2)

(b) What do you mean by the V-parameter of an optical fibre? Show how the number of modes allowed in fibre is calculated by using V-parameter. 3+5

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