M. Sc. 4th Semester Examination, 2024

PHYSICS

PAPER — PHS-403.1 & 403.2

Full Marks : 50

Time : 2 hours

Answer **all** questions

The figures in the right hand margin indicate marks

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

PAPER — PHS-403.1

(*Transport Propertion and Semiconductor Devices*)

Marks : 20

A . Answer any *two* bits : 2×2

   1. Find an expression of transport coefficient in a *PNP* transistor under common base configuration.

2. Explain the principle of Hayne's Shockley experiment to measure the drift mobility in a doped semiconductor.

3. Show the configuration of SCS and its usefulness.

4. Explain what is meant by Modulation doping and it's utility.

B. Answer any *two* bits : 2×4

5. Explain with band diagrams the I-V characteristics of a tunnel diode.

6. Draw the MOSFET configuration and explain how the channel is opened in such device.

7. Derive the condition to show the variation of mobility with distance from the junction in a nondegenerate semiconductor.

8. Explain the operation of phototransistor and its usefulness as a photodetector.

C. Answer any *one* bit : 1 × 8

9. Find the expression of channel conductance of a JFET assuming applied drain voltage is large.

10. Explain the operation of Schokley Diode and find an expression of current through this device. Explain the different process of triggering to initiate switching in such a device.

PAPER — PHS-403.2

(*Applied Optics*)

Marks : 20

A . Answer any *two* questions : 2 × 2

11. Why does call-drop happen for copper wire communication ?

12. Why does the refractive index of a material remain constant when exposed to normal tungsten light but changes under high-intensity laser light ?

13. Construct an optical NOT gate.

14. What is 'Spatial Light Modulator (SLM)' and what is its characteristics ?

B. Answer any *two* questions : 2×4

15. Explain single mode step-index, multimode step-index and multimode graded index optical fibers.

16. What is the fractional refractive index change (Δ) ? How can we express the numerical aperture of an optical fiber in terms of the fractional refractive index change ?

17. Find the range of diameters for a step-index optical fiber with core and cladding refractive indices of 1.50 and 1.48 respectively. The fiber should be capable of carrying only one symmetrical and one asymmetrical modes of light at a wavelength of 1.5 μm.

(*Continued*)

18. Explain, how optical NOR and OR can be achieved in practice ?

C. Answer any *one* question : 1 × 8

19. What do you mean by second harmonic generation of laser ? What do you mean by phase matching condition ? Discuss the method of obtaining the second harmonic light from a non-linear material with supporting figure. 3 + 1 + 4

20. What are the supiority of optical logic gates over electronic gates and optoelectronic gates ? Construct optoelectronic half adder circuit and verify its truth-table.

3 + 5

[Internal Assessment — 10 Marks]