505665

D 101307

(Pages : 2)

Name.....................................

Reg. No.................................

FOURTH SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, APRIL 2024

(CBCSS)

Physics

PHY 4E 22—PHYSICS OF SEMICONDUCTORS

(2019 Admission onwards)

Time : Three Hours

Maximum : 30 Weightage

Section A

8 Short questions, each answerable within 7½ minutes.
Answer **all** *questions.*
Each question carries weightage 1.

1. What types of transitions are considered "forbidden" in the context of optical properties ?

2. What is the recombination process in semiconductors ?

3. How does doping affect the Fermi level in semiconductors ?

4. Briefly explain the theory of carrier transport in P-N junctions.

5. Describe the structure and operation of a tunnel diode.

6. Explain photovoltaic effect.

7. What is a thin film ?

8. What is a quantum well in semiconductor physics ?

(8 × 1 = 8 weightage)

Section B

4 Essay questions, each answerable within 30 minutes.
Answer any **two** *questions.*
Each question carries weightage 5.

9. Explain :

   (i) The phonon-assisted transitions in semiconductor materials and their spectral shapes in optical spectra.

   (ii) The Burstein-Moss effect.

Turn over

505665

10. Discuss the factors that determine the electrical conductivity of a semiconductor.

11. Discuss the formation and characteristics of a Schottky barrier. How does it differ from p-n junction ?

12. Explain the Quantum Hall effect and its significance in physics of semiconductors.

(5 × 2 = 10 weightage)

Section C

7 Problems answerable within 15 minutes.

Answer any **four** *questions.*

Each question carries weightage 3.

13. If the thickness of a GaAs semiconductor is 1cm and 50 percent of the incident monochromatic photon energy is absorbed, determine the incident photon energy and wavelength.

14. Determine the temperature at which a state, located 0.5 eV above the Fermi energy has 2% probability of being occupied, given Boltzmann's constant as 1.38×10^{-23} J/K.

15. Determine the current flowing through a *p-n* junction at room temperature when a forward bias of 0.6 V is applied across it, given a saturation current of 1.5 μA.

16. Determine the width of a potential well such that the binding energy of an electron (with effective mass m* = 0.055 me) equals 0.03 eV, given the potential well height of 0.06 eV.

17. Compute the mobility and carrier concentration of carriers in a semiconductor with a Hall coefficient (R_H) of 4.75×10^{-4} m^3/C, and a resistivity of 7.2×10^{-3} Ωm.

18. Sketch the energy band diagram of a *p-n* homo-junction under equilibrium.

19. A InP LED emits light at a wavelength of 1300 nm. If the device operates with a forward current of 15 mA, determine the power output given that the internal quantum efficiency is 5 %.

(4 × 3 = 12 weightage)