Roll No. .....

# 40006

## . Tech. 2nd Sem. (Artificial Intelligence & Data Science) Examination – May, 2026

### SEMICONDUCTOR PHYSICS

**Paper : 25BSC-PHY-103-H**

*Time : Three Hours ]* *[ Maximum Marks : 70*

*Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.*

**Note :** Attempt *five* questions in all, selecting *one* question from each Unit. Question No. 1 is ***compulsory***. All questions carry equal marks.

**1.** Attempt any *seven* sub-questions : $7 \times 2 = 14$

(a) Explain the photoelectric effect.

(b) What do you mean by the de-Broglie hypothesis ? Write the equation for de-Broglie wavelength.

(c) An X-ray photon of wavelength 0.060 nm is scattered by an electron at a scattering angle of 90°. Calculate the change in wavelength (Compton shift) and the wavelength of the scattered photon. (Given : $h/m_eC = 0.00243$ nm)



https://www.mdustudy.com

(d) Draw the energy band diagrams of intrinsic, p- type, and n- type semiconductors.

(e) What do you mean by the photovoltaic effect ?

(f) Define the fill factor of a solar cell.

(g) Explain normal and metastable excited states.

(h) Write a very short note on reverse saturation current.

(i) What do you mean by a Schottky junction ?

(j) Define population inversion in laser.

### UNIT – I

**2.** (a) Derive Planck's Radiation Law and discuss how it helps to explain Black body radiation. 10

(b) Write limitations of Classical Physics. 4

**3.** (a) Derive time-independent Schrödinger wave equation. 10

(b) Explain Physical significance of wave function of matter wave and write its important properties. 4

### UNIT – II

**4.** (a) Write down the significant properties of metals. Define Ohm's Law and explain it using Drude's free electron theory of metals. 10

https://www.mdustudy.com

(b) Derive effective mass of an electron in periodic potential and draw $m^*$-K diagram. 4

5. Explain energy band theory in solids. Mathematically illustrate how the Kronig-Penney model introduces the concept of allowed and forbidden energy regions. 14

## UNIT – III

6. (a) Derive formulas for electron-hole concentration and Fermi energy in an intrinsic semiconductor. Explain the effect of temperature on the Fermi level. https://www.mdustudy.com 10

(b) Define drift current and diffusion current and write their expressions. 4

7. (a) What is a solar cell ? Explain its principle, construction and working using proper diagram. Discuss its performance parameters. 10

(b) What is meant by forward biasing and reverse biasing of a p-n junction ? Also specify which type of biasing is used in LED and photo-conducting cell. 4



https://www.mdustudy.com

## UNIT – IV

8. (a) Discuss light-matter interaction phenomena and derive the relation between Einstein's coefficients. 10

(b) List the important applications of LASER radiation. 4

9. (a) Explain construction, working and energy level diagram of solid state laser (Ruby Laser). 10

(b) A semiconductor Laser emits radiations of frequency band width 1 GHz then find out coherence time ($\tau_C$) and coherence length ($L_C$). 4

https://www.mdustudy.com