UPH120526BA-1

Reg No.: ____________ Name: ____________

Jyothi Engineering College(Autonomous)

B. Tech Degree S2 (R) Examination, May 2026(2025 Scheme)

25PHT101 - PHYSICS FOR INFORMATION SCIENCE

Total Mark: 60 **Total Time: 2hrs 30 min**

CO MARK

PART A

(Answer All Questions. Each question carries 3 marks)

1. Draw neat and labelled energy band diagrams for conductors, semiconductors, and insulators, and clearly show the valence band, conduction band, forbidden energy gap in each case. CO1 (3)

2. Write any three applications of superconductors. CO1 (3)

3. Write the normalization condition for a wavefunction and mention its significance. CO2 (3)

4. Starting from the wave equation and introducing energy and momentum of the particle obtain an expression for one dimensional wave function. CO2 (3)

5. In a rectifier circuit, a silicon diode operates at **300 K** with a reverse saturation current of **8 nA** . If a forward voltage of **0.5 V** is applied across the diode, determine the resulting forward current. Given $V_T = .026V$ CO3 (3)

6. Explain how doping a semiconductor with acceptor atoms affects the position of the Fermi level. CO3 (3)

7. Explain the concept of connecting solar cells in series or parallel, known as stringing. CO4 (3)

8. Explain the working principle of a semiconductor laser. CO4 (3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module - 1

9. Based on the assumptions of classical free electron theory, obtain the expressions for current density and electrical conductivity of a metallic conductor in terms of the concentration of free electrons. CO1 (9)

OR

10. Explain the band theory of solids and classify materials based on energy gap. CO1 (9)

Module - 2

11. Determine the normalized wave functions for a particle confined in a one-dimensional box and sketch the first three normalized wave functions inside the box. CO2 (9)

OR

12. a) Using deBroglie's formula and Einstein's relation for photon energy, derive the time-dependent Schrödinger equation starting from a plane wave. CO2 (5)

b) Explain how the finite lifetime of an excited atom causes natural broadening of spectral lines using Heisenberg's uncertainty principle. CO2 (4)

Module - 3

13\. a) Explain Fermi energy. Using the Fermi–Dirac distribution function, obtain an expression for the probability of occupancy of a hole in the valence band of an intrinsic semiconductor. CO3 (5)

b) With the help of a neat diagram, explain the V–I characteristics of a p n junction diode. CO3 (4)

OR

14\. Derive the expression for the intrinsic carrier concentration in a semiconductor and explain how it varies with temperature. List and explain the main properties of intrinsic semiconductors. CO3 (9)

Module - 4

15\. a) Explain the working of a tunnel diode with its V–I characteristics. CO4 (5)

b) A bridge rectifier supplies power to a **200 Ω** load. The transformer secondary provides an RMS voltage of **20 V**. Calculate (a) the DC output voltage, (b) the DC load current, and (c) the RMS value of the load current. CO4 (4)

OR

16\. a) With the help of a labelled diagram, explain how a centre-tap full-wave rectifier converts AC into DC. CO4 (5)

b) Explain any four advantages of Light Emitting Diodes (LEDs) in practical applications. CO4 (4)

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