School of Basic Sciences
Master of Science in Physics
Mid Term Examination - Nov 2023

Duration : 90 Minutes
Max Marks : 50

### Sem I - C1PO101B - Solid State Electronics

General Instructions
Answer to the specific question asked
Draw neat, labelled diagrams wherever necessary
Approved data hand books are allowed subject to verification by the Invigilator

1) Explain the energy band in solids and classify the materials based on energy gap. — K2 (2)

2) Why is a semiconductor an insulator at ordinary temperature? — K1 (3)

3) Illustration of band diagram of pn junction with and without biasing. — K2 (4)

4) Show that in an intrinsic semiconductor the conductivity of the material is given by the expression; s= e n (µe +µp), where [s =conductivity, n carrier density µe = mobility of electron and µp= mobility of hole and e= electronic charge]. — K2 (6)

5) Discuss the varation of charge density, porential and electric field with distance in depletion region of p-n Junction . — K3 (6)

6) A 2V battery is connected across the points A and B as shown in the figure. Assuming that the resistance of each diode is zero in forward bias and infinity in reverse bias, Find the current supplied by the battery when its positive terminal is connected to A. If 2V battery is replaced by 0.2 V, then find the current in the circuit assuming each diode as practical diode made of germanium. — K3 (9)
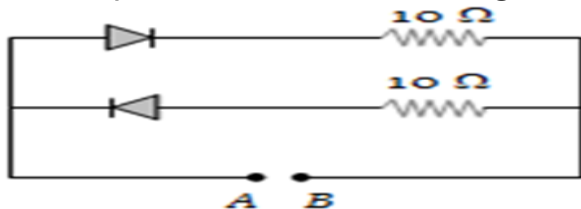
7) Define built-in-potential (potential barrier). What will be direction of internal electric field developed due to potential barrier in a zero biased p-n junction diode? — K4 (8)

8) For an intrinsic semiconductor with gap with, Eg = 0.7 eV, determine the position of the Fermi level at 300 K if m_p^* = 6 m. Also calculate the density of holes and electrons at 300 K. How are these quantities altered if E, = 7 eV? — K4 (12)

OR

Obtain the expression for junction capacitance of pn junction. To calculate the junction capacitance of silicon pn junction with $V_{bi} = 0.635V, N_a = 10^{16} cm^{-3}, N_d = 10^{15} cm^{-3}, \varepsilon s = 11.7 \ and \ V_r = 5V.$ — K4 (12)