

School of Basic Sciences
Bachelor of Science Honours in Mathematics
Mid Term Examination - Mar 2024

Duration : 90 Minutes
Max Marks : 50

Sem VI - C1UD604B - Analog and Digital Principles and Applications

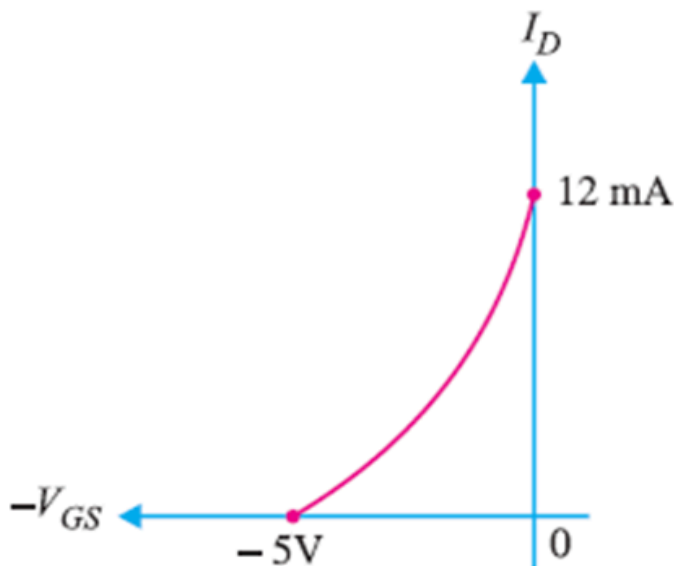
General Instructions

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) Discuss the expression for intrinsic carrier concentration of semiconductors K2 (2)
- 2) Explain threshold voltage (knee voltage) and breakdown voltage in a p-n junction diode K1 (3)
- 3) Explain the depletion mode and enhancement mode of MOSFET. K2 (4)
- 4) A sample of germanium is made of p-type material by adding acceptor atoms at a rate of one atom per 4×10^8 germanium atoms. $n = 2.5 \times 10^{19}/m^3$ at 300 K and all the acceptor atoms are ionised at 300 K. The density of germanium atoms is $4.4 \times 10^{28}/m^3$. Compare the density of electrons with intrinsic charge carriers. K2 (6)
- 5) Figure shows the transfer characteristic curve of a JFET. Write the equation for drain current K3 (6)



- 6) Calculate the intrinsic conductivity at 300 K for germanium. Calculate also the dependence of conductivity on temperature about room temperature. K3 (9)
 Given:

$$\mu_e = 0.39 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1} \text{ and } \mu_p = 0.19 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}, K_B = 1.38 \times 10^{-23} \text{ J/k}, h = 6.626 \times 10^{-34} \text{ J-s and } m_0 = 9.1 \times 10^{-31} \text{ kg}$$

- 7) Write the important difference between transistor and FET. Discuss the operation of common source configuration of FET. K4 (8)

- 8) For an intrinsic germanium semiconductor, determine the position of the Fermi level at 300 K if $m_p^* = 6 m_e^*$. Also calculate the density of holes and electrons at 300 K. How are these quantities altered if $E_g = 7$ eV? K4 (12)
 Given:

$$K_B = 1.38 \times 10^{-23} \text{ J/k}, h = 6.626 \times 10^{-34} \text{ J-s and } m_0 = 9.1 \times 10^{-31} \text{ kg}.$$

OR

- For the JFET in Figure, $V_{GS(off)} = -4\text{V}$ and $I_{DSS} = 12\text{mA}$. Determine the minimum value of V_{DD} required to put the device in the constant-current region of operation. K4 (12)

