

JK Lakshmipat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, December 2023
 B. Tech. (ECE), Semester III, 2022-26

Roll No.....

EE1101: Electronic Devices and Circuits

Time: 2.5 hours

Max. Marks: 30

Instructions to students:

1. Do not write anything other than your roll number on the question paper.
2. Mention all the assumptions for your answers clearly.

- Q. 1 A silicon sample is doped with 10^{17} As atoms/cm³. The intrinsic concentration for Silicon at room temperature is 1.5×10^{10} /cm³. What is the equilibrium hole concentration at room temperature? Show the position of the Fermi level. 3.0 (LO1)
- Q. 2 A bar of n-type Ge of size 0.010m x 0.001m x 0.001m is mounted in a magnetic field of 2×10^{-1} T. The electron density in the bar is 7×10^{21} /m³. If one millivolt is applied across the long ends of the bar, determine the current through the bar and the voltage between Hall electrodes placed across the short dimensions of the bar. Assume mobility of electron = $0.39 \text{ m}^2/\text{V}\cdot\text{sec}$ 4.0 (LO1)
- Q. 3 The figure 1 shows a common emitter transistor amplifier having $R_1 = 25 \text{ k}\Omega$, $R_2 = 5 \text{ k}\Omega$, $R_C = 1 \text{ k}\Omega$ and $R_E = 100 \Omega$. Find the percentage change in the collector current, if the transistor with $h_{fe} = 50$ is replaced by another transistor with $h_{fe} = 150$. It is given that the base-emitter drop $V_{BE} = 0.6 \text{ V}$. 4.0 (LO2, 3)

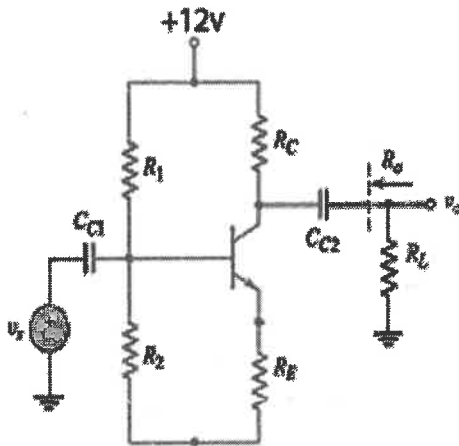


Figure 1

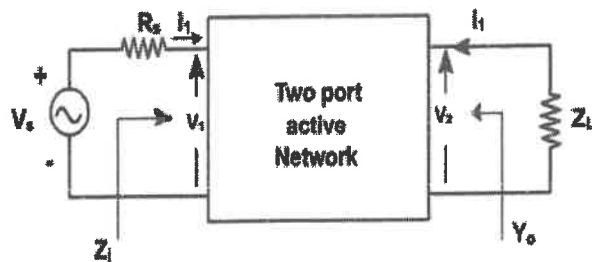


Figure 2

- Q. 4 Develop the small signal equivalent circuit of the transistor shown by Figure 2 is connected as a common emitter amplifier. The h-parameters of the circuit are $h_{11} = 1.1 \text{ k}\Omega$, $h_{12} = 2.5 \times 10^{-5}$, $h_{21} = 50$ and $h_{22} = 24 \mu\text{A/V}$. If $R_L = 20 \text{ k}\Omega$ and $R_S = 1 \text{ k}\Omega$, find the input impedance, output impedance, voltage gain and current gain. 4.0 (LO2, 3)
- Q. 5 How does the voltage applied influence the depletion width and the capacitance of the MOS capacitor? Discuss the voltage dependence of capacitance in a MOS capacitor under accumulation, depletion, and inversion modes. 4.0 (LO4)

- Q. 6 Analyze the circuit shown below to determine the voltage at all the nodes and the current through all branches. Let $V_t = 1$ V and $k_n'(W/L) = 1$ mA/V². Neglect the channel length modulation effect. 4.0
(LO5)

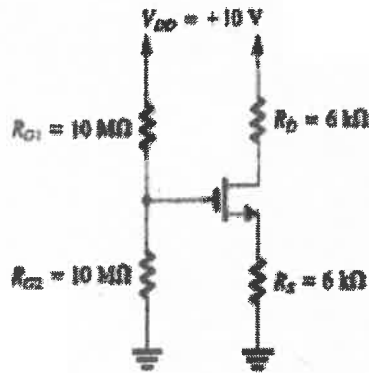


Figure 3

- Q. 7 For a given discrete enhancement MOSFET amplifier shown in figure 4, in which the input signal v_i is coupled to the gate via a large capacitor, and the output signal at the drain is coupled to the load resistance R_L via another large capacitor. We wish to analyze this amplifier circuit to determine its small-signal voltage gain and its input and output resistance. The transistor has $V_t = 2.5$ V, $K_n(W/L) = 0.20$ mA/V², and $V_A = 20$ V. Assume the coupling capacitors are sufficiently large so as to act as short circuits at the signal frequencies of interest. 4.0
(LO4, 5)

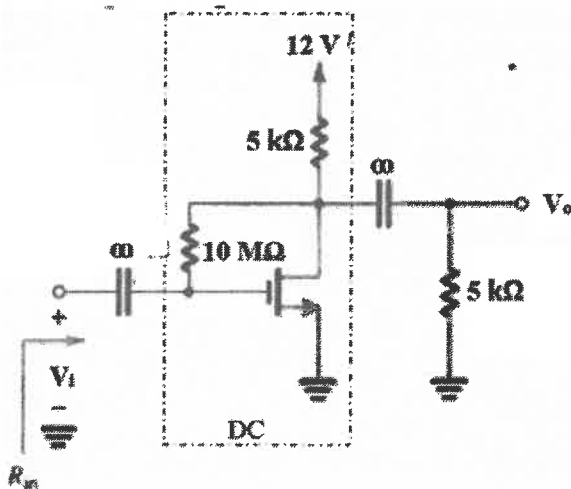


Figure 4

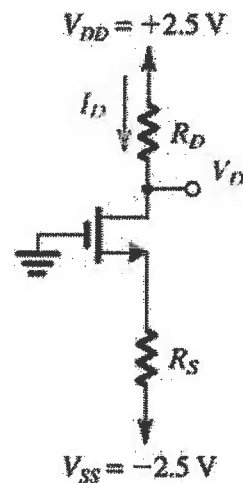


Figure 5

- Q. 8 Design the circuit of the below figure so that the NMOS transistor operates at $I_D = 0.4$ mA and $V_D = 0.5$ V. The given MOSFET has $V_t = 0.7$ V, $\mu_n C_{ox} = 100$ μ A/V², $L = 1$ μ m. Neglect the channel length modulation effect. 3.0
(LO5)

all the best!