JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Tech.-III Semester (ECE/ECS/EE VLSI)

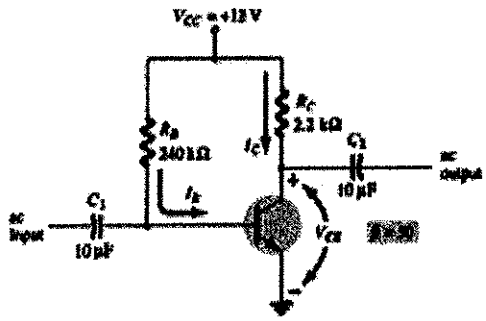
COURSE CODE (CREDITS): 25B11EC313 (04) MAX. MARKS: 35

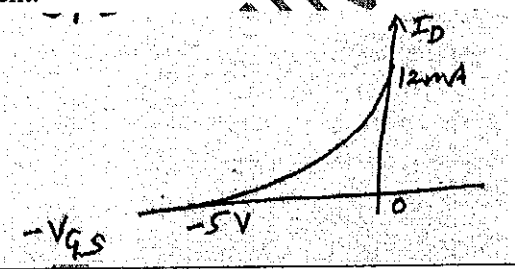
COURSE NAME: Electronic Devices and Circuits

COURSE INSTRUCTORS: Dr. Shruti Jain MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

Q.No	Question	CO	Marks
Q1	i. For a voltage divider biased NPN transistor $V_{CC} = 18$ V, $R_1 = 39$ kΩ, $R_2 = 10$ kΩ, $R_C = 3.3$ kΩ, $R_E = 1$ kΩ, $\beta = 150$, Find Q-point. What is the function of the emitter resistor R_E? ii. From the given circuit, using a silicon transistor, what is the value of I_{BQ} and V_{BC}?  $R_C = 2.2K\Omega$ $R_B = 240K\Omega$ $\beta = 50$ $V_{CC} = 12V$	2	2.5 + 2.5
Q2	A microcontroller operates at 3.3 V, and is used to drive a 12 V DC motor through a power transistor. The motor draws a peak current of 1.5 A. The designer chooses an n-channel Enhancement MOSFET instead of a BJT. i. Why is a BJT not ideal for this switching application? ii. Explain why an enhancement MOSFET is suitable as a high-current switch. Write current equations for three regions. iii. What is the role of threshold voltage V_{th} in deciding MOSFET turn-on? Explain all conditions. iv. How does using a MOSFET improve efficiency and reduce heating? v. Write the equation of V_{DS} considering the circuit as voltage divider biasing.	3	1 × 5
Q3	i. For an n-channel self-bias JFET : $I_{DSS} = 12$ mA, $V_P = -4$ V, $R_S = 1$ kΩ. Find I_D and V_{GS} ii. For a given n-MOSFET $V_{DD} = 10$ V, $R_D = 2.2$ kΩ, $V_{GS} = 4$ V, $V_{TH} = 2$V, $k = 1$ mA/V^2. Find I_D and V_{DS}.	4	2 + 1 + 1 + 1

	iii.	In a CS amplifier, given that $r_{ds} = 0.5M\Omega$ and $g_m = 5m\Omega^{-1}$, the load is 10kΩ, source resistance is 44 kΩ. Calculate the internal amplification factor for the small signal model.		
	iv.	For an n-channel JFET with I_{DSS} = 12 mA and $V_P = -3$ V. Find the small-signal transconductance g_m at $V_{GS} = -1$ V.		
Q4	i.	The JFET with $g_m \approx 5.33$ mS at the bias point is used in a common-source amplifier with drain resistor R_D = 10 kΩ . The source is bypassed (source at AC ground). Estimate the small-signal voltage gain A_v (neglect r_o).	5	1.5 + 3.5
	ii.	Explain Sita the difference between Low-frequency response of BJT amplifier and Low-frequency response of FET amplifier. Also, explain her High frequency transistor models and small signal models.		
Q5	i.	A sensor output very small voltage signal and need extremely high input impedance at the amplifier stage. Which FET type would you select and why?	5	1 × 5
	ii.	In a battery-powered IoT device, energy efficiency is critical. Explain why MOSFETs are used in the on/off control stage instead of BJTs.		
	iii.	A mixer circuit in RF uses a JFET as a voltage-controlled element. Explain how the JFET's pinch-off behaviour contributes to mixing.		
	iv.	What are the two intercepts of a DC load line for JFET?		
	v.	Fig shows the transfer characteristics of JFET. Write the equation for drain current. 		
Q6	i.	What happens to g_m if I_D increases? Explain with equation	6	1 + 2 + 2
	ii.	The datasheet of a JFET gives following information I_{DSS} = 3 mA, V_P = −6 V, g_{m0} = 5000μS. Determine the transconductance for V_{GS} = −4V. Evaluate R_S.		
	iii.	What are the three main frequency regions of a single-stage amplifier? Which region shows maximum flat gain? How does cascading amplifiers affect overall gain?		
Q7	Shyam is working on his major project. He got confused in rectifiers and clippers. Differentiate between rectifiers, and clippers. Explain the purpose of each circuit with suitable examples and waveforms.		1	5