

**S.No. of Question Paper : 1751**

Name of the Course : B. Sc.(H) Instrumentation (Core)

Name of the Paper : Analog Devices and Circuits

Unique Paper Code : 2512043602

Semester : VI

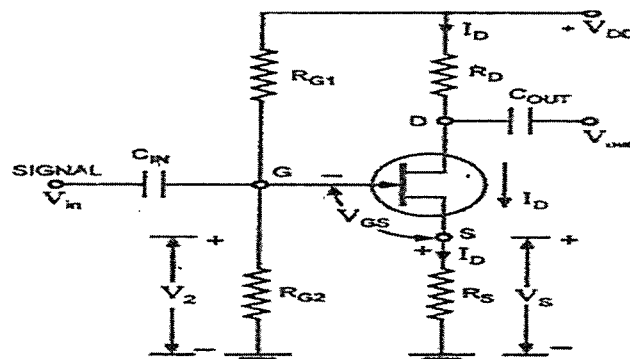
Duration : 3 hours

Maximum Marks : 90

**Instructions for candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any five questions in all. Question 1 is compulsory
3. Use of non-programmable scientific calculator is allowed.

- Q.1 (a) Explain the working principle of IR emitter and its applications. (3)
- (b) Given  $I_{DSS} = 12 \text{ mA}$  and  $V_p = -4 \text{ V}$ . Sketch the transfer characteristics for the JFET. (3)
- (c) An n-channel Enhancement MOSFET has  $V_{th} = 2 \text{ V}$ ,  $k = 0.5 \text{ mA/V}^2$ . If  $V_{GS} = 4 \text{ V}$ , calculate drain current  $I_D$ . (3)
- (d) If a CMOS inverter operates at  $V_{DD} = 3.3 \text{ V}$  and load capacitance is  $10 \text{ pF}$ , calculate dynamic power dissipation at frequency  $5 \text{ MHz}$ . (3)
- (e) A UJT relaxation oscillator uses  $R = 10 \text{ k}\Omega$  and  $C = 100 \mu\text{F}$ . If  $\eta = 0.5$  and  $V_{BB} = 12 \text{ V}$ , find the time period of oscillation. (3)
- (f) Determine the transition capacitance of a diffused junction varicap diode at a reverse potential of  $4.2 \text{ V}$ . if  $C(0) = 80 \text{ pF}$  and  $V_T = 0.7 \text{ V}$ . (3)
- Q.2 (a) Compare Schottky Diode and PN junction diode with characteristics and their applications. (6)
- (b) Explain the working principle of LCD and compare it with LED display. (6)
- (c) Describe the construction, working, characteristics, and applications of Solar Cell. (6)
- Q.3 (a) Explain in detail the construction, working, channel formation, pinch-off and output characteristics of JFET with neat diagrams. (6)
- (b) Discuss different FET biasing methods and explain self-bias in detail. (6)
- (c) For the network circuit shown below, Determine  $I_{DQ}$  and  $V_{GSQ}$ . Given  $V_{DD} = 20 \text{ V}$ ,  $R_{G1} = 910 \text{ K}\Omega$ ,  $R_{G2} = 110 \text{ K}\Omega$ ,  $R_D = 2.2 \text{ K}\Omega$ ,  $R_S = 1.1 \text{ K}\Omega$ ,  $I_{DSS} = 10 \text{ mA}$  and  $V_p = -3.5 \text{ V}$ . (6)



- Q.4 (a) Explain the small signal model of MOSFET. (6)
- (b) Explain and analyze the MOSFET Common Source amplifier and derive expressions for its voltage gain, input impedance, and output impedance. (6)
- (c) What is UJT? Explain the working of UJT as a relaxation oscillator. (6)
- Q.5 (a) Explain the working principle of a MOS inverter with diagram. (6)
- (b) Explain the impact of supply voltage scaling on power, delay and noise margin. (6)
- (c) Draw and explain the VTC of CMOS inverter. (6)
- Q.6 (a) What is a thermistor? Discuss the working principle of a thermistor. A thermistor has  $5\text{ k}\Omega$  resistance at  $25^\circ\text{C}$ . If temperature coefficient is  $-4\%$  per  $^\circ\text{C}$ , find its resistance at  $35^\circ\text{C}$ . (6)
- (b) Derive the Shockley equation for JFET. (6)
- (c) Differentiate between JFET and MOSFET in terms of structure, operation, input impedance, control mechanism, and performance parameters. (6)
- Q.7 (a) Compare Resistive-Load inverter and CMOS inverter. A CMOS inverter has  $V_{OH} = 5\text{V}$ ,  $V_{IH} = 3.5\text{V}$ ,  $V_{IL} = 1.5\text{V}$ ,  $V_{OL} = 0\text{V}$ . Calculate Noise Margin High (NMH) and Noise Margin Low (NML). (6)
- (b) Explain in detail the principle of operation and V-I characteristics of Tunnel Diode with neat diagram. (6)
- (c) For the network circuit shown below, sketch the ac equivalent network and calculate  $Z_i$ ,  $Z_o$  and  $A_v$ . Given  $V_{GSQ} = 0.35\text{V}$  and  $I_{DQ} = 7.6\text{mA}$ . (6)

