

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/ Backlog), November-December 2015

B. Tech in Electronics and Communication Engineering / Computer Science and Engineering /
Electrical Engineering, Semester III

Roll No.....

ECE 301: Electronic Devices and Circuits

Time: 3 hours

Max. Marks: 100

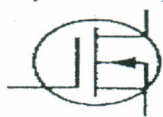
Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

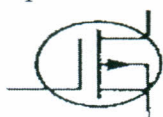
Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

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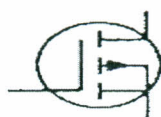
- i. When the temperature of a doped semiconductor is increased, its conductivity (a) decreases (b) increases (c) does not change (d) increases or decreases depending on whether it is p- or n-type.
- ii. Which of the following doping will produce an n-type semiconductor (a) Germanium with phosphorus (b) Silicon with Germanium (c) Germanium with Indium (d) Silicon with Boron
- iii. Zener breakdown results basically due to (a) collision of thermally generated minority carriers with a crystal ion (b) strong electric field across the junction (c) emission of electrons (d) rise in temperature
- iv. Which symbol represents p-channel depletion MOSFET?



(a)



(b)



(c)



(d)

- v. In a JFET, at pinch-off voltage applied on the gate (a) the drain current becomes almost zero (b) the drain current begins to decrease (c) the drain current is almost at saturation value (d) the drain-to-source voltage is close to zero volts.
- vi. The transconductance, g_m of a JFET is computed at constant V_{DS} by the following: (a) $\Delta I_D / \Delta V_{GS}$ (b) $\Delta V_{GS} / \Delta I_D$ (c) $\Delta I_D \times \Delta V_{GS}$ (d) $\Delta I_D / (\Delta I_D + \Delta V_{GS})$
- vii. When the Q point moves along the load line, V decreases when the collector current (a) Decreases (b) Stay the same (c) Increases (d) None of these.
- viii. When the BE junction is reverse biased and the CB junction is forward biased, the transistor is operating in which mode? (a) Saturation (b) Active (c) Cut-off (d) Reverse Active.
- ix. A transistorized voltage follower circuit has a voltage gain of (a) Infinity (b) Zero (c) Unity (d) less than unity.
- x. An amplifier operating in the frequency range up to a few megahertz may be classified as (a) audio (b) video (c) radio-frequency (d) ultrahigh-frequency.

Q.2 Short answer type questions (4 questions @ 2.5 marks) 10

Q.2A In an NPN silicon transistor $\alpha = 0.995$, $I_E = 10 \text{ mA}$, leakage current is $0.5 \mu\text{A}$. Determine I_C , I_B , β and I_{CEO} .

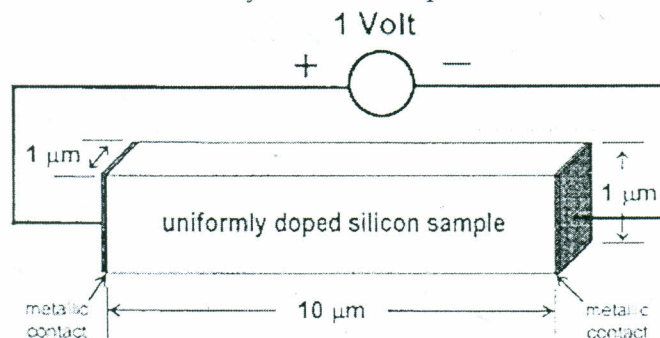
Q.2B Give a brief comparison between a BJT and a FET transistor.

Q.2C Draw only the transfer characteristics of N-channel JFET, DE MOSFET and E-only MOSFET.

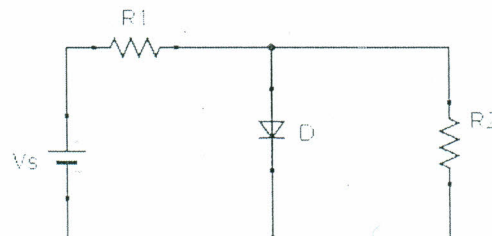
Q.2D Give the classification of amplifiers based on their **method of operation**.

Q.3A Consider a Si sample of length $10 \mu\text{m}$ and cross sectional area $1 \mu\text{m}^2$, uniformly doped with 10^{18} cm^{-3} arsenic, maintained at $T = 300^\circ\text{K}$. A potential difference of 1 Volt is applied across its length as shown below: 05

- What are the electron and hole concentrations (n and p) in this sample?
- What is the resistance of this sample?
- What is the conductivity of this sample?



Q.3B For the diode circuit shown below, $V_S = 2 \text{ V}$ and the silicon diode has a saturation current of 1 nA at 300 K . Given that the diode current $i_D = 0.5 \text{ mA}$, find (a) R_2 when $R_1 = 1 \text{ K}\Omega$ and (b) R_1 when $R_2 = 1 \text{ K}\Omega$. 05



Q.4A A triangular wave shown in Fig. (a) is applied to the circuit in Fig. (b). What is the name of this type of circuit? Explain the working of the circuit. Sketch the output waveform. 05

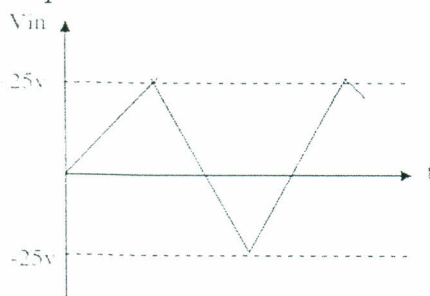


Fig. (a)

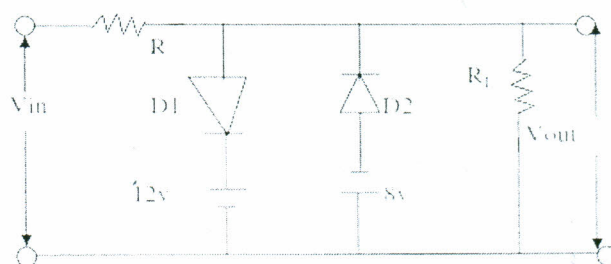
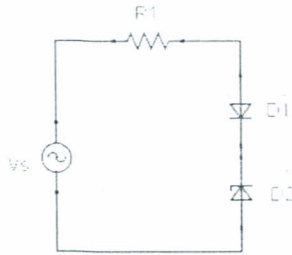


Fig. (b)

- Q.4B For the circuit shown below D1 is an ideal diode while D2 is a Zener diode with a breakdown voltage of 12 volts. If the input voltage $V_S = 24 \sin \omega t$, sketch the output voltage v_o . 05



- Q.5A Design a clamper circuit to shift an input waveform of 50 V peak-to-peak in such a way that the negative amplitude of the output waveform becomes -40 volts. 05
- Q.5B What is a Field Effect Transistor (FET)? Discuss the operation of n-channel depletion MOSFET by drawing its characteristics? 05

- Q.6A What is a Full Wave rectifier circuit? Discuss the operation of a Full Wave Bridge Rectifier circuit by indicating its advantages and disadvantages. 05

- Q.6B The typical h-parameter values of a Common Emitter amplifier is given as $h_{ie} = 1100 \Omega$, $h_{re} = 2.5 \times 10^{-4}$, $h_{fe} = 50$, $h_{oe} = 24 \mu A / V$. If the load resistance $R_L = 15K$ and the source resistance $R_S = 2K$, find A_{IS} , R_i , A_{VS} , Z_o . 05

OR

- Q.6B Draw the **small signal FET model** and label them correctly (by showing all the gains, voltages and impedances). You need to write the relevant equations. 05

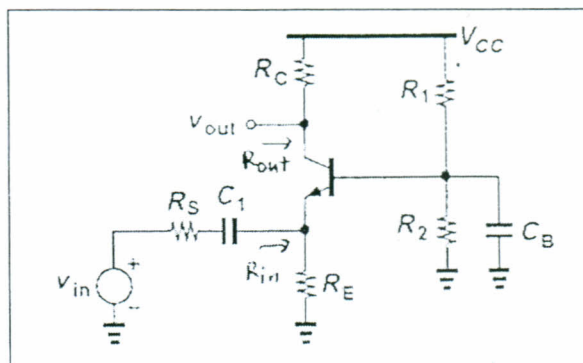
- Q.7A What do you understand by **biasing of a transistor** How will you obtain the generic formula for **Stability Factor**? Discuss its significance by considering a **Self-Bias** circuit. 05

- Q.7B Explain the **output characteristics only** of a Common Base (CB) Amplifier by indicating the circuit used and related plots. What is the significance of CB configuration characteristics? 05

OR

- Q.7B Explain the **output characteristics only** of a Common Emitter (CE) Amplifier by indicating the circuit used and related plots. What is the significance of CE configuration characteristics? 05

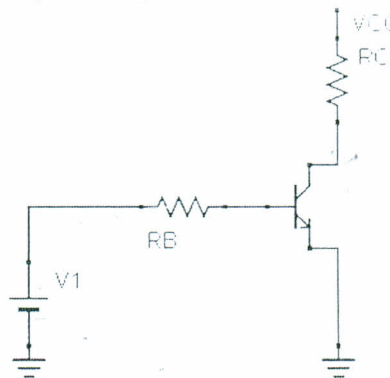
- Q.8 Consider the circuit shown:
(a). Is this a CE, CB or CC configuration circuit?
(b). Draw the h-parameter model diagram for the circuit. 10



Q.9A For the circuit shown below, suppose that $V_{CC} = 5\text{ V}$.

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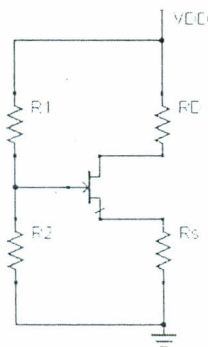
- Find the minimum value of h_{FE} required to saturate the BJT for the case that $R_B = 50\text{ K}\Omega$, $R_C = 1\text{ K}\Omega$, and $V_1 = 5\text{ V}$.
- Find the minimum value of R_C required to saturate the BJT for the case that $h_{FE} = 100$, $R_B = 50\text{ K}\Omega$, and $V_1 = 5\text{ V}$.
- Find the minimum value of R_B required to saturate the BJT for the case that $h_{FE} = 100$, $R_C = 1\text{ K}\Omega$, and $V_1 = 5\text{ V}$.
- Find the minimum value of V_1 required to saturate the BJT for the case that $h_{FE} = 100$, $R_B = 50\text{ K}\Omega$, and $R_C = 1\text{ K}\Omega$.



(Note: In the Figure V_{CC} is positive and you need to identify the transistor voltages and currents accordingly)

- Q.9B For the circuit shown below, the JFET has $I_{DSS} = 9\text{ mA}$ and $V_p = -3\text{ V}$. Given that $R_1 = 150\text{ K}\Omega$, $R_2 = 50\text{ K}\Omega$, $R_D = R_S = 7\text{ K}\Omega$, and $V_{DD} = 20\text{ V}$, assume active-region operation and determine (a) v_{GS} , (b) i_D , and (c) v_{DS} . Justify that the JFET is operating in the active-region. (Note: In the Figure V_{DD} is positive and you need to identify the JFET voltages and currents accordingly)

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OR

- Q.9B Discuss and perform the ac analysis of the **small signal Common Source JFET Amplifier model** (by labeling correctly all the gains, voltages and impedances). You need to write the relevant equations.

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*****ALL THE BEST*****