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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: III - THEORY EXAMINATION (2022 - 2023)

Subject: Electronic Devices

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of three Sections -A, B, & C. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.
2. Maximum marks for each question are indicated on right -hand side of each question.
3. Illustrate your answers with neat sketches wherever necessary.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.
6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION A

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1. Attempt all parts:-

- | | | |
|------|---|---|
| 1-a. | In P-N Junction Diode, Depletion region always penetrates more in the..... (CO1) | 1 |
| | (a) Lightly doped side | |
| | (b) Heavily doped side | |
| | (c) n- side | |
| | (d) p- side | |
| 1-b. | The Fermi-level in a p type semiconductor is shifted towards (CO1) | 1 |
| | (a) Conduction band | |
| | (b) Valence band | |
| | (c) Does not shift | |
| | (d) None of these | |
| 1-c. | In the active region of BJT, while the collector-base junction is _____-biased, the base-emitter is _____-biased. (CO2) | 1 |
| | (a) forward, forward | |
| | (b) forward, reverse | |

- (c) reverse, forward
- (d) reverse, reverse
- 1-d. In BJT, Determine the value of α when $\beta = 100$. (CO2) 1
- (a) 1.01
- (b) 101
- (c) 0.99
- (d) Cannot be solved with the information provided
- 1-e. In a JFET, the change in drain current for a given change in gate-to-source voltage, with the drain-to-source voltage constant, is (CO3) 1
- (a) breakdown.
- (b) reverse transconductance.
- (c) forward transconductance.
- (d) self-biasing.
- 1-f. The BJT is a _____ device. The FET is a _____ device. (CO3) 1
- (a) bipolar, bipolar
- (b) bipolar, unipolar
- (c) unipolar, bipolar
- (d) unipolar, unipolar
- 1-g. Which of the following describe(s) the difference(s) between JFETs and depletion-type MOSFETs? (CO4) 1
- (a) V_{gs} can be positive or negative for the depletion-type.
- (b) I_d can exceed I_{dss} for the depletion-type.
- (c) The depletion-type can operate in the enhancement mode.
- (d) All of the above
- 1-h. The gate-to-source voltage V_{gs} of a(n) _____ must be larger than the threshold $V_{gs}(Th)$ for the transistor to conduct. (CO4) 1
- (a) JFET
- (b) D-type MOSFET
- (c) E-type MOSFET
- (d) None of the above
- 1-i. The varactor is usually _____. (CO5) 1
- (a) Unbiased

- (b) Reverse biased
 - (c) Forward biased
 - (d) In the breakdown region
- 1-j. Which of the below mentioned statements is false regarding Schottky diodes? (CO5) 1
- (a) Schottky diodes have a Al-Silicon junction
 - (b) There is no storage of charges in a Schottky diode
 - (c) The majority charge carriers in a Schottky diode are holes
 - (d) Schottky diodes can be switched off faster than a p-n junction diode of the same rating

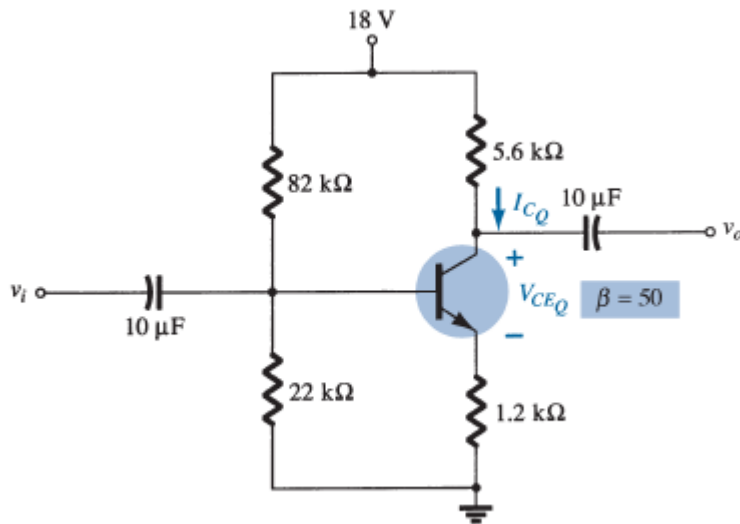
2. Attempt all parts:-

- 2.a. Briefly explain the meaning of doping and how it increases the conductivity of semiconductor? (CO1) 2
- 2.b. Write down the difference between pnp and npn transistors. (CO2) 2
- 2.c. How MOSFET different from JFET? (CO3) 2
- 2.d. Enlist the advantages of JFET Common Source amplifier. (CO4) 2
- 2.e. Give the symbol and structure of schottky diode. (CO5) 2

SECTION B 30

3. Answer any five of the following:-

- 3-a. Calculate the fermi level position in Si containing 10^{16} phosphorous atoms/cm³ at 1000 degree K assuming 50% of the impurities are ionized at this temperature. Also calculate the equilibrium electron and holes concentrations. (CO1) 6
- 3-b. Define and derive the expression of the built-in potential voltage and describe how it maintains thermal equilibrium. (CO1) 6
- 3-c. Determine the levels of I_{CQ} and V_{CEQ} for the voltage-divider configuration of given BJT Figure. (CO2) 6



- 3-d. (a) Calculate β for two BJT transistors for which $\alpha = 0.99$ and 0.98 . For collector currents of 10 mA , find the base current of each transistor. 6
- (b) A BJT transistor for which $I_S = 10^{-16} \text{ A}$ and $\beta = 100$ is conducting a collector current of 1 mA . Find V_{BE} . (CO2)
- 3.e. What is JFET? Given $I_{DSS} = 9 \text{ mA}$ and $V_P = -4 \text{ V}$, Determine Drain Current I_D when: a.) $V_{GS} = 0 \text{ V}$ b.) $V_{GS} = -2 \text{ V}$. (CO3) 6
- 3.f. Explain JFET as an amplifier with circuit diagram and graph. (CO4) 6
- 3.g. Describe the Zener diode and Explain its application as voltage regulator with circuit diagram and mathematical equations. (CO5) 6

SECTION C

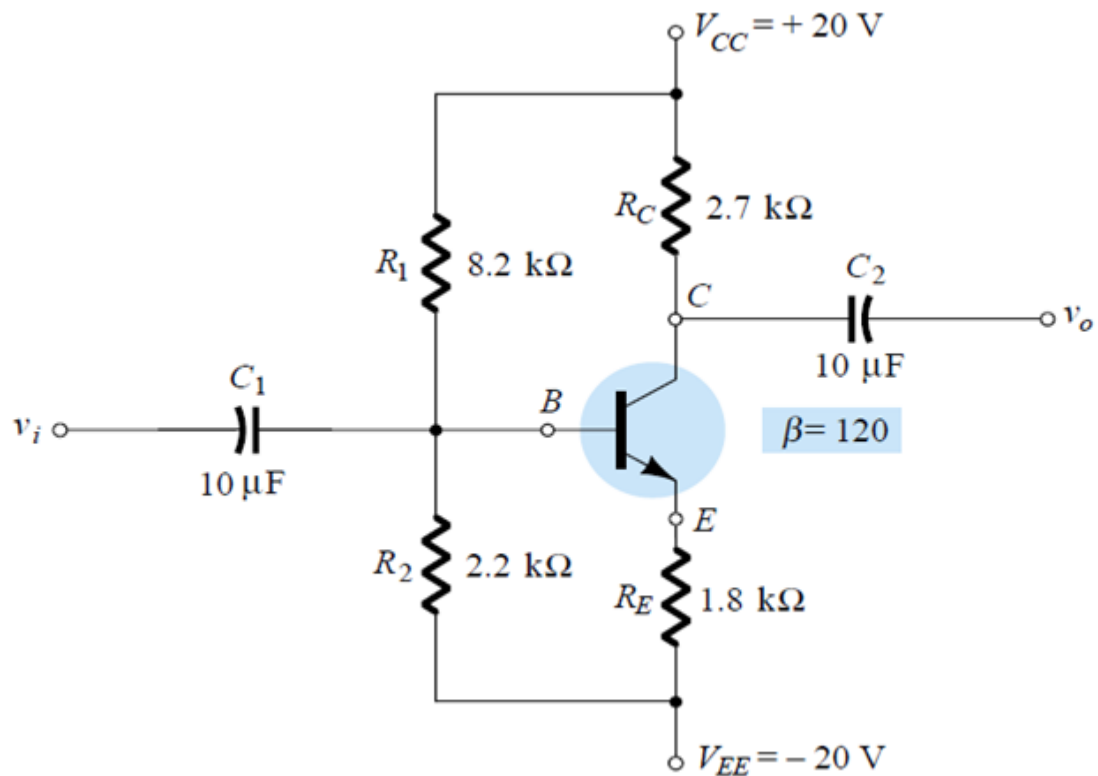
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4. Answer any one of the following:-

- 4-a. What is Potential Barrier in P-N junction Diode? A Si p-n junction has doping concentration as $N_a = 5 \times 10^{18} / \text{cm}^3$ and $N_d = 5 \times 10^{15} / \text{cm}^3$. Determine the space charge region width of the region at $T = 300 \text{ degree K}$ and at $V_r = 4 \text{ V}$. Assume $n_i = 1.5 \times 10^{10} \text{ per cm}^3$, $\epsilon_0 = 8.85 \times 10^{-14} \text{ F/m}$ and relative dielectric constant $\epsilon_r = 11.8$. (CO1) 10
- 4-b. Sketch P-N Junction diode diagram in forward Bias. Also Calculate V_b and W , if boron is implanted into an n-type sample ($N_d = 10^{16} \text{ per cm}^3$), forming an abrupt junction of square cross-section. Assuming that the acceptor concentration in p-type region is $N_a = 4 \times 10^{18} \text{ per cm}^3$, given that $n_i = 1.5 \times 10^{10} \text{ per cm}^3$, $\epsilon_0 = 8.85 \times 10^{-14} \text{ F/m}$ and relative dielectric constant $\epsilon_r = 11.8$. (CO1) 10

5. Answer any one of the following:-

- 5-a. Determine V_C and V_B for the network of given BJT Figure. (CO2) 10



- 5-b. Define current gain in BJT. A germanium BJT transistor is to be operated at zero signal $I_C = 10$ mA. If the collector supply $V_{CC} = 12$ V, what is the value of R_B in the base resistor method? Take $\beta = 100$. (ii) If another BJT transistor of the same batch with $\beta = 50$ is used, what will be the new value of zero signal I_C for the same R_B ? (CO2)
6. Answer any one of the following:-
- 6-a. Explain the working of enhancement mode and depletion mode for both n-channel and p-channel MOSFET devices with graph. (CO3) 10
- 6-b. Sketch Input and output characteristics of n-Channel JFET. The device parameters for an n-Channel JFET are: Maximum current $I_{DSS} = 10$ mA, Pinch off voltage, $V_p = -4$ V. Calculate the drain current for $V_{GS} = -1$ V. (CO3) 10
7. Answer any one of the following:-
- 7-a. Draw the AC equivalent circuit of n channel JFET and explain working of n-Channel JFET with graphs. (CO4) 10
- 7-b. Sketch and explain the simplified small-signal r_e model of the transistor biased in the forward-active mode. (CO4) 10
8. Answer any one of the following:-
- 8-a. Draw solar cell circuit diagram and sketch its characteristics. A solar cell has a short-circuit current of 50 mA and an open-circuit voltage of 0.7 V under full illumination. What is the maximum power delivered by this cell if the fill factor is 0.8? (CO5) 10
- 8-b. Explain working of Photo diode with circuit diagram and V-I characteristics. Also discuss 10

the characteristics and application of photodiode. (CO5)