SEMESTER: MONSOON, SESSION: 2022-23

Examination & Semester: End Semester Exam- 1st Sem, B.Tech (Common) [Modular]
Subject: Basics of Electronics Engineering
Time: 3 Hours

Subject Code: ECI 101
Max Marks: 100

Instructions: **Attempt all the questions in sequence as they are written.**
(The right-side numbers indicate marks.)

Q1. (a) Show the Transfer Characteristics (Vo vs Vin) of a parallel negative clipping circuit by pn junction diode and clearly marking the on and off conditions of the non-ideal diode [5]

(b) Sketch i_R (current through 10 kΩ resistor) and V_o (output voltage) for the network shown in **Fig.1** below. The input signal V_i is a triangular waveform with 10 V as its peak value. The Si diodes used have 0.7 V as the forward bias voltage (cut-in voltage). [10]

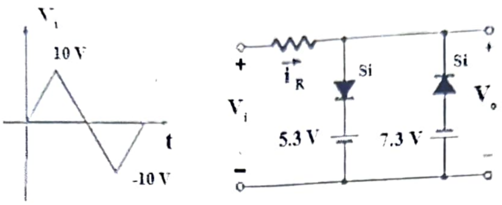


Fig.1

Q2. Obtain the output voltage v_o for the rightmost 4.4 kΩ resistor in the circuit shown in **Fig.2** below. The input voltage v_i is a sinusoid with 100 V as its peak amplitude. The diodes are considered to be ideal. [10]

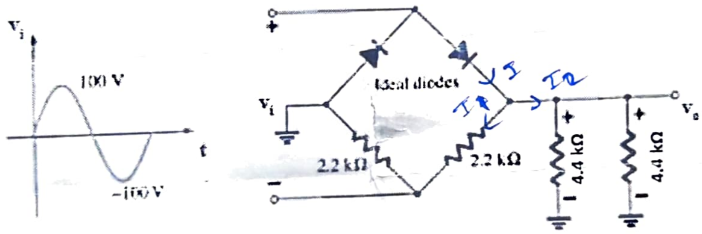


Fig.2

Q3. (a) I_{CBO} and I_{CEO}. How are they different? How are they related? Are they typically close in magnitude? [5]

(b) The current gain of the transistor is $\beta = 120$. Determine I_C and V_{CE} for the circuit given in the **Fig.3**. [5]

(c) For the circuit in **Fig.4** in which $|V_{BE}| = 0.7$ V and $\beta = 20$, find the collector, base and emitter voltages and currents. [5]

Q4. (a) Draw the basic construction of a p-channel JFET. Draw the circuit to show the proper biasing of the JFET and sketch the depletion region. [5]

(b) For the circuit in **Fig.5**, the transistor parameters are $I_{DSS} = 4$ mA and $V_P = -3$ V. Find R_D such that $V_{DS} = |V_P|$. What is the value of I_D? [5]

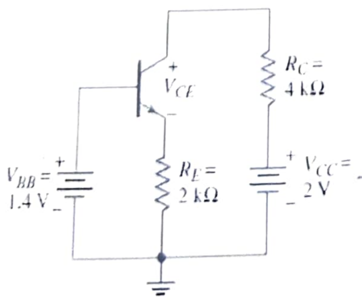


Fig.3

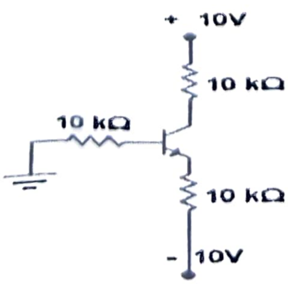


Fig.4

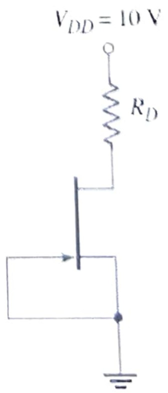


Fig.5

Q5. (a) Describe in brief the important characteristics of an ideal op-amp which are necessary to understand the fundament concepts of op-amp operation. [5]

(b) Draw the schematic of a voltage follower using an ideal op-amp and derive its voltage gain. Mention one important characteristic of a voltage follower. [5]

Q6. (a) In the differential amplifier shown in **Fig.6**, $R_1 = 10\ K\Omega, R_2 = 10\ K\Omega, R_3 = 100\ K\Omega$, and $R_f = 100\ K\Omega$. Determine the output voltage V_0 if [5]

(i) $V_1 = 5\ mV$ and $V_2 = 0\ mV$, (ii) $V_1 = 0\ mV$ and $V_2 = 5\ mV$, (iii) $V_1 = 50\ mV$ and $V_2 = 25\ mV$, (iv) $V_1 = 25\ mV$ and $V_2 = 50\ mV$

(b) Find v_0 and i_0 in the op-amp circuit shown in **Fig.7**. [5]

(c) If $v_1(t) = 20\cos(3t)\ mV$ and $v_2(t) = 2t\ mV$ in **Fig.8**, find $v_0(t)$ for $t > 0$. Assume that the voltage across the capacitor is zero at $t = 0$. [5]

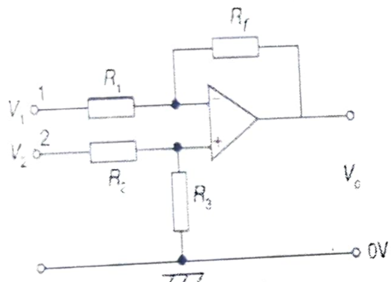


Fig. 6

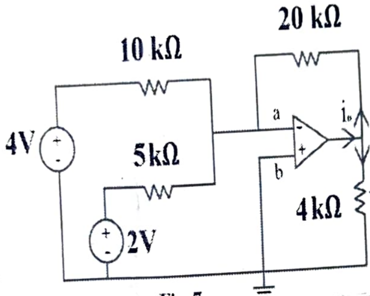


Fig. 7

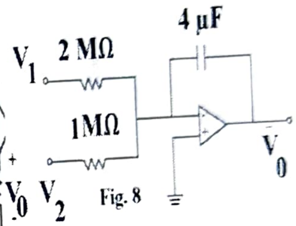
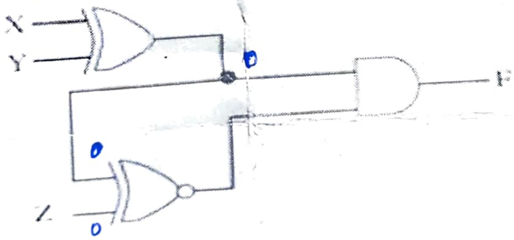


Fig. 8

Q7. (a) Express output F in canonical SOP form? [2]



(b) Convert $(57)_8$ into a number system whose radix is 6. [2]

(c) Convert $(46)_{10}$ into octal system. [2]

(d) Perform $(-7)_{10} - (13)_{10}$ in binary using **1's** complement method. [4]

(e) Simplify $F = \overline{(A + \overline{BC})}\,(A\overline{B} + ABC)$ [5]

Q8. (a) Prove the following using Boolean algebraic theorem [5]

$$\overline{A}BC + A\overline{B}C + AB\overline{C} + ABC = AB + BC + CA$$

(b) Consider the Boolean function $f(A,B,C,D) = \Sigma m(1,3,7,11,15) + \Sigma d\,(0,2,5)$ where m stands for min-term and d stands for don't care. [5]
Simplify the above function using K-Map and implement the simplified function using minimum number of 2-input NAND gates only.