B.E. MECHANICAL ENGINEERING FIRST YEAR FIRST SEMESTER - 2023

ELECTRONICS

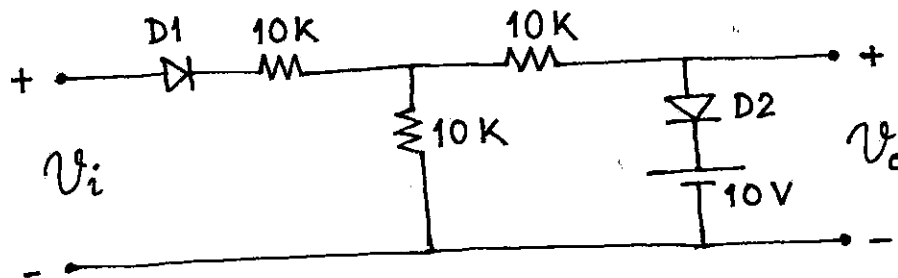**Time : 3 hrs**   **Full Marks: 100**

Use Separate Answer scripts for each part

PART - I
Answer Question 1 and any three from the rest.

1. Draw the block diagram of the Zero Crossing Detector and explain the functions of individual blocks with the help of waveforms.   10

2 a) Draw the transfer characteristic curve for the following circuit assuming diodes to be ideal.   10

b) For the transistor in the following figure, $\beta = 100$, the values of V_{BE} and V_{CE} at saturation are 0.8V and 0.2V respectively. What is the minimum value of R_C for the transistor to operate in the saturation region?   10
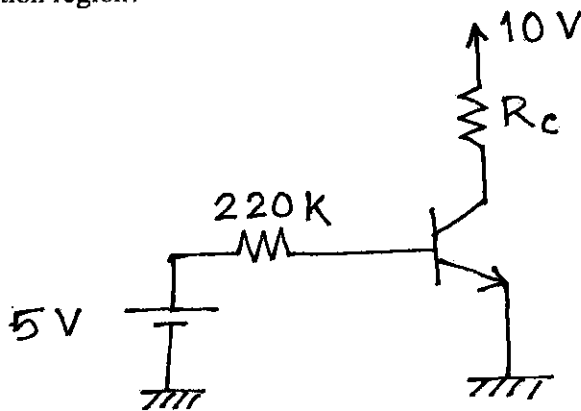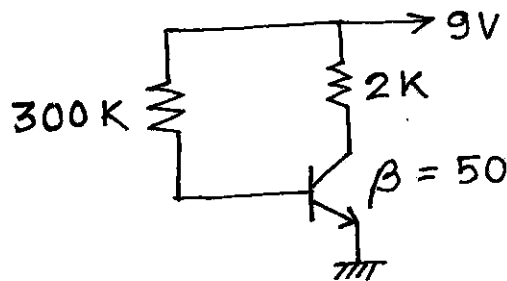
3. a) For the circuit shown, find the maximum and minimum value of zener current. 10

5K

80-120 V   50 V   10 K
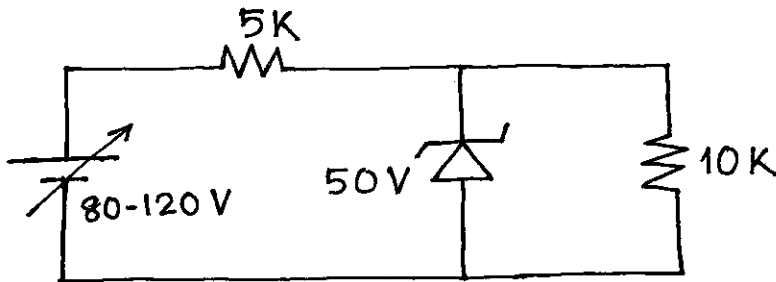
b) Find the Q-point for the following circuit and plot it on the load line. Neglect V_{BE}. 10

300 K   9V   2K $\beta = 50$

4. a) The turns ratio of the transformer used in a bridge rectifier is N1:N2 = 12:1 . The primary is connected to 220V, 50Hz power mains. If the diode voltage drop is zero, find the dc voltage across the load. What is the PIV of each diode? If the same dc voltage is obtained by using a center-tap rectifier, what is the PIV? 10

b) An amplifier has an open-circuit voltage gain of 10, an input resistance of 1 kΩ, and an output resistance of 10 Ω. The amplifier is connected to a sinusoidal voltage source of 2V rms, which has an output resistance of 100 Ω, and to a load resistance of 50 Ω. What will be the rms value of the output voltage? 10

5. a) For the following circuit assume that the transistor has a β of 100. Find (i) the voltage gain from the base to the output, (ii) The output voltage for an input voltage of 1mV rms. 6+6=12

+20 V   10 K V_{out} 10 K V_{in} 1mV rms   10 K   20K   -20 V
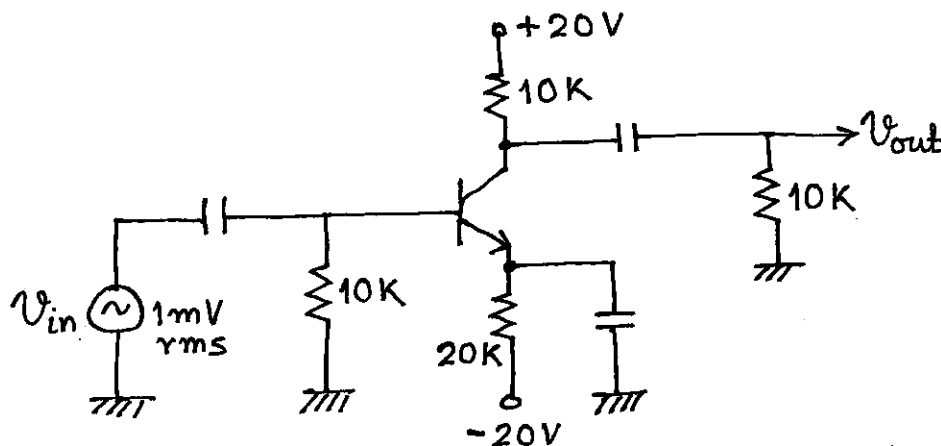
b) Draw the circuit diagram of an op-amp based voltage follower. Why is it named so? What is its most important application? Explain it with an example. 2+1+2+3=8

6. Write notes on the following: 4x5=20
   (a) Sensors and Actuators
   (b) Ripple factor and Rectification efficiency
   (c) Characteristics of an ideal op-amp
   (d) Frequency response of an amplifier

PART - II
Answer Question 7 and any one from the rest.

7. a) Estimate PIV of the diode used in a half wave rectifier circuit. 2
   b) What do you mean by the Band Width of an amplifier? 2
   c) Write the expression for the transistor current gain β in terms of the current gain α. Find the value of β, if the value of α is 0.99 2
   d) Write the truth table of a two input XNOR gate. 2
   e) Convert the following octal number to hexadecimal and binary: 41637 2

8. a) Realize $f = A'B + AB'$ using a minimum number of universal gates. Draw the truth table and logic circuit of the Full Subtractor. Briefly explain the 8-to-1 multiplexer. 2+6+2 = 10
   b) What is a transistor? Why is it so called? Define transistor currents. Explain npn and pnp transistors with diagrams. 2+3+3+2 = 10

9. a) What is a D flip-flop? Show how an S-R flip-flop can be converted into a D flip-flop. Realize T flip-flop using (i) J-K and (ii) D flip-flops. Give the difference between positive and negative edge triggering. 2+3+3+2 = 10

   b) What is Extrinsic Semiconductor? Briefly explain their types. Briefly explain the limitations in the Operating Conditions of pn Junction. 1+6+3=10

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