B. Sc. in EEE, 2nd Semester / B.Sc. in TE (3 yr), 2nd Semester — July 09, 2025

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination — **Summer Semester A.Y. 2023-2024**
Course No.: EEE 4203/ EEE 4297 — **Full Marks: 120**
Course Title: Electronics I — **Time: 120 Minutes**

There are **4 (four)** questions. Answer **all four (4)** questions. The symbols have their usual meanings. Marks of each question and corresponding COs are written in the brackets.

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1. a) For the network shown in Fig. 1(b2), the current flowing through the capacitor is 9.24 mA. **(15) (CO2)**

i. Determine the value of the capacitor using the given current and relevant circuit parameters. [Capacitive reactance $X_c = \frac{1}{2\pi f}\ \Omega$]

ii. Evaluate whether the capacitor will retain its voltage during the discharge period. Justify your answer based on appropriate calculations.

iii. Sketch the output voltage waveform (V_o) and provide the necessary calculations to support your sketch.

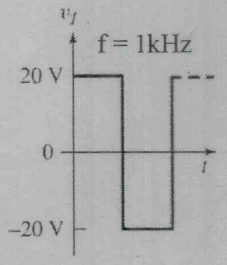

Fig. 1(b1)

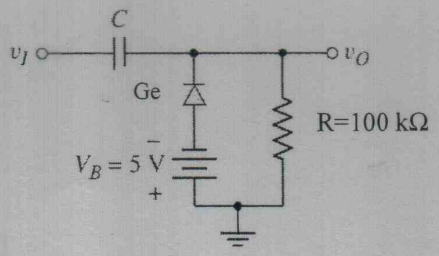

Fig. 1(b2)

b) The Shockley diode equation is given by: **(15) (CO1)**

$$I_D = I_S(e^{V_D/nV_T} - 1)$$

i. Define each term in the Shockley diode equation.

ii. A silicon diode has $I_S = 10^{-12}A, n = 1$ and V_D = 0.6 V. Calculate the forward current I_D at room temperature. (T=300 K)

iii. If the forward bias voltage across the diode increases by 60 mV, by what factor does the diode current increase? Justify your answer mathematically using the Shockley diode equation.

2. a) Discriminate between a Normal PN Junction Diode and a Zener Diode with respect to the breakdown effect. Explain how each diode behaves under reverse bias. **(15) (CO1)**

b) Design a diode-based logic circuit to implement the Boolean expression: $Y = A + (B \cdot C \cdot D)$ **(15) (CO2)**

i. Write the complete truth table for the given logic function with inputs A, B, C, and D.

ii. Design and sketch a diode-resistor logic circuit that implements the given expression. Clearly label all components and connections.

3. a) Sketch the effect of an increasing level of R_C and lower value of Vcc on the load line and the Q point in output characteristics curve of BJT. **(10) (CO1)**

b) Explain the construction and working principle of a Bipolar Junction Transistor (BJT). Illustrate the current flow through different terminals for an NPN transistor in active mode using a labeled diagram. **(10) (CO1)**

c) The transistor in the circuit shown in Fig. 3(c) has β=100 and exhibits a V_{BE} of 0.7 V at i_C =1 mA. Design the circuit so that a current of 2 mA flows through the collector and a voltage of +5 V appears at the collector. **(10) (CO3)**

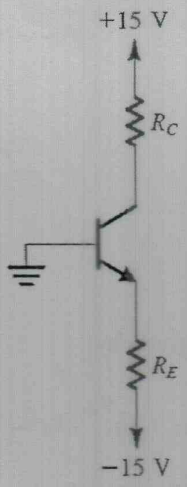

Fig. 3 (c)

4. a) Write down BJT's different modes of operation and mention their corresponding junction biasing with application. **(08) (CO1)**

b) Show that the DC value of a full-wave rectifier's output is approximately 0.636 times the peak voltage, V_m. **(10) (CO2)**

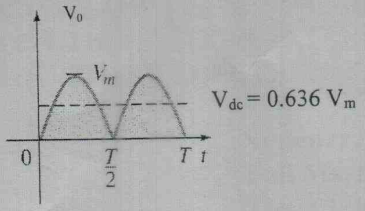

Fig. 4(b)

c) Sketch Output Voltage (V_o) for the given network shown in Fig. 4(c). Also, show the necessary calculation. **(12) (CO2)**

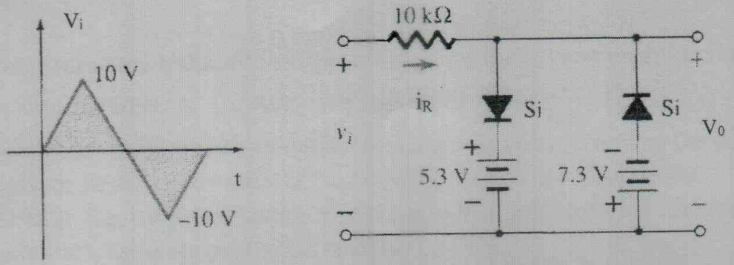

Fig. 4 (c)