ID:	Sec:	Name:

Set: 02

Brac University

Semester: Summer 2023
Course No: CSE251
Course Title: Electronic Devices and Circuits
Section: 1 to 10

Midterm Exam
Full Marks: 30
Time: 1 hour 30 minutes
Date: 16 July, 2023

Answer **any 3 questions**. All the questions carry equal marks.

Question 1 [CO2, CO3] **10**

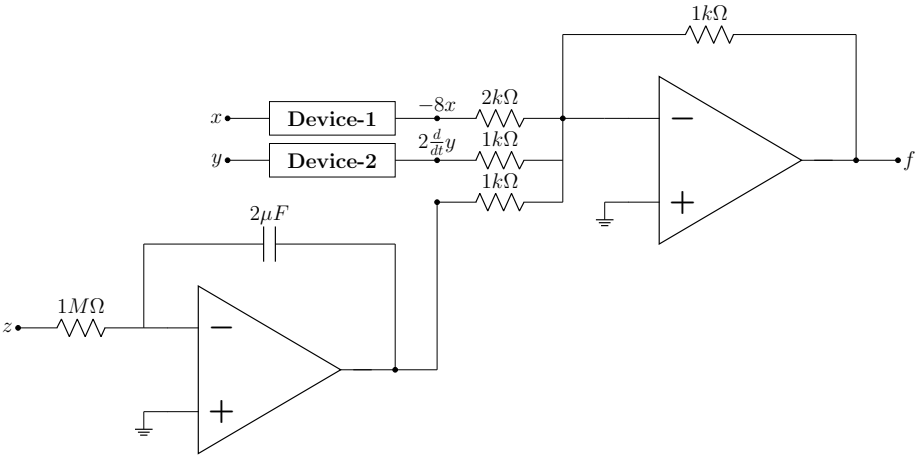

Figure 1: Circuit for Question 1

(a) **Identify** Device-1 and **design** the circuit. Assume any value if necessary. [2]

(b) **Identify** Device-2 and **design** the circuit. Assume any value if necessary. [2]

(c) **Determine** the expression of the function, *f*. [1.5]

(d) Assume, $x = 1$ V, $y = \cos(8t)$ V and $z = -8\sin(30t)$ V. **Determine** the expression of the function, *f*. [2.5]

(e) **Draw** the Voltage Transfer Characteristics (VTC) of a non-inverting Op-Amp comparator and **explain** the VTC briefly. [2]

Question 2 [CO1, CO2] **10**

A voltage waveform $v_i = 10\sin(200\pi t)$ V is fed into a Half-wave rectifier with a load resistor, $R = 10$ kΩ. Silicon diodes are used in this circuit where, $V_{D_0} = 0.7$ V.

(a) **Draw** the rectifier circuit. **Label** the input and output voltages properly. Briefly **explain** the application of the circuit. [1+1+1]

(b) **Calculate** the DC value of the output voltage, V_{dc} and the output frequency, f_o. [1+1]

(c) **Draw** the Voltage Transfer Characteristics (VTC) of the Half-wave rectifier and **label** it properly. [2]

(d) Now, you have to connect a capacitor in parallel with the load resistor. You have two capacitors of 4 μF and 7 μF at your disposal. Which capacitor will you use? **Explain** briefly with necessary calculations. [3]

(e) [**Bonus**] A different input waveform is fed into the half-wave rectifier. The new peak-to-peak ripple voltage is 50% of the previous one calculated from (d) with the 4 μF capacitor. The new output frequency is 300 Hz. **Determine** the equation of the input waveform. [2]

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Question 3 [CO3] **10**

(a) **Identify** the equivalent linear circuit model for the IV characteristics with brief explanation. [2]

(b) **Draw** the circuit and **calculate** the model parameters. [1+2]

(c) You are given **two** 1kΩ **resistors, one** 1V **voltage source, one** 5V **voltage source**. Can you **design** the circuit by only using these elements? [2]

(d) **Analyze** the diode logic circuit and **determine** the output voltage, V_o. [3]

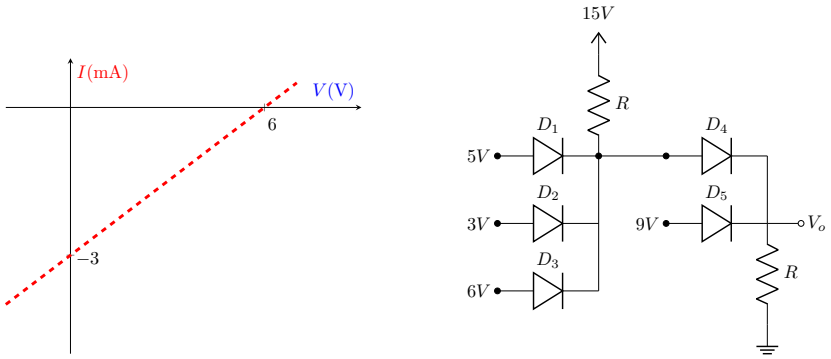

Figure 2: (i) IV Characteristics (ii) Diode Logic Circuit

Question 4 [CO2] **10**

The voltage at the node, V_a of the resistor-diode network as exhibited in Figure 3 is fed into a circuit with an Ideal Op-Amp. In this circuit, $V_{sat}^{+} = +10\text{V}$ and $V_{sat}^{-} = -10\text{V}$, $V_{D_0} = 0.7\text{V}$.

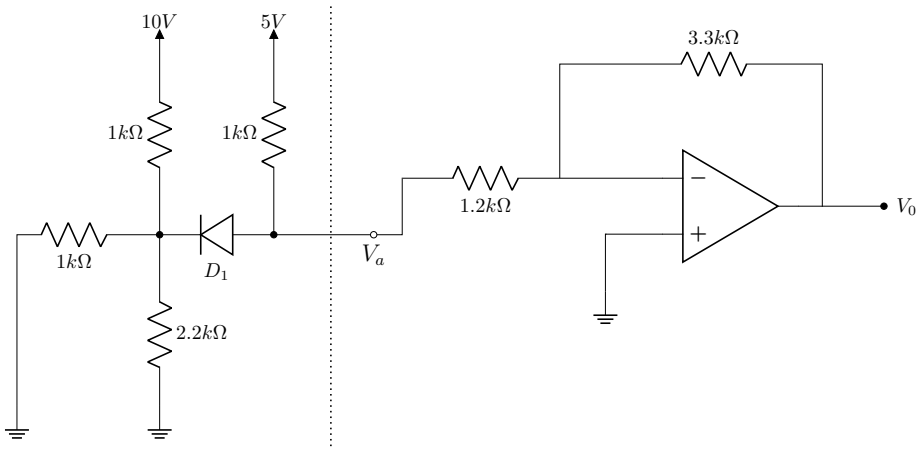

Figure 3: Circuit for Question 4

(a) **Analyze** the circuit to **determine** the operating mode of the diode, D_1. You must **validate** your assumption with necessary calculation. **Calculate** the voltage, **"**V_a**"**. [2+2+1]

(b) **Calculate** the voltages at: (i) **non-inverting** input terminal, (ii) **inverting** input terminal. [2]

(c) **Determine** the output voltage, **"**V_o**"**. [3]