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Brac University

Semester: Summer 2023 Course No: CSE251 Course Title: Electronic Devices and Circuits

Course Title: Electronic Devices and Circuits
Section: 1 to 10

BRAC UNIVERSITY

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

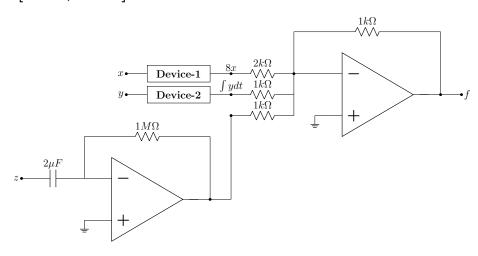


Figure 1: Circuit for Question 1

- (a) **Identify** Device-1 and **design** the circuit. Assume any value if necessary.
- (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, $y = 8\cos(30t) \text{ V}$ and $z = \sin(4t) \text{ V}$. **Determine** the expression of the function, f. [2.5]
- (e) **Draw** the Voltage Transfer Characteristics (VTC) of an inverting Op-Amp comparator and **explain** the VTC briefly.

Question 2 [CO1, CO2]

10

[2]

A voltage waveform $v_i = 5\sin(200\pi t)$ V is fed into a Full-wave rectifier with a load resistor, R = 5 k Ω . Silicon diodes are used in this circuit where, $V_{D_0} = 0.6$ 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 Full-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 5 μF and 1 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 Full-wave rectifier. The new peak-to-peak ripple voltage is 50% of the previous one calculated from (d) with the 5 μF capacitor. The new output frequency is 300 Hz.
 Determine the equation of the input waveform.

Question 3 [CO3]

10

[2]

[3]

- (a) **Identify** the equivalent linear circuit model for the IV characteristics with brief explanation.
- (b) **Draw** the circuit and **calculate** the model parameters.

[1+2]

- (c) You are given two $4k\Omega$ resistors, one 4V voltage source, one 2V voltage source. Can you design the circuit by only using these elements?
- (d) Analyze the diode logic circuit and determine the output voltage, V_o .

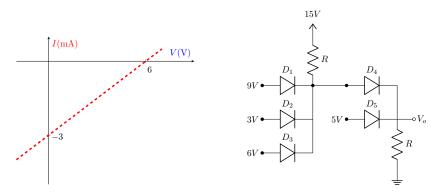


Figure 2: (i) IV Characteristics (ii) Diode Logic Circuit

Question 4 [CO2]

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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, $V_{sat}^+ = +10$ V and $V_{sat}^- = -10$ V, $V_{D_0} = 0.7$ V.

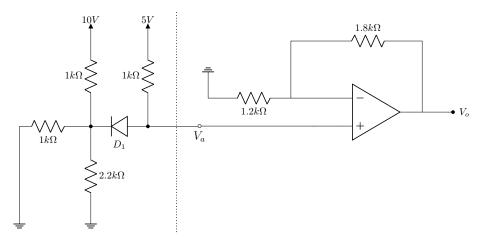


Figure 3: Circuit for Question 4

- (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]