| ID: | Sec: | Name: |
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**Set: 01**

**Brac University**

Semester: Fall 2022
Course No: CSE251
Course Title: Electronic Devices and Circuits
Section: 1 to 14

Midterm
Full Marks: 30
Time: 1 hour 30 minutes
Date: November 11, 2022

Answer **any 3 out of 4 questions**. All the questions carry equal marks.

## Question 1 [CO1] **10**

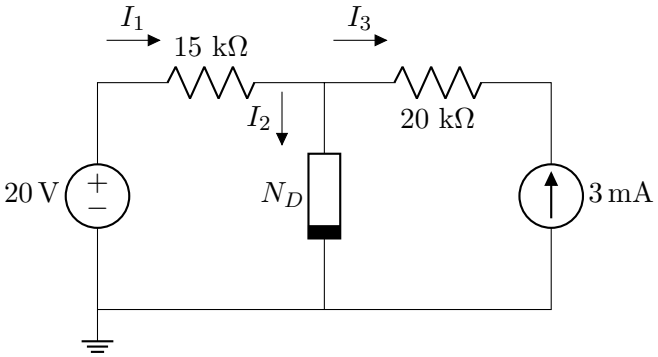



Figure 1: A circuit with a non-linear device $N_D$

(a) **Draw** the IV characteristics of a voltage source $V_o = 10$ V in series with a resistor $R = 15$ kΩ. Also, **determine** the IV equation and **calculate** the slope, $m$. [1.5+1.5]

(b) You are tasked to design a non-linear electronic device with following characteristics (here $V_D$ is the voltage across the device and $I_D$ is the current through the device):

(i) for $-5$ m$A < I_D \leq -1$ m$A$, the device should behave like a voltage source with $V_o = -2$ V

(ii) for $-2$ V $< V_D \leq 3$ V, the $I_D$ should increase linearly with $V_D$ with a slope of 2 m$A$/V

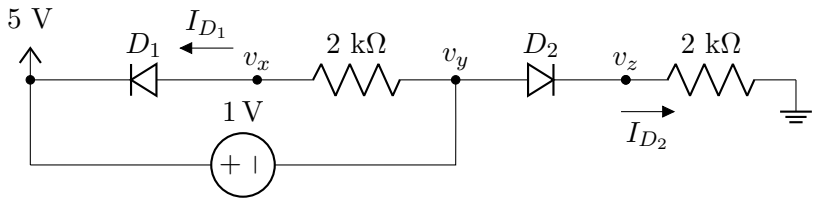
(iii) for 3 V $< V_D \leq 5$ V, the device should act like a current source. [**Hint**: calculate $I_o$ from (ii)]

**Draw** the IV characteristics of the non-linear device with appropriate labelling. [1.5+0.5]

(c) **Show** the alternative representation of the circuit in Fig 1 above. **Analyze** the alternative representation to **deduce** any two KVL equations and one KCL equation. [4]

## Question 2 [CO1] **7+3**

**Analyze** the circuit to find the values of $I_{D_1}$, $I_{D_2}$, $v_x$, $v_y$, and $v_z$. Use the diode's CVD Model with $V_{D_0} = 0.5$ V. You must **validate** your assumptions. [**Hint**: Start by calculating the node voltages first]



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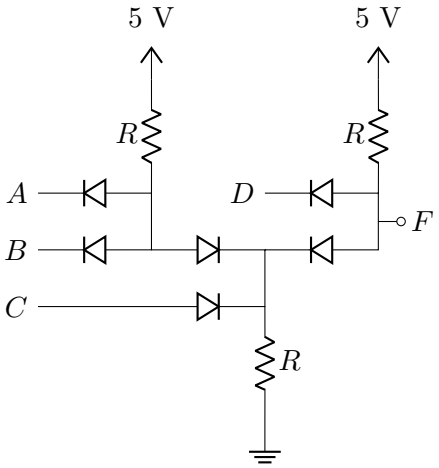
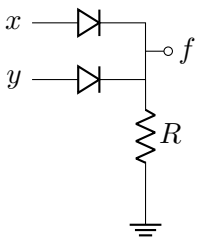
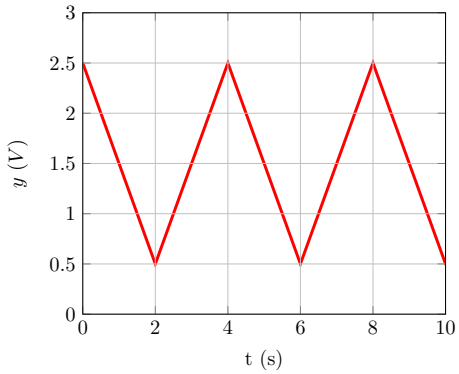
## Question 3 [CO2] **10**




(a) Circuit-1




(b) Circuit-2




(c) Graph-1

For this question, assume all of the diodes are ideal.

(a) **Analyze** Circuit-1 to find the logical expression of $F$ in terms of boolean inputs $A$, $B$, $C$, $D$. [4]

(b) **Design** a circuit to implement the logic function $F = (A + B).(C + D)$. Here "+" and "." denotes logical OR and AND, respectively, and $A$, $B$,$C$, $D$ are boolean inputs. [4]

(c) **Analyze** the Circuit-2 to find the waveform (voltage vs time graph) of $f$ assuming $x$ and $y$ are voltage signals, where $x = 1.5$ V and $y$ has a waveform as shown in the Graph-1. [2]

## Question 4 [CO2] **10**

A voltage waveform $v_i = 8\sin(100\pi t)$ V is is fed into a rectifier with a load resistance $R = 10$ k$\Omega$. Silicon diodes are used in this circuit for which the forward drop is $V_{D_0} = 0.8$ V. The output frequency of the rectifier is 100 H$z$.

(a) **Identify** the type of rectifier used (full-wave or half-wave). Give proper reasoning. [2]

(b) **Show** the circuit with proper input and output labels. [2]

(c) **Illustrate** the input and output waveforms in separate graphs. Label the graph and **indicate** the voltage levels properly. [2]

(d) **Calculate** the DC value of the output. [1]

A capacitor is now added to reduce the fluctuation of the output voltage, which makes the peak to peak ripple voltage 5% of the maximum output voltage $V_P$.

(e) **Deduce** is the value of the capacitor from the given data. [2]

(f) **Calculate** the DC value of the output after adding the capacitor and **compare** the result with that found in part (d). [1]