BRAC University
Dept. of Computer Science and Engineering

Assessment: Assignment 1
Due: 11:59 PM 8 February 2024
Full Marks: **60**

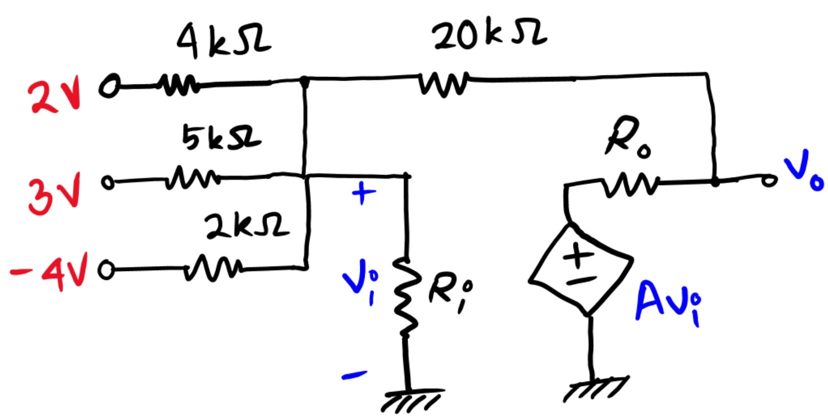
Semester:	Spring 2024
Course Code:	CSE251
Section:	**10 / 11**
Course Name:	Electronic Devices and Circuits

Name: ______________________________

Student ID: ______________________________

- ✓ Write down your student ID on the **top right corner of each of the pages**.
- ✓ Clearly write the solutions, along with the questions, on white paper with black ink (no need to use color pen, don't use pencils).
- ✓ Use **CamScanner**, or **Adobe Scan**, or **Microsoft Office Lens**, or any other software to scan the pages and make a **single PDF file**.
- ✓ After creating the PDF, make sure that **(a)** there are no pages missing, **(b)** all of the pages are legible, **(c)** your student ID on each page are visible.
- ✓ Please note, **collaboration ≠ copying**. You are allowed to discuss the questions and clear confusion you might have, but you have to write your solutions independently and be able to explain your answers during a random viva.
- ✓ [**Very Important**] Rename the PDF in the following format: **"<Section>_A1_StudentID_FullNameWithoutSpace.pdf"**. For example, if I am in section **10** and my student ID is 12345678 and my name is Shadman Shahid, the filename should be **"10_A1_12345678_ShadmanShahid.pdf"**.
- ✓ **Submission Link: https://forms.gle/DCqCu22oxdxKRod96**

Question 1: 10 Marks



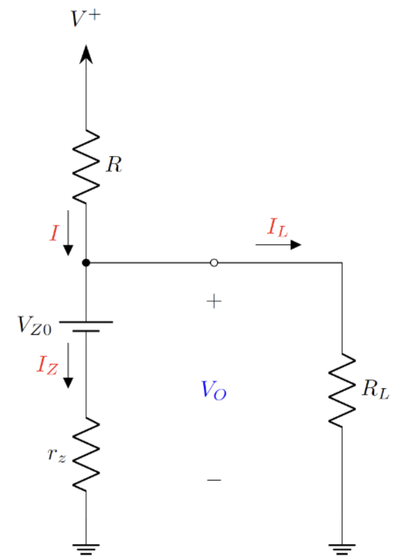
In the above circuit $A = 200$, $R_i = 200\ k\Omega$ and $R_o = 1\ k\Omega$. Answer the following questions

a) Write the node equations for the nodes indicated by v_i and v_o. [CO1] 4

b) Solve the node equations to find the values of v_i and v_o. [CO2] 3

c) Can circuit theorems based on linearity principle (such as superposition principle) be applied to the above circuit? Explain in short why or why not. [CO1] 3

Question 2: 8 Marks

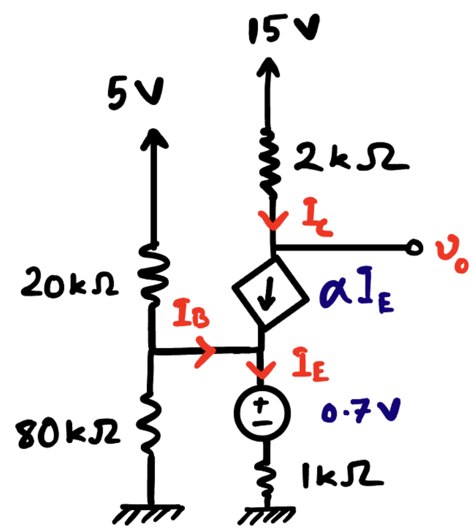


For $R = 200\ \Omega$, $R_L = 20\ k\Omega$, $r_z = 40\ \Omega$, $V_{ZO} = 2.5\ V$, and $I_L = 0.5\ mA$.

a) Find V_O, I_Z [CO2] 4

b) Find I, V^+. [CO2] 4

Question 3: 10 Marks



In the adjacent circuit $\alpha = 0.95$.

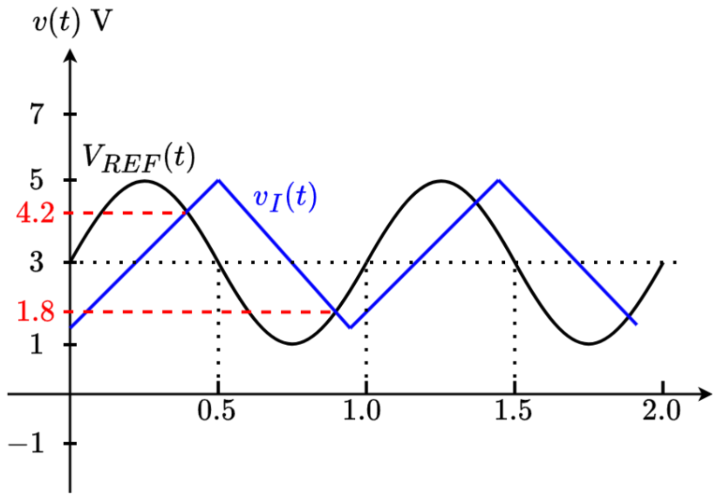
a) Derive an expression of I_E in terms of I_B and α. [CO1] 3

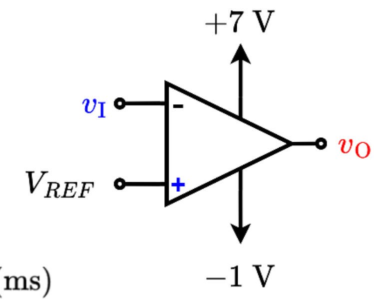
b) Find the value of the currents I_E, I_B and I_C. [CO2] 4

c) Find the value of the voltage at the output node v_o. [CO2] 3

Question 4: [CO2] 12 Marks

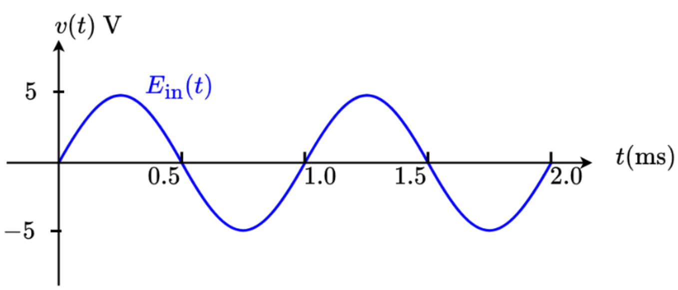
a) Assume that the Op-amp on the right is ideal. The wave shapes of $\boldsymbol{v_I}$ and $\boldsymbol{V_{REF}}$ are shown on the adjacent graph. 6

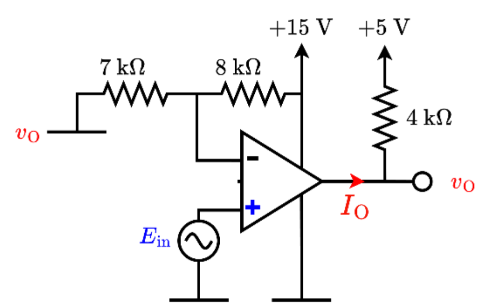




- **Draw** the waveshape of the output voltage of the op-amp $\boldsymbol{v_O(t)}$ on the graph provided above. Indicate the time ($\boldsymbol{t}$) in which switching would occur in $\boldsymbol{v_O(t)}$. **(Print this page and draw the graph on the same graph paper)**

b) Assume that the Op-Amp on the right is ideal. Answer the following questions. 6

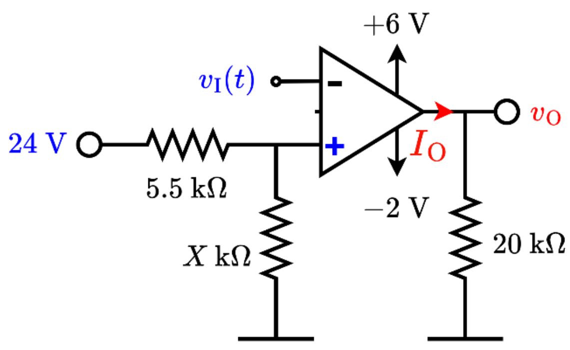


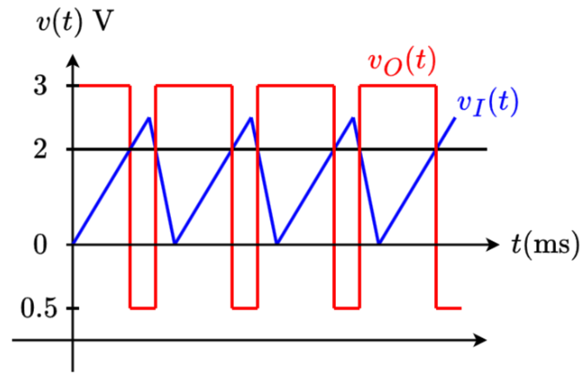


i. Sketch accurately the graph of $\boldsymbol{V_O}$ vs $\boldsymbol{E_{in}}$ **(VTC).**

ii. Sketch accurately the graphs of $\boldsymbol{V_O}$ vs $\boldsymbol{t}$. Find out the time ($\boldsymbol{t}$) in which switching would occur in $\boldsymbol{V_O(t)}$.

Question 5: 10 Marks

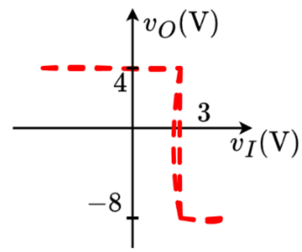




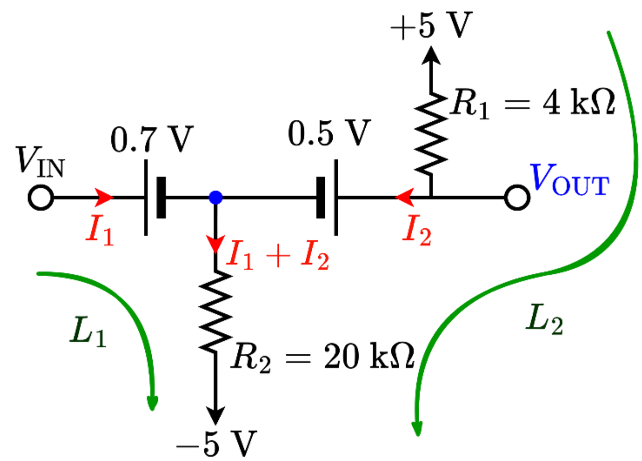
a) For $X = 2.5$, and $v_I = 9$ V, find v_O and I_O. [CO3] 3

b) Find the value of $\boldsymbol{X}$ and the new saturation voltages (positive and negative) to implement the waveshape in the right figure. [CO3] 4

c) Design a circuit using op-amp that has the voltage transfer characteristics as shown in the figure below. $\boldsymbol{v_O}$ $(\mathbf{V})$ is the output voltage and $\boldsymbol{v_I}$ $(\mathbf{V})$ is the input voltage. [CO3] 3

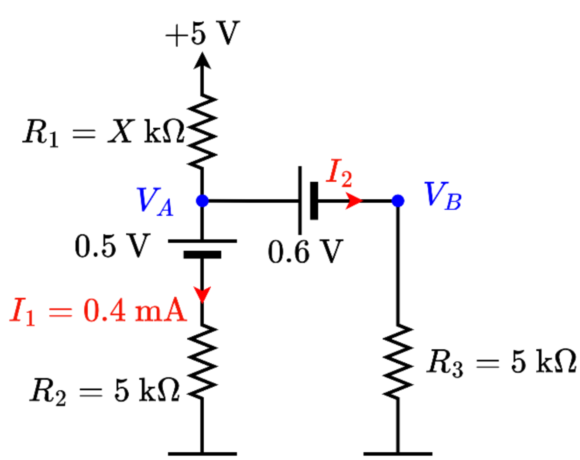


Question 6: 10 Marks



a) [$V_{IN} = 4.0$ V] Write down the two KVL equations for the lines (loops) indicated by the red lines L_1 and L_2. [CO1] 3

b) [$V_{IN} = 4.0$ V] Solve the circuit to find V_{OUT}, I_1 and I_2. You may use either mesh analysis or nodal analysis. [CO2] 4



c) Design the circuit; i.e., find X to get $\boldsymbol{I_1 = 0.4}$ **mA**. [Use any technique of your choice.] Find V_A, I_2 and V_B. [CO2] 3