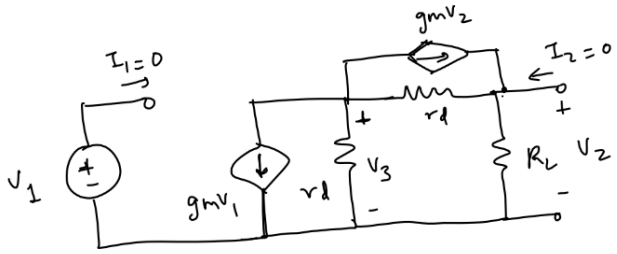
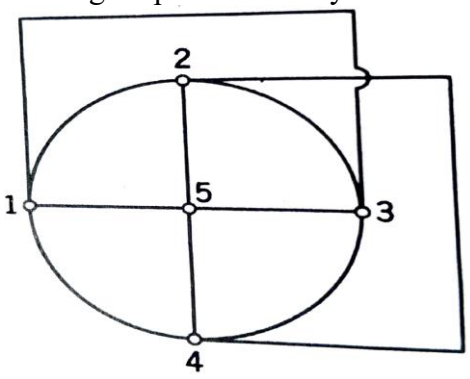
ECE 10, Winter 2023, Homework #2, Due February 3, 2023, 11:59 pm PST

Problem 1: You will analyze the network shown in the figure below using the node voltage analysis method. Assume $I_2 = 0$.



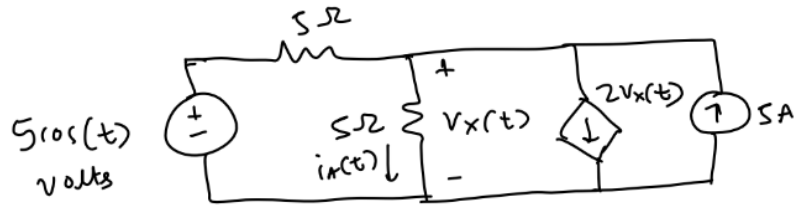
Node voltage analysis
(a) Mark the datum node and unknown node-to-datum voltages on the figure above.
(b) Write your appropriate equations to solve for the unknown node-to-datum voltages.
(c) Collect them into a matrix form but do not solve them.
(3 + 5 + 4 = 12 points)

Problem 2: Refer to the figure below. Assume that every edge in this circuit is a 2 Ohm resistor except for the edge between the nodes 1 and 4, which is a 2V voltage source, positive at node 1. The goal is to analyze this circuit using loop current analysis method.



(a) Mark your loop current unknowns clearly on the circuit
(b) Write the minimum number of appropriate KVL equations needed to solve for the unknowns
(c) Collect them into a matrix form
(d) Solve the equations from part (c) and obtain numerical values for the loop currents. **Note**: Feel free to use calculators or computers or on-line software or apps for any required matrix inversions.
(6 + 12 + 3 + 4 = 25 points)

Problem 3: Refer to the circuit schematic shown in the below figure. Assume that the independent voltage source is vs(t) = 5cos(t) Volts and the independent current source is I = 5A. Use superposition to determine $v_X(t)$ for all time t.
(15 points)



Problem 4: Refer again to the above figure. However, this time, ignore (remove) the dependent current source, $2v_X(t)$. Determine $i_A(t)$ for all time t, but using a series of source transformations. **(10 points)**

Problem 5:

(a) Derive Norton's equivalent of the circuit shown in the below figure.

(b) Use Norton's equivalent derived from part a) to determine the value of v_x if a 200 Ohm resistor is connected across 1 and 1'? If you are unsure of your answer from part a), leave your answer in terms of I_N and R_N for partial credit. **(10 + 10 = 20 points)**

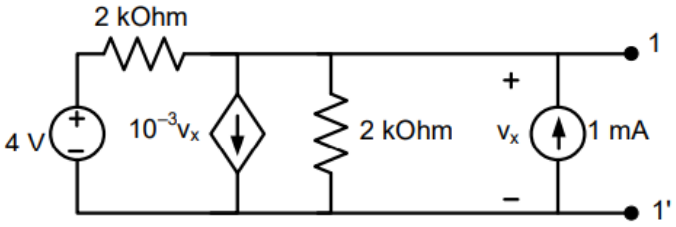


Figure 2

Problem 6: The circuit shown in Figure 3 is called a Wheatstone bridge. Derive Thevenin's equivalent of the circuit shown in Figure 3 looking into the "+" and "–" pair of terminals labeled V_O. Make sure to draw a schematic of your Thevenin's equivalent circuit. **(5 + 5 + 5 = 15 points)**

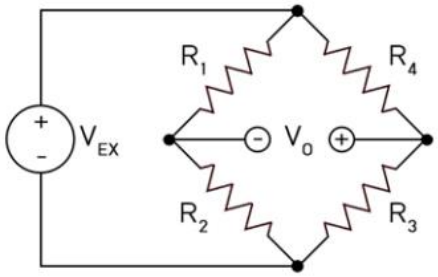


Figure 3