LUMS
A Not-for-Profit University

Department of Electrical Engineering
School of Science and Engineering

EE240 Circuits I - Fall 2021

ASSIGNMENT 2

Due Date: 12:15pm, Thursday, October 21, 2021 (Submit in-class)
Format: 9 problems, for a total of 90 marks

Instructions:

- Solve the assignment on blank A4 sheets and submit after the class.
- Upload the solved assignment on LMS in the "Assignments" tab under Assignment 2.
- Naming convention should be as follows: "Name_RollNumber_Assignment_2.pdf"
- Feel free to contact the instructor or the teaching assistants if you have any concerns.

- You represent the most competent individuals in the country, do not let plagiarism come in between your learning. In case any instance of plagiarism is detected, the disciplinary case will be dealt with according to the university's rules and regulations.

Course Learning Outcomes Covered:

Derive and apply working principle of passive components R, L,C and independent and controlled energy sources for device and circuit modeling and analysis

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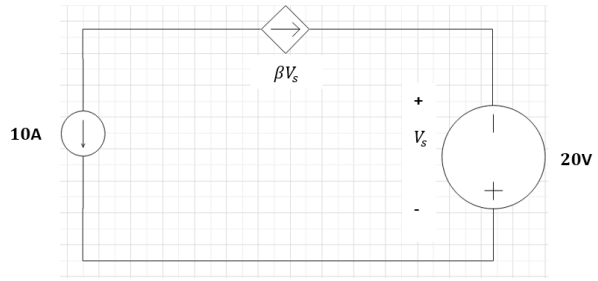
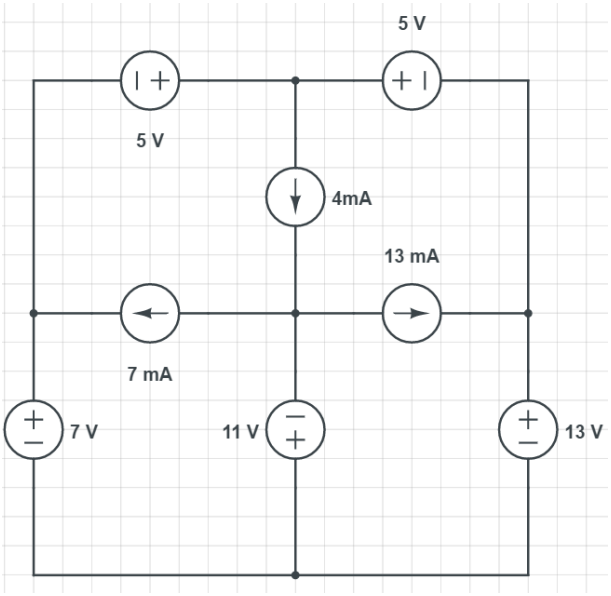
Problem 1 (5 marks)

The above circuit has been made by your friend in the lab who argues that this interconnection is valid for all values of β. Do you agree or disagree with this? For what value(s) of β is your friend's circuit valid?



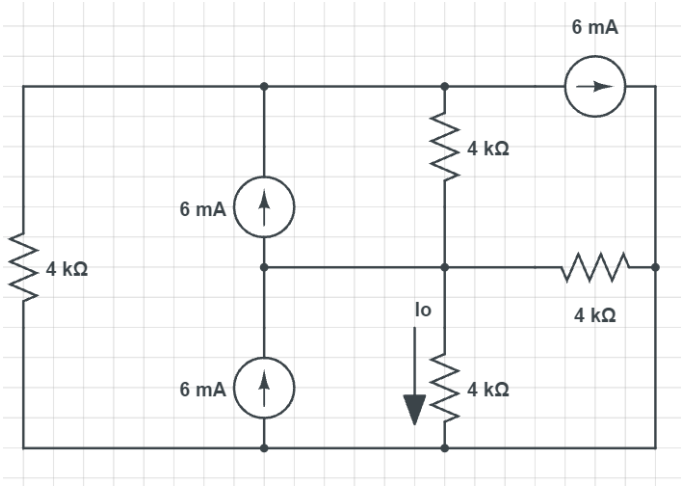
Problem 2 (5 marks)

Is the interconnection of sources valid in the above circuit? If yes, find the total power developed in the circuit and if no then, explain why?



Problem 3 (5 marks)

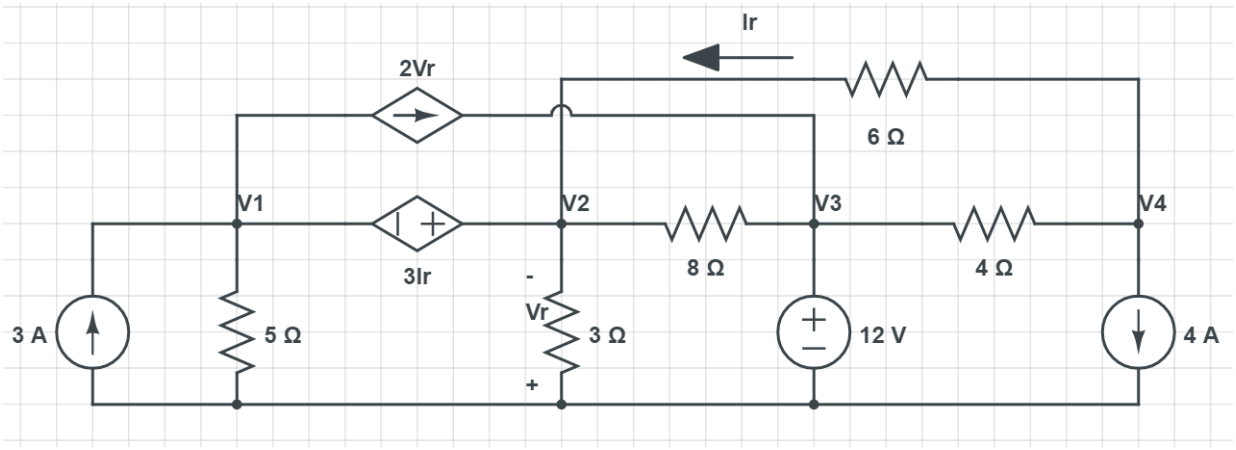
Use nodal analysis to determine I_o in the following network.



You may also simplify circuit by rearranging circuit elements (e.g., current sources, resistors) before carrying out nodal analysis.

Problem 4 (10 marks)

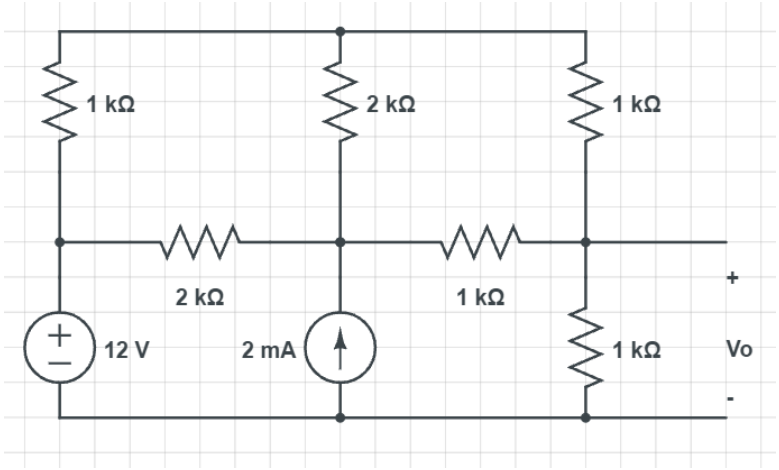
Formulate network equations using loop (mesh) analysis for the following circuit.



Note: This is a non-planar circuit, that is, it cannot be drawn on a flat surface without crossing wires.

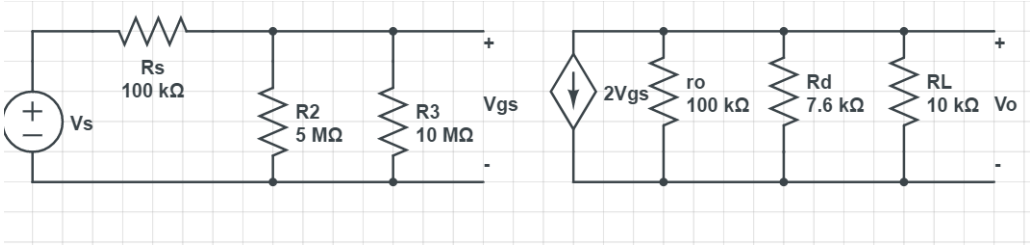
Problem 5 (15 marks)

Use nodal analysis to determine V_o in the following network.



Problem 6 (10 marks)

In the following circuit:



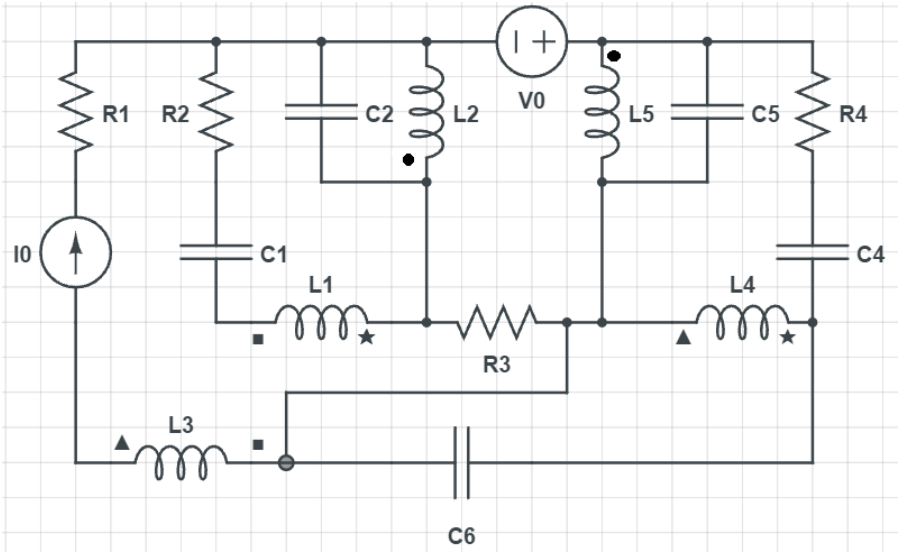
(a) Find $\frac{V_{gs}}{V_s}$

(b) Find $\frac{V_o}{V_{gs}}$ and determine $\frac{V_o}{V_s}$

Note: You'll see similar circuits more often in higher-level courses :)

Problem 7 (20 marks)

For the circuit given below, apply Loop/Mesh Analysis to obtain the complete set of loop equations. Make sure to adhere to the dot convention.
Mutual Inductances: L_1 and $L_3 = M_a$, L_1 and $L_4 = M_b$, L_2 and $L_5 = M_c$.



Note: All loops should be defined in the clockwise direction. You are only required to formulate the loop equations. You do not need to solve.

Problem 8 (10 marks)

Refer to the circuit given in the previous question.

(a) [**3 marks**] Identify and label the number of nodes in the circuit.

(b) [**1 mark**] Determine the number of nodal equations required to solve this circuit.

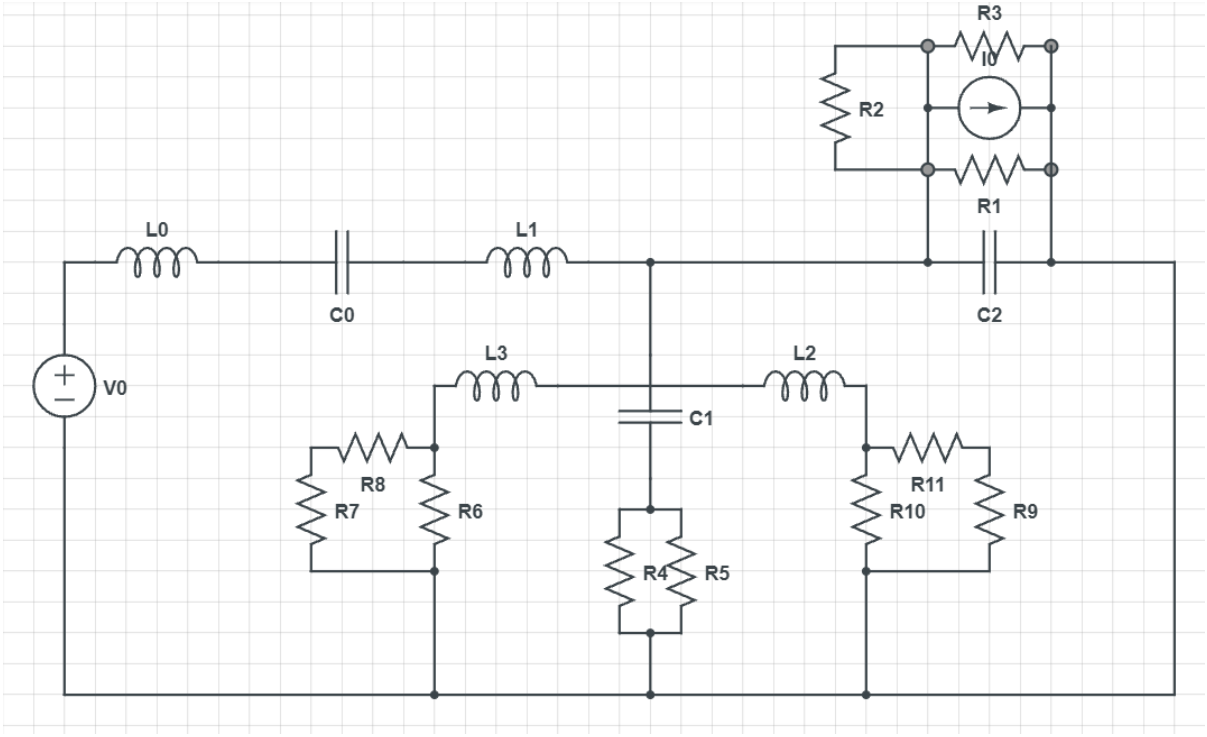
(c) [**1 mark**] How many branches are in the circuit?

(d) [**3 marks**] Draw the graph of the circuit.

(e) [**2 marks**] Draw a tree of the circuit.

Problem 9 (20 marks)

Obtain the set of nodal equations for the circuit given below.



Note: You are only required to formulate the nodal equations. You do not need to solve.