ECE 100 (Spring 2021) - Quiz #1

(Format: 3 questions, 50 minutes)

Name: _____

Student ID: _____

Score: _____ out of 80

Instructions:

1. Register for the quiz (if you are seeing this, you should have already registered)
2. Once you register for the quiz, you will have 50 minutes to complete the quiz
3. After the quiz, you have 15 minutes to submit and upload your quiz to CCLE (under "Week 3 → Quiz 1").
4. Please fill out this 'End of Quiz' survey to acknowledge that you have completed the quiz and submitted your answer sheet to CCLE: https://forms.gle/n2wxogiiQdKjAT5B6

Rules:

- Quiz is closed book. No computers, cell phones, etc.
- Scientific calculator allowed.
- Box all of your answers & show your work.
- **If you have questions on the exam, please DO NOT post on Piazza. Email instructor(s) directly.**

Quiz Start Time:

Wednesday, April 14th @ 6:00pm PDT

Note: Once you register for the quiz, you will have 1hr 5m to complete & upload your results. (50 minutes to take the exam, 15 minutes to upload).

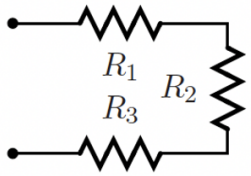
End Time:

Thursday, April 15th @ 11:59am PDT (answer sheet must be submitted by this time)

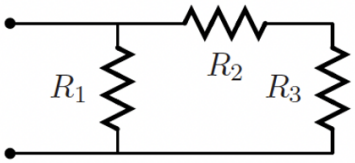
No late submissions

Problem 1: Circuit Analysis (20 points)

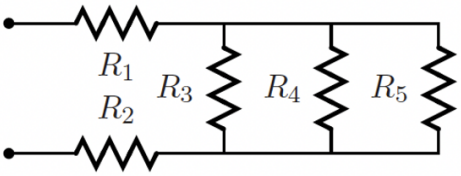
(a) Find the equivalent resistance, as viewed from its port, of each resistor network shown below (3x2 = 6 points)



(i)



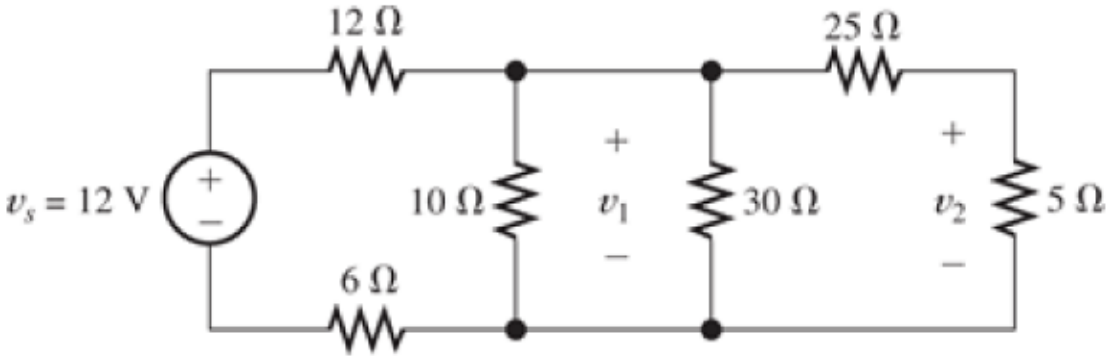
(ii)



(iii)

(b) Beginning with 1-Ω resistors, synthesize a resistor of (i) 0.75 Ω and (ii) a resistor of 1.5 Ω. Use no more than four 1-Ω resistors in each case. (2x3= 6 points)

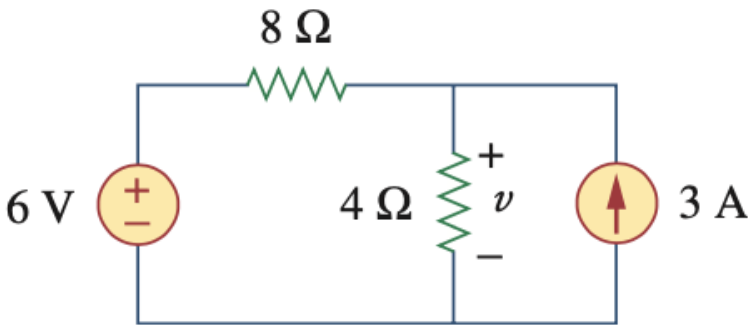
(c) Find the voltages V_1 and V_2 and for the circuit shown below. (8 points)



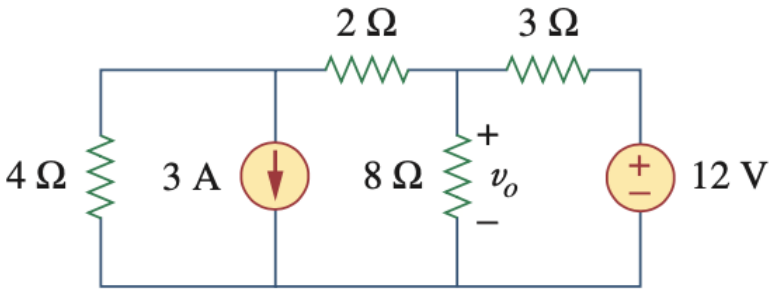
Problem 2: Superposition & Source Transformations (20 points)

Hint: The following circuits can be solved using Superposition or Source Transformations.

(a) Find voltage,v. (8 points)



(b) Find voltage,v_o. (12 points)



Problem 3: Transformers (40 points)

We studied the ideal transformer in class.

(a) Draw the symbol for an ideal transformer. (4 points)

(b) If the transformer has N_P primary turns and has a turns ratio of n, what are the number of turns in the secondary coil N_S? (4 points)

(c) For this ideal transformer, if the primary voltage is V_P, what is the secondary voltage V_S? Does V_S depend on the current being drawn out of the secondary turns, I_S? (4 points)

(d) For a secondary current I_S, what is the primary current, I_P? (4 points)

(e) What is the output power P_S? What is the input power P_P? What is the transformer efficiency, η_1? (4 points)

(f) In practice, the transformer is not ideal. If the coils have a resistance, ρ_τ / turn, how would you represent this non-ideality in the symbol for the transformer? Draw it. (4 points)

(g) Now let's assume the transformer also has core losses. Assume that the core losses only depend on the input voltage, V_i, to the transformer. How would you represent this loss on the model for the transformer? (4 points)
Hint: some of the primary current will be diverted to heating up the transformer core (the iron part of the transformer).

(h) For an input current, I_i, and an input voltage, V_i, what is the output voltage,V_o, and output current, I_o? (4 points)

(i) What is the efficiency of this non-ideal transformer, $\eta_{non\text{-}ideal}$? (4 points)

(j) Which do you think is a bigger factor: the series resistance of the coils or the shunt conductance of the core losses? (4 points)