EE 302, Introduction to Electrical and Computer Engineering

Dr. Archie Holmes, Jr.

Exam #2

Solution

Please remember….

- **Read the entire exam before starting**
- **If you feel you need more information than is given, please ask!!!**
- **Show all work for credit!!!**
- **Relax!!!**

PROBLEM #1: PROBLEM SET-UP (25 POINTS)

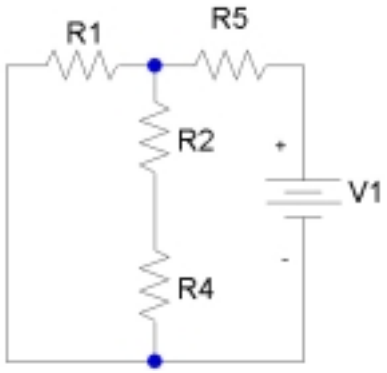
(a) Which of the nodes below will be unknown if the ground node is placed at E? Check all that apply.

B & D

(b) Which of the mesh current values are unknown in the circuit above? Check all that apply

i_2 & i_3

(c) Draw the circuit you would you to analyze the effect that V1 **alone** has on the circuit?



(d) Write the node voltage equation for Node B

$$\frac{V_B - V_A}{R1} + \frac{V_B}{R2 + R4} + \frac{V_B - V_C}{R5}$$

(e) Write the mesh current equation for loop i_3.

$$(R2 + R4 + R5)i_3 - R5i_1 - (R2 + R4)i_2 + V1 = 0$$

(f) Using the mesh current values, write the expression for the power being dissipated by resistor R5.

$$(i_1 - i_3)^2 R5$$

(g) Using node voltage values, write the expression for the power being dissipated by resistor R4.

$$V_B \frac{R4}{R4 + R5}$$

PROBLEM #2: GENERAL CIRCUIT ANALYSIS I (25 POINTS)

a) Using one of the techniques discussed in class (node voltage, mesh current, or superposition) solve for the power being dissipated by resistor R5 in the circuit below. Assume that R1 = 1Ω, R2 = 4Ω,R3 = 6Ω,R4 = 14Ω, and R5 = 5Ω. **Note**: 80% of the points for this part of the problem will be given for a correct set-up of the problem.

b) Confirm that your solution in part (a) is correct by solving the problem again using a method DIFFERENT from the one used in part (a).

The answer is zero watts. Easiest to solve using mesh currents and superposition

PROBLEM #3: THEVENIN EQUIVALENT CIRCUIT (15 POINTS)

Find the Thevenin equivalent circuit seen by the resistor RL. Use R1 = 14Ω, R2 = 1Ω,R3 = 4Ω,R4 = 8Ω, R5 = 24Ω, and R6 = 15Ω.

V_{TH} = 2.5 V
R_{TH} = 6 Ω

PROBLEM #4: GENERAL CIRCUIT ANALYSIS II (15 POINTS)

Solve for the power being dissipated by each resistor in the circuit. Assume that they all have a value of 2Ω.

Power dissipated by resistor R1 = 0.125 W
Power dissipated by resistor R2 = 0.605 W
Power dissipated by resistor R3 = 0.125 W

Best solved using Node Voltage

PROBLEM #5: FLASHLIGHT DESIGN (20 POINTS)

a) In order to maximize the power from the flashlight, what resistance of filament would you use? How much power do you get out of the flashlight?

Resistance of light is 2.4Ω; the power from the light is 3.75 W

b) A client desires a "dimmer" switch which allows the flashlight to be operated with two modes: full power mode and half-power mode. How would you change the schematic shown above to allow this "dimming" effect to occur? Provide both a drawing and numerical values as needed.

To make a dimmer we need to have the switch go to two positions: one as in (a) and one where there is a resistor in line. The value of the resistor is approx. 2Ω.

Bonus (10 points): In a manufacturing error[†] the package which holds the batteries is set up to take 4 "D" batteries but they will be connect in parallel to each other as opposed to series. Redo part (a) to determine any changes needed in the light bulb selection or flashlight specification. (Hint: draw the circuit…)

Resistance of light is 0.15Ω; the power from the light is 3.75 W

[†] The manufacturing unit is run by two Mechanical Engineers: one from Texas A&M and one from OU. Figures…☺

BONUS SECTION (3 POINTS)

1) Who won this year's Nobel Prize for Peace

The president of South Korea

2) What important Austin transportation issue will appear on this November ballot?

Light Rail