COLLEGE OF ENGINEERING AND MINES
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

COURSE CODE	EE F102 F01 (CRN: 34544)
COURSE NAME	INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING
SEMESTER	SPRING
YEAR	2022
TYPE AND NUMBER OF SUBMISSION	HOMEWORK 3
METHOD OF SUBMISSION	ONLINE TO : maher.albadri@alaska.edu
DATE OF ASSIGNMENT	THURSDAY 27 JAN 2022

DUE DATE OF SUBMISSION	FRIDAY 04 FEB 2022	**DUE TIME OF SUBMISSION**	23:59

STUDENT NAME	Jacob Guenther

MAKE THIS FORM A "COVER PAGE" FOR YOUR HOMEWORK SUBMISSION.

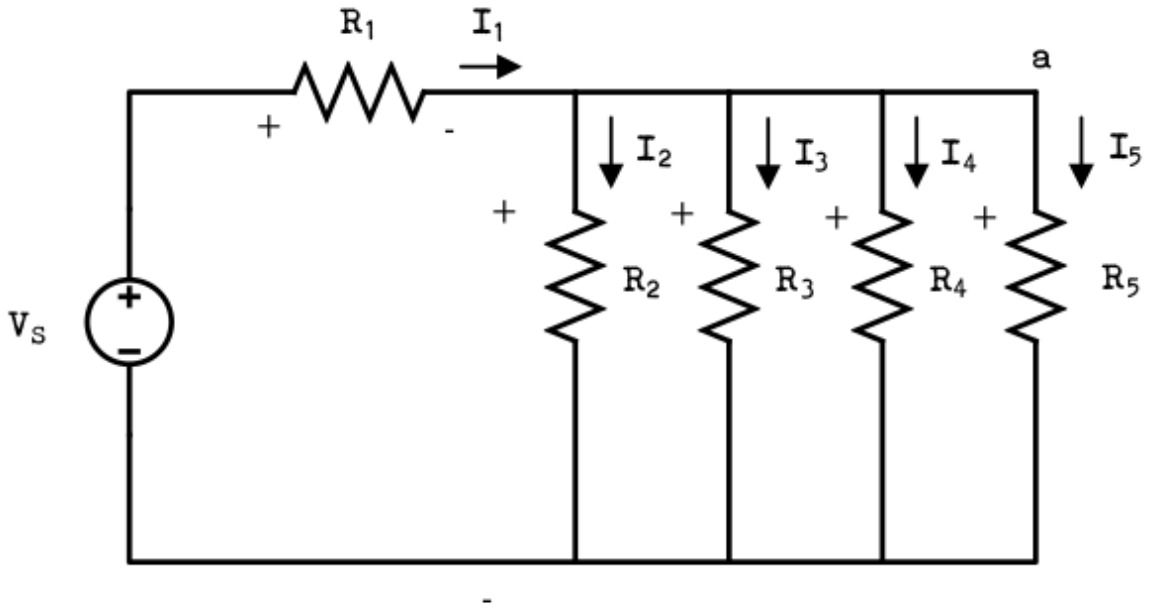
FOR THE TA USE ONLY

REMARKS:

FOR THE TA USE ONLY		
PROBLEM NUMBER	**MAXIMUM POINTS POSSIBLE**	**POINTS EARNED**
PROBLEM 1	50	
PROBLEM 2	50	
PROBLEM 3	50	
TOTAL	150	

1 Problem HW-3-1

(1) For the circuit shown, measurements are conducted and the following data is made available: pts



- $V_s = 120V$
- $V_a = 73.4V$
- $P_s = 2795W$
- $P_1 = 1085W$
- $P_2 = 539W$
- $P_4 = 385W$
- $P_5 = 337W$
- (a) Determine the number of branches.
  There are **6 branches** in the circuit. 5 resistors and 1 voltage source.
- (b) Determine the number of nodes.
  There are **3 nodes** in the circuit.
  - between V_s and R_1
  - between R_1, R_2, R_3, R_4, and R_5
  - between R_2, R_3, R_4, R_5, and V_s
- (c) Determine the number of independent loops.
  Note:

$$l = b - n + 1 \tag{1}$$

  Solution:

$$\begin{aligned} \text{let } b &= 6 \\ \text{let } n &= 3 \\ l &= 6 - 3 + 1 \\ &= 4 \text{ independent loops} \end{aligned}$$

  Answer: There are **4 independent loops** in the circuit.

- (d) Determine P_3.
  Note:

$$\sum P_i = 0 \tag{2}$$

  Solution

$$\begin{aligned} 2795\text{W} &= 539\text{W} + \text{P}_3 + 385\text{W} + 337\text{W} \\ \text{P}_3 &= 1261\text{W} - 2795\text{W} \\ &= 1534\text{W} \end{aligned}$$

  Answer: $\mathbf{P_3 = 1534\ W}$

- (e) Determine I_1.
  Note:

$$(closedloop) \sum \text{V}_i = 0 \tag{3}$$

$$\text{P} = \text{I} \cdot \text{V} \tag{4}$$

  Solution:

$$\begin{aligned} \text{V}_1 &= \text{V}_s - \text{V}_a \\ &= 120\text{V} - 73.4\text{V} \\ &= 46.6\text{V} \\ \text{I}_1 &= \frac{1084\text{W}}{46.6\text{V}} \\ &= 23.26\text{A} \end{aligned}$$

  Answer: $\mathbf{I_1 = 23.26\ A}$

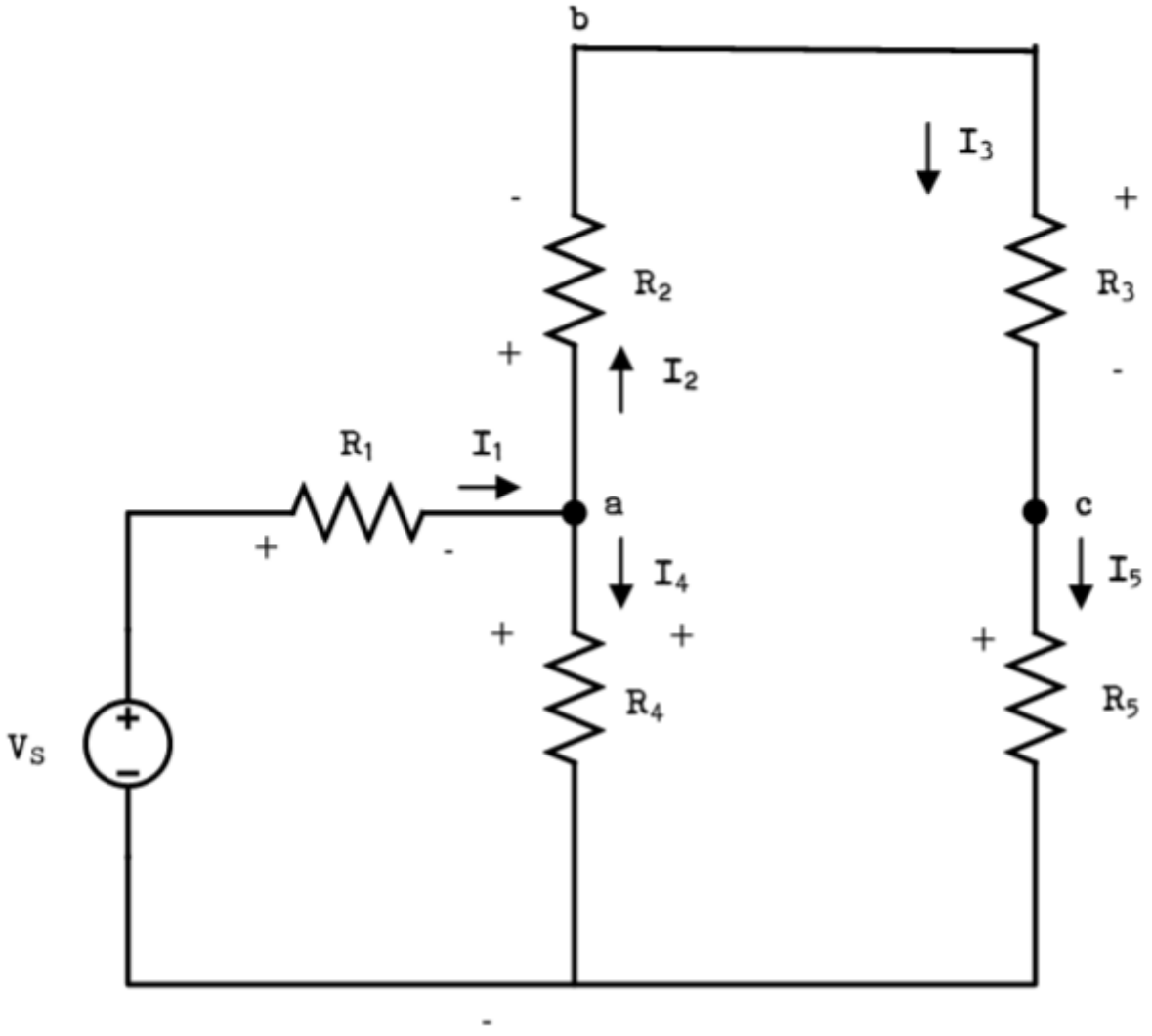
- (f) Determine I_3.
  Solution:

$$\begin{aligned} \text{I}_3 &= \frac{\text{P}_3}{\text{V}_a} \\ &= \frac{1534\text{W}}{73.4\text{V}} \\ &= 20.9\text{A} \end{aligned}$$

  Answer: $\mathbf{I_3 = 20.9\ A}$

2 Problem HW-3-2

(1) For the circuit shown, measurements are conducted and the following data is made available: pts



- $V_s = 120V$
- $V_a = 72V$
- $V_b = 48V$
- $V_c = 24V$
- $P_s = 1152W$
- $P_1 = 460.8W$
- $I_4 = 7.2A$
- (a) Determine the number of branches.
  There are **6 branches** in the circuit. 5 resistors and 1 voltage source.
- (b) Determine the number of nodes.
  There are **5 nodes** in the circuit.
  - between V_s and R_1
  - between R_1, R_2, and R_4
  - between R_2, and R_3
  - between R_3, and R_4
  - between V_s, R_4, and R_5

- (c) Determine the number of independent loops.
  Solution:

$$\begin{aligned} \text{let } b &= 6 \\ \text{let } n &= 5 \\ l &= 6 - 5 + 1 \\ &= 2 \text{ independent loops} \end{aligned}$$

  Answer: There are **2 independent loops** in the circuit.

- (d) Determine V_{ac}. **Note:**

$$\begin{aligned} \text{Note } \mathrm{V}_a &= 72\mathrm{V} \\ \text{Note } \mathrm{V}_c &= 24\mathrm{V} \end{aligned}$$

$$\begin{aligned} \mathrm{V}_{ac} &= \mathrm{V}_a - \mathrm{V}_c \\ &= 72\mathrm{V} - 24\mathrm{V} \\ &= 48\mathrm{V} \end{aligned}$$

  Answer: $\mathbf{V}_{ac} = \mathbf{48\ V}$

- (e) Determine P_2.
  Note:

$$\sum I_{in} = \sum I_{out} \tag{5}$$

  Solution:

$$\begin{aligned} \mathrm{V}_1 &= 120\mathrm{V} - 72\mathrm{V} \\ &= 48\mathrm{V} \\ \mathrm{I}_1 &= \frac{\mathrm{P}_1}{\mathrm{V}_1} \\ &= \frac{460.8\mathrm{W}}{48\mathrm{V}} \\ &= 9.6\mathrm{A} \\ \mathrm{I}_1 &= \mathrm{I}_2 + \mathrm{I}_4 \\ \mathrm{I}_2 &= 9.6\mathrm{A} - 7.2\mathrm{A} \\ &= 2.4\mathrm{A} \\ \mathrm{V}_2 &= \mathrm{V}_{ab} \\ &= \mathrm{V}_a - \mathrm{V}_b \\ &= 72\mathrm{V} - 48\mathrm{V} \\ &= 24\mathrm{V} \\ \mathrm{P}_2 &= \mathrm{I}_2 * \mathrm{V}_2 \\ &= 2.4\mathrm{A} \cdot 24\mathrm{V} \\ &= 57.6\mathrm{W} \end{aligned}$$

  Answer: $\mathbf{P}_2 = \mathbf{57.6\ W}$

- (f) Determine P_3.
  Note:

$$\begin{aligned} \mathrm{V_b} &= 48\mathrm{V} \\ \mathrm{V_c} &= 24\mathrm{V} \\ \mathrm{I}_2 &= 2.4\mathrm{A} \end{aligned}$$

Solution:

$$\begin{aligned} \mathrm{I}_2 &= \mathrm{I}_3 \\ \mathrm{I}_3 &= 2.4\mathrm{A} \\ \mathrm{V}_{bc} &= \mathrm{V}_b - \mathrm{V}_c \\ &= 48\mathrm{V} - 24\mathrm{V} \\ &= 24\mathrm{V} \\ \mathrm{P}_3 &= \mathrm{I}_3 \cdot \mathrm{V}_{ab} \\ &= 2.4\mathrm{A} \cdot 24\mathrm{V} \\ &= 57.6\mathrm{W} \end{aligned}$$

Answer: $\mathbf{P_3 = 57.6\ W}$

- (g) Determine P_4.
  Note:

$$\begin{aligned} \mathrm{V_a} &= 72\mathrm{V} \\ \mathrm{I}_4 &= 7.2\mathrm{A} \end{aligned}$$

Solution:

$$\begin{aligned} \mathrm{P}_4 &= \mathrm{I}_4 \cdot \mathrm{V}_a \\ &= 7.2\mathrm{A} \cdot 72\mathrm{V} \\ &= 518.4\mathrm{W} \end{aligned}$$

Answer: $\mathbf{P_4 = 518.4\ W}$

- (h) Determine P_5.
  Note:

$$\begin{aligned} \mathrm{V_c} &= 24\mathrm{V} \\ \mathrm{I}_2 &= 2.4\mathrm{A} \end{aligned}$$

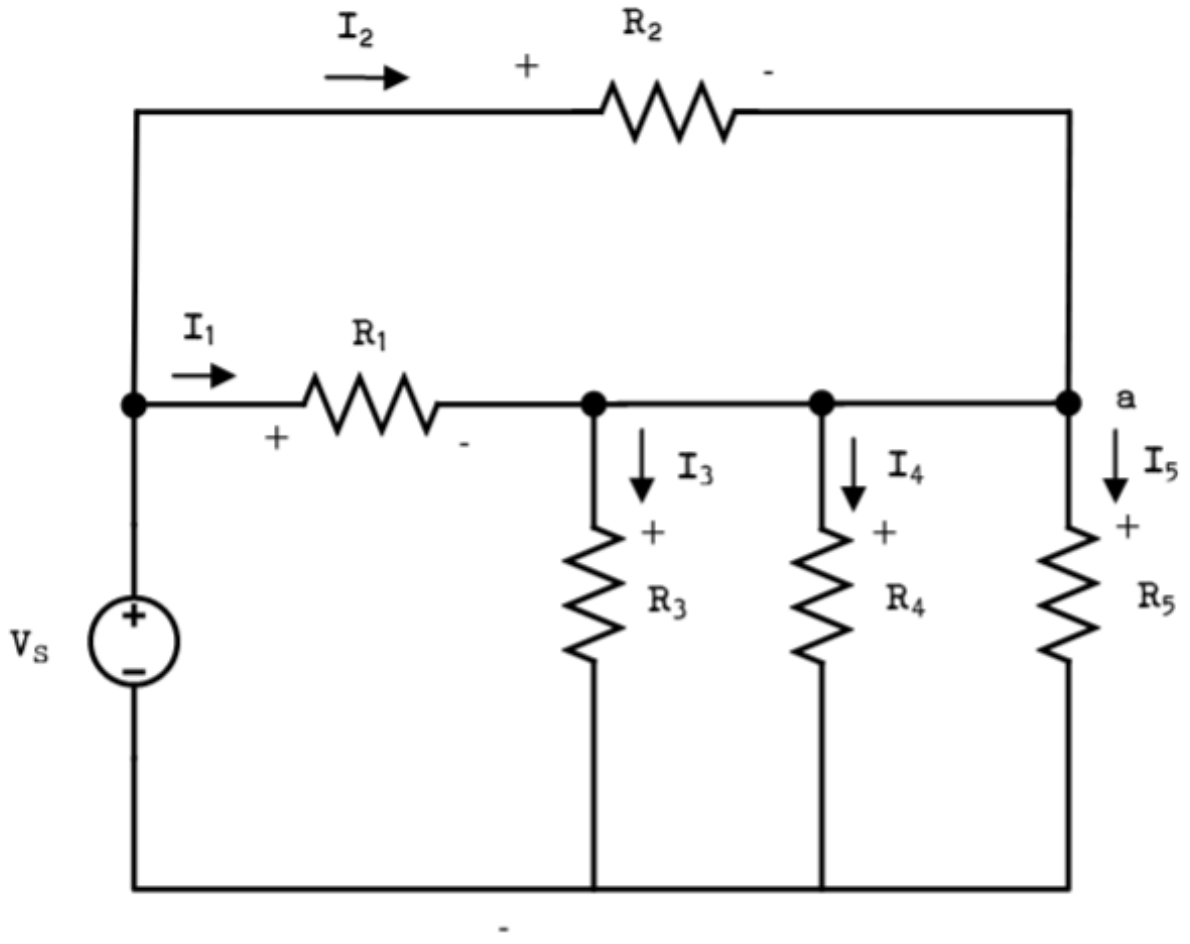
Solution:

$$\begin{aligned} \mathrm{I}_2 = \mathrm{I}_3 = \mathrm{I}_5 &= 2.4\mathrm{A} \\ \mathrm{P}_5 &= \mathrm{I}_5 \cdot \mathrm{V}_c \\ &= 2.4\mathrm{A} \cdot 24\mathrm{V} \\ &= 57.6\mathrm{W} \end{aligned}$$

Answer: $\mathbf{P_4 = 57.6\ W}$

3 Problem HW-3-1

(1) For the circuit shown, measurements are conducted and the following data is made available: pts



- $V_s = 120V$
- $V_a = 48V$
- $P_s = 1728W$
- $P_1 = 518.4W$
- $P_3 = P_4 = P_5 = 230.4W$
- (a) Determine the number of branches.
  There are **6 branches** in the circuit. 5 resistors and 1 voltage source.
- (b) Determine the number of nodes.
  There are **3 nodes** in the circuit.
  - between V_s, R_1, and R_2
  - between R_1, R_2, R_3, R_4, and R_5
  - between V_s, R_3, R_4, and R_5
- (c) Determine the number of independent loops.

$$\begin{aligned} \text{let } b &= 6 \\ \text{let } n &= 3 \\ l &= 6 - 3 + 1 \\ &= 4 \text{ independent loops} \end{aligned}$$

Answer: There are **4 independent loops** in the circuit.

- (d) Determine P_2.
  Solution:

$$\begin{aligned}\sum P_i &= 0\\ 0 &= P_s + P_1 + P_2 + P_3 + P_4 + P_5\\ P_2 &= -P_s - P_1 - P_3 - P_4 - P_5\\ &= 1728\text{W} - 518.4\text{W} - 230.4\text{W} - 230.4\text{W} - 230.4\text{W}\\ &= 518.4\text{W}\end{aligned}$$

  Answer: $\mathbf{P_2 = 518.4\ W}$

- (e) Determine I_3.
- (f) Determine I_4.
- (g) Determine I_5.
  Note:

$$\begin{aligned}V_a &= 48\text{V}\\ P_3 = P_4 &= P_5 = 230.4\text{W}\end{aligned}$$

  Solution:

$$\begin{aligned}I_3 &= \frac{P_3}{V_a}\\ &= \frac{230.4\text{W}}{48\text{V}}\\ &= 4.8\text{A}\\ I_3 = I_4 &= I_5 = 4.8\text{A}\end{aligned}$$

  Answer:

  (e) $\mathbf{I_3 = 4.8\ A}$
  (f) $\mathbf{I_4 = 4.8\ A}$
  (g) $\mathbf{I_5 = 4.8\ A}$

4 References

[1] Denise Thorsen, Maher Al-Badri, INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING, University of Alaska Fairbanks, 2022.