ELEC 2110

Electric Circuit Analysis

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Section 002

Recitation and MATLAB: AC Mesh and Nodal Analysis

Introduction

Lab 10 is for the student to practice solving ac circuits and also learn to start using MATLAB to solve the circuit variables by inserting circuit equations.

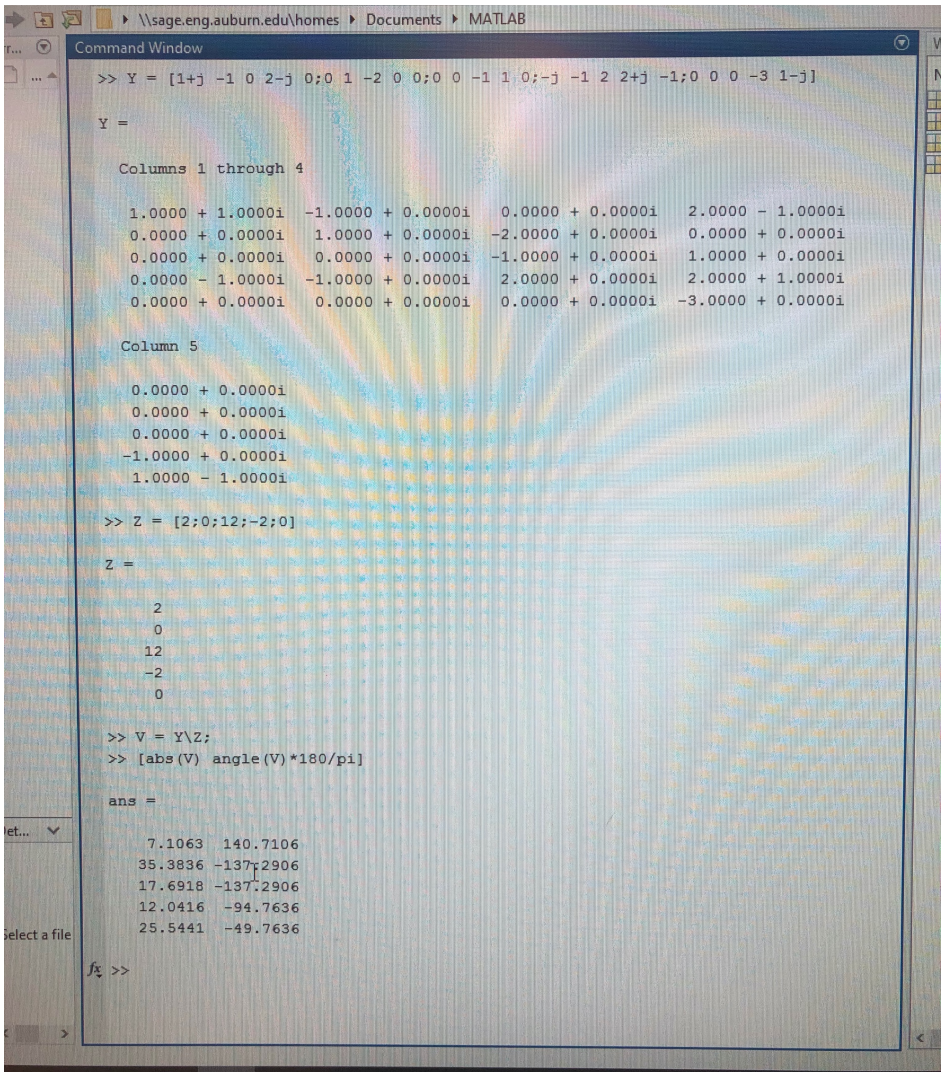
Exercise 1

Use MATLAB to solve the following set of equations. Then convert them to polar form.

$$\begin{bmatrix} 1+j & -1 & 0 & 2-j & 0 \\ 0 & 1 & -2 & 0 & 0 \\ 0 & 0 & -1 & 1 & 0 \\ -j & -1 & 2 & 2+j & -1 \\ 0 & 0 & 0 & -3 & 1-j \end{bmatrix} \begin{bmatrix} \bar{V}_1 \\ \bar{V}_2 \\ \bar{V}_3 \\ \bar{V}_4 \\ \bar{V}_5 \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \\ 12 \\ -2 \\ 0 \end{bmatrix}$$

(1)

Equations for exercise 1



(2)

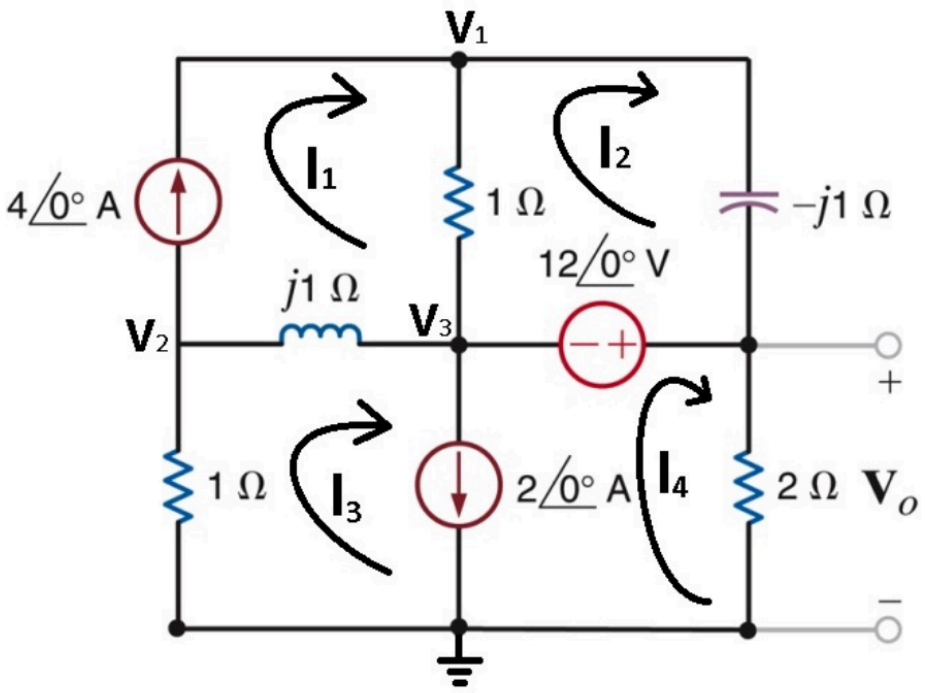
MATLAB code

Summary Table (In Polar Form)

Vector	**Angle (degrees)**
7.1063	140.7106
35.3836	-137.2906
17.6918	-137.2906
12.0416	-94.7636
25.5441	-49.7636

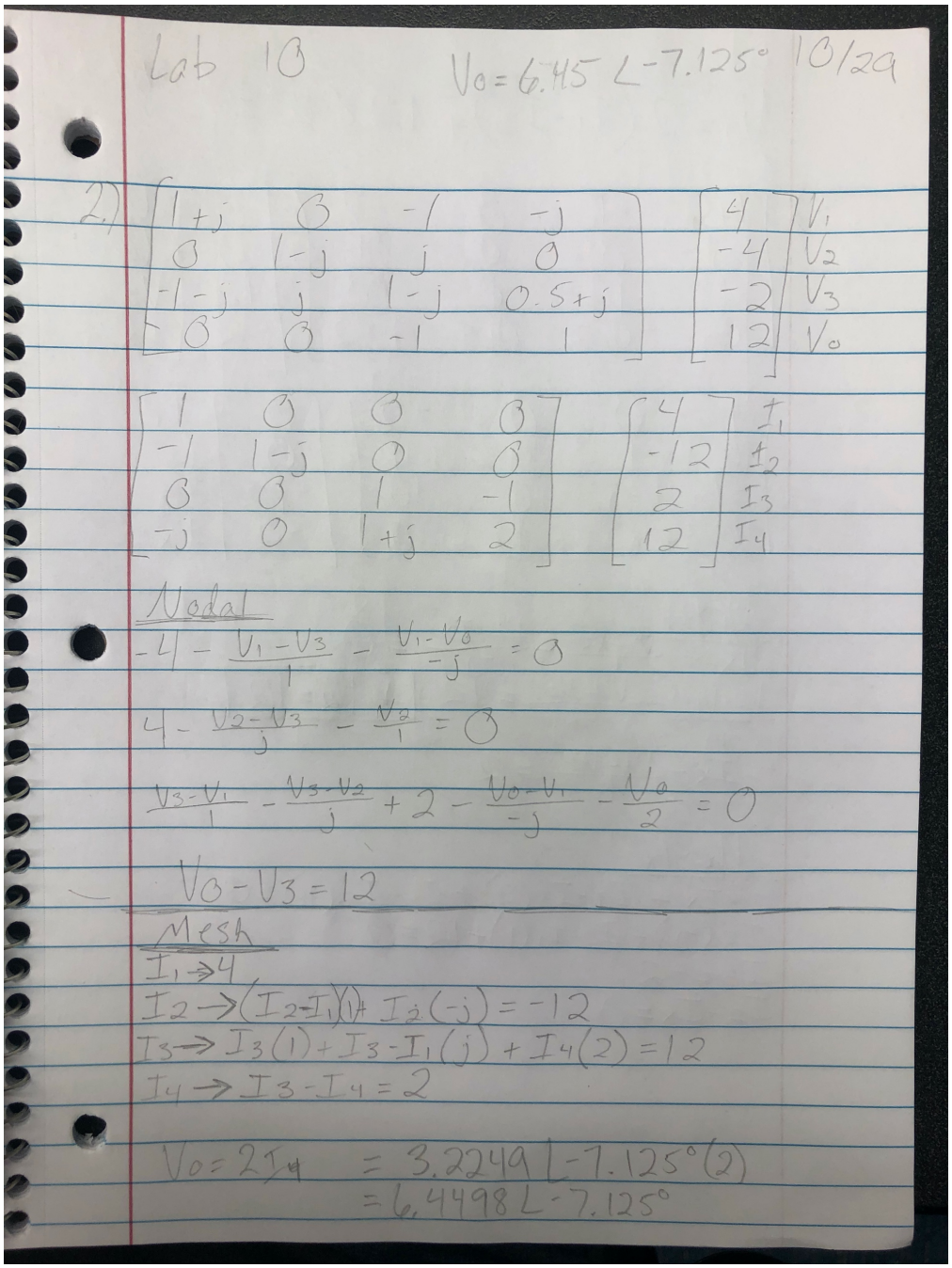
Exercise 2

Write nodal equations for the circuit and solve using MATLAB. Then repeat using mesh analysis.

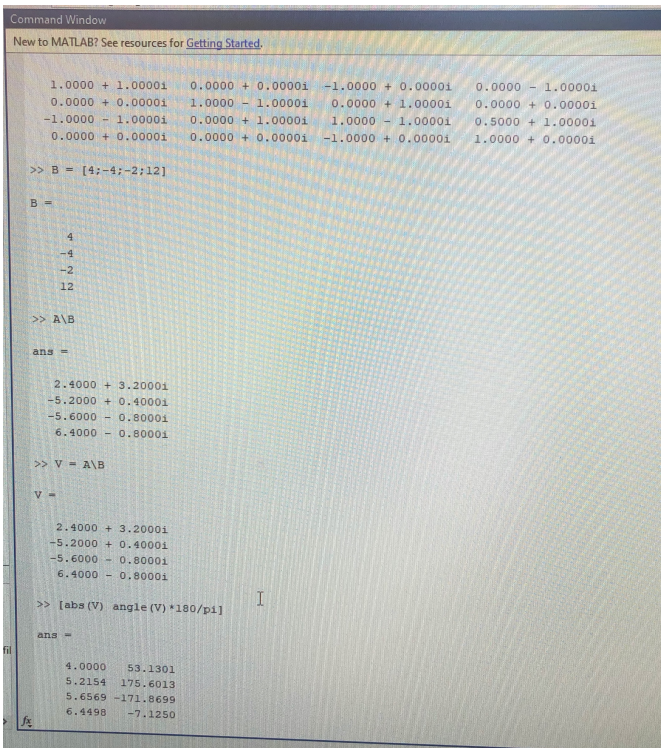


(3)

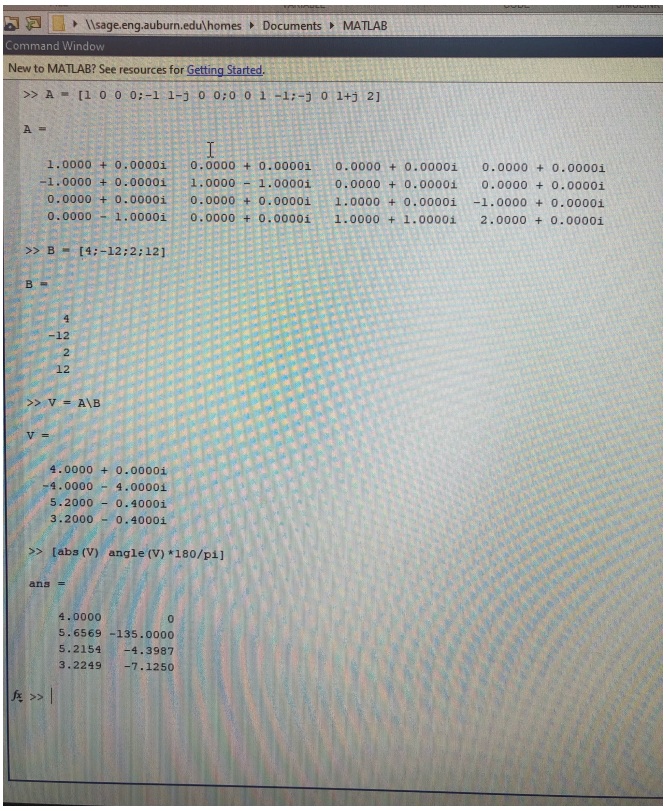
Circuit for exercise 2



Equations for exercise 2



Nodal equations MATLAB (5)



Mesh equations MATLAB (6)

Nodal Summary Table (In Polar Form)

	Vector	Angle (degrees)
V1	4.00	53.1301
V2	5.2154	175.6013
V3	5.6569	-171.8699
Vo	6.4498	-7.1250

Vo = Vo = 6.4498 <-7.1250 V

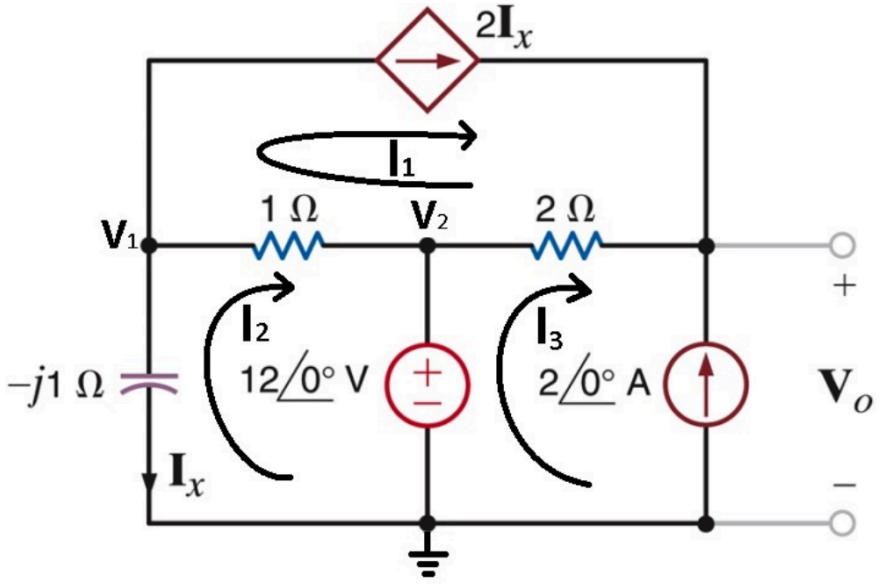
Mesh Summary Table (In Polar Form)

	Vector	Angle (degrees)
I1	4.00	0
I2	5.6569	-135.00
I3	5.2154	-4.3987
I4	3.2249	-7.1250

Vo = I4 * 2 = 2 * 3.2249 <-7.1250 = 6.4498 <-7.1250 V

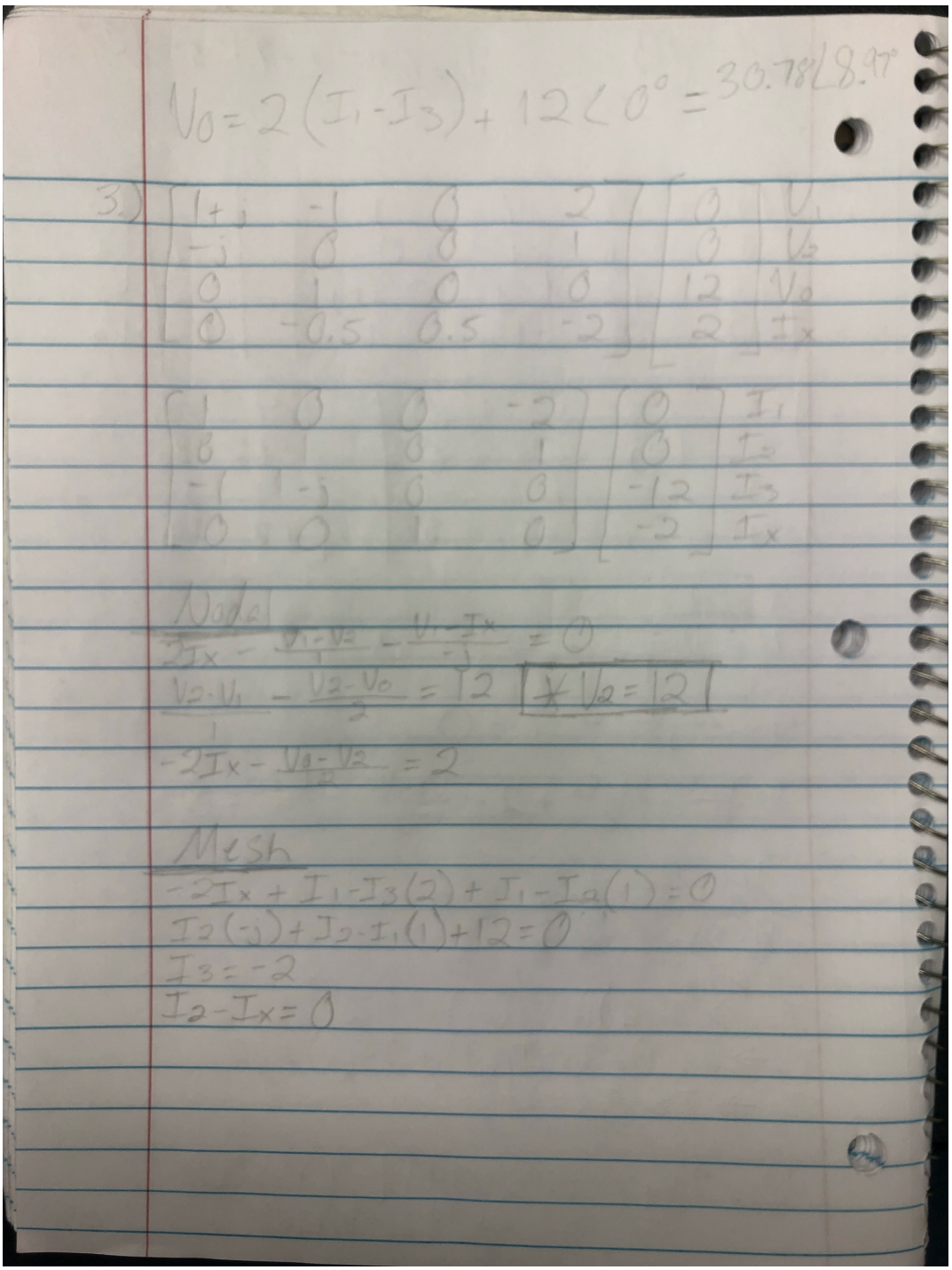
Exercise 3

Write nodal equations for the circuit and solve using MATLAB. Then repeat using mesh analysis.



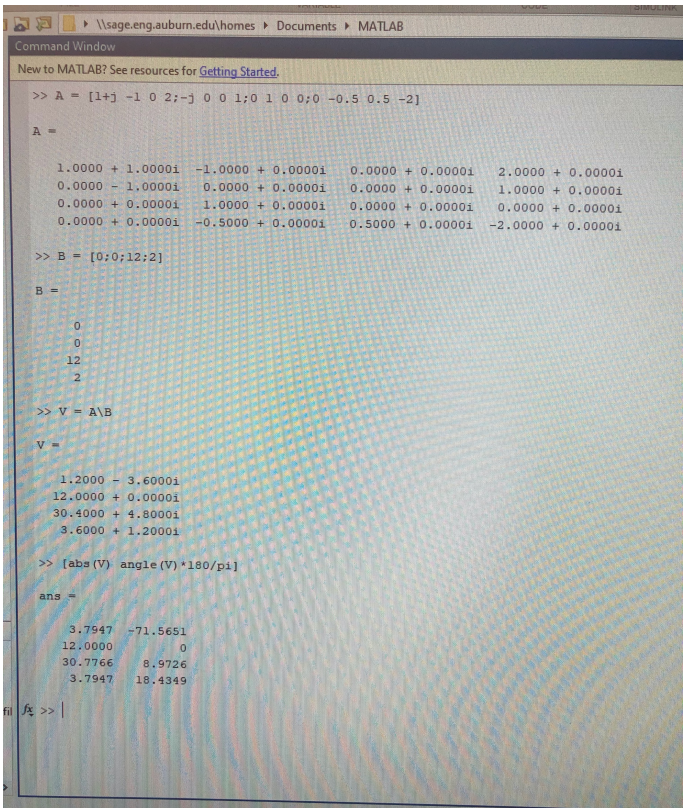
(7)

Circuit for exercise 3

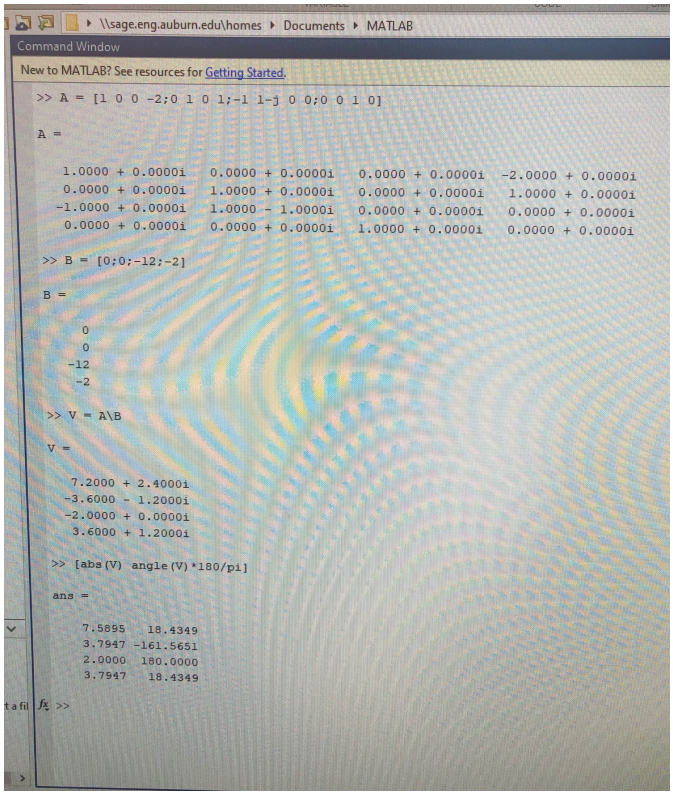


(8)

Equations for exercise 3



Nodal equations MATLAB (9)



Mesh equations MATLAB (10)

Nodal Summary Table (In Polar Form)

	Vector	Angle (degrees)
V1	3.7947	-71.5651
V2	12.00	0
Vo	30.7766	8.9726
Ix	3.7947	18.4349

Vo = Vo = 30.7766 <8.9726 V

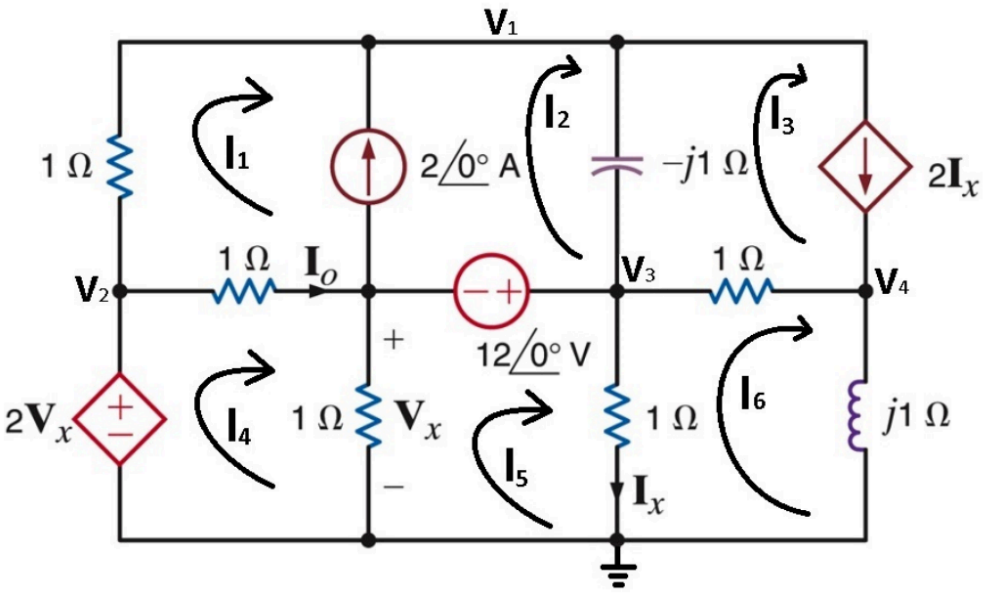
Mesh Summary Table (In Polar Form)

	Vector	Angle (degrees)
I1	7.5895	18.4349
I2	3.7947	-161.5651
I3	2.00	180
Ix	3.7947	18.4349

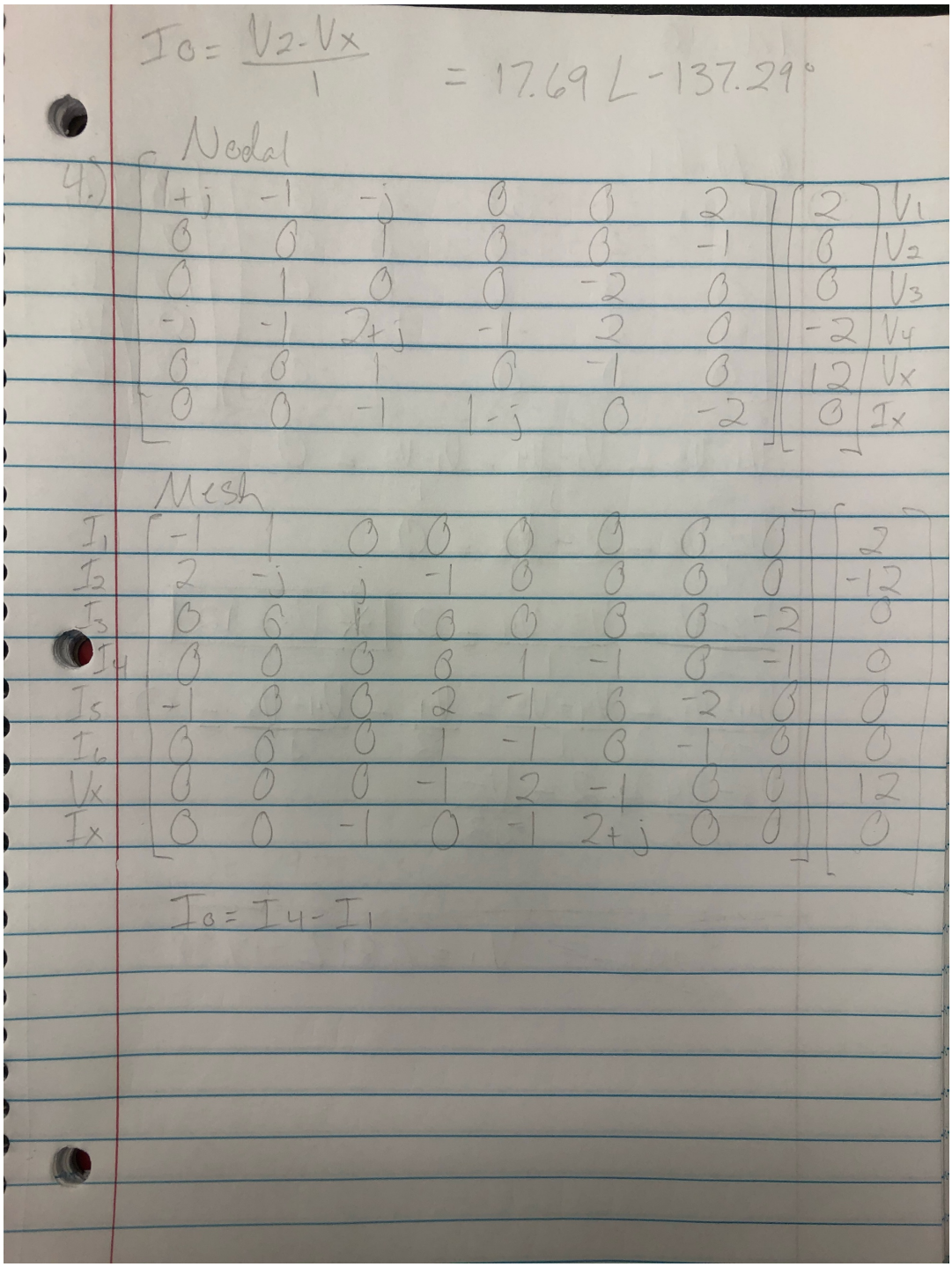
Vo = 2(I1-I3) + 12 = 2(7.5895 <18.4349 – 2.00 < 180) + 12 <0 = 30.7766 <8.9726 V

Exercise 4

Write nodal equations for the circuit and solve using MATLAB. Then repeat using mesh analysis.

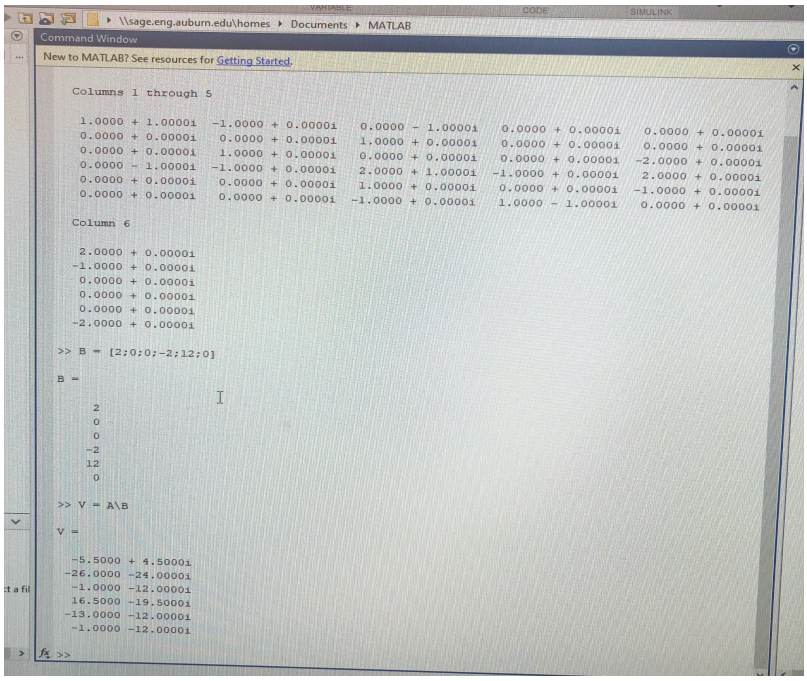


Circuit for exercise 4 (11)



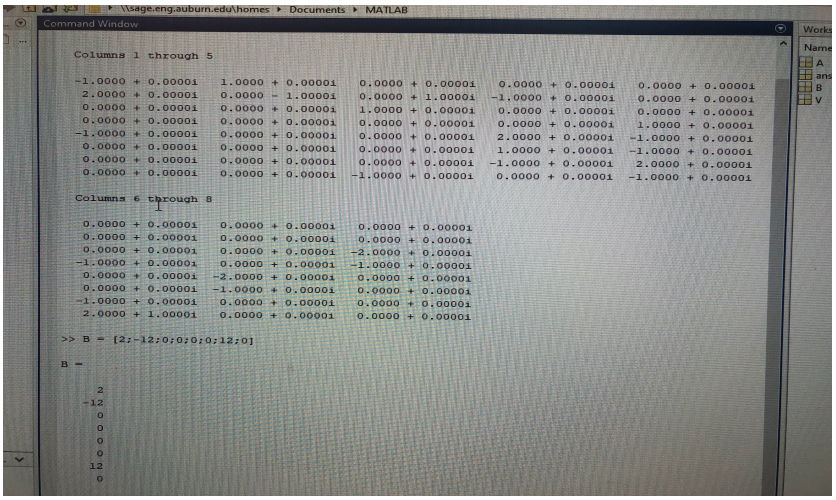
(12)

Equations for exercise 4

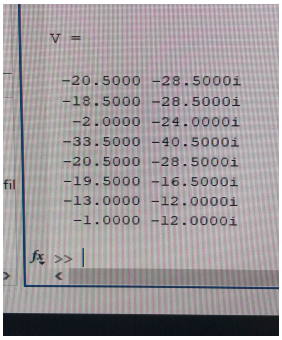


(13)

Nodal equations MATLAB **Not in Polar form**



Mesh equations MATLAB part 1 (14)



Mesh equations MATLAB part 2 (15) **Not in Polar form**

Nodal Summary Table (In Polar Form)

	Vector	Angle (degrees)
V1	7.10634	140.711
V2	35.3836	-137.291
V3	12.0416	-94.7636
V4	25.5441	-130.236
Vx	17.6918	-137.291
Ix	12.0416	-94.7636

Io = (V2 – Vx)/1 = 35.3836 <-137.291 – 17.6918 <-137.291 = 17.69 <-137.291 A

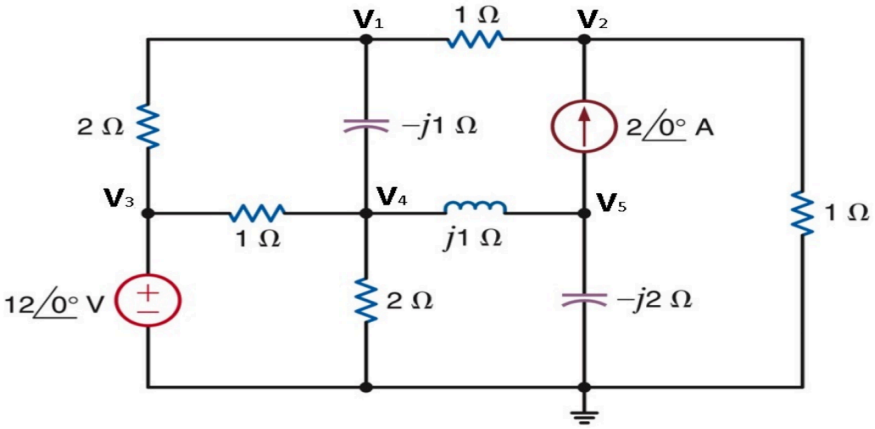
Mesh Summary Table (In Polar Form)

	Vector	Angle (degrees)
I1	35.107	-125.727
I2	33.9779	-122.989
I3	24.0832	-94.7636
I4	52.5595	-129.596
I5	35.107	-125.727
I6	25.5441	-139.764
Vx	17.6918	-137.291
Ix	12.0416	-94.7636

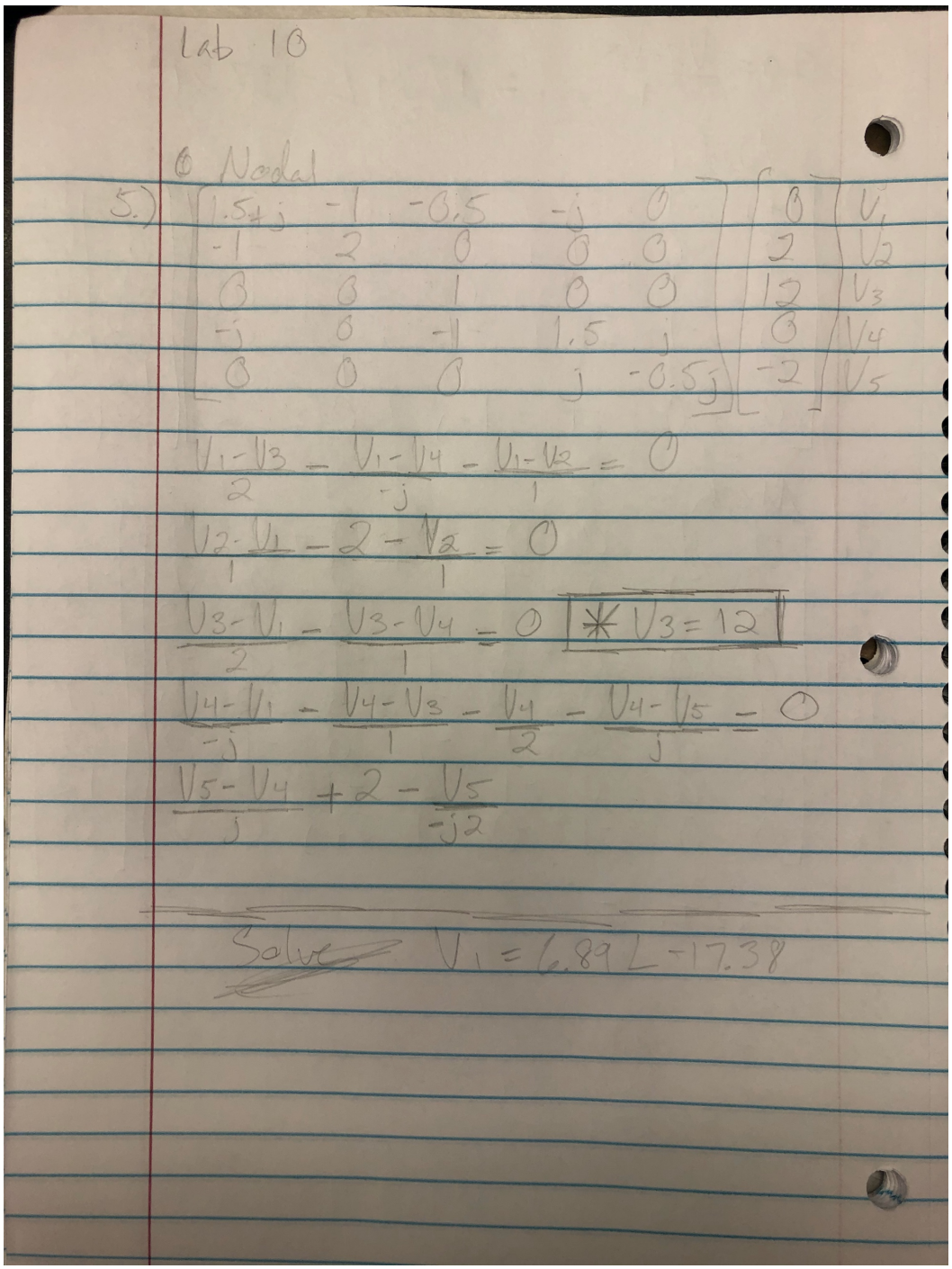
Io = I4 – I1 = 52.5595 <-129.596 – 35.107 <-125.727 = 17.69 <-137.291 A

Exercise 5

Write nodal equations for the circuit and solve using MATLAB.

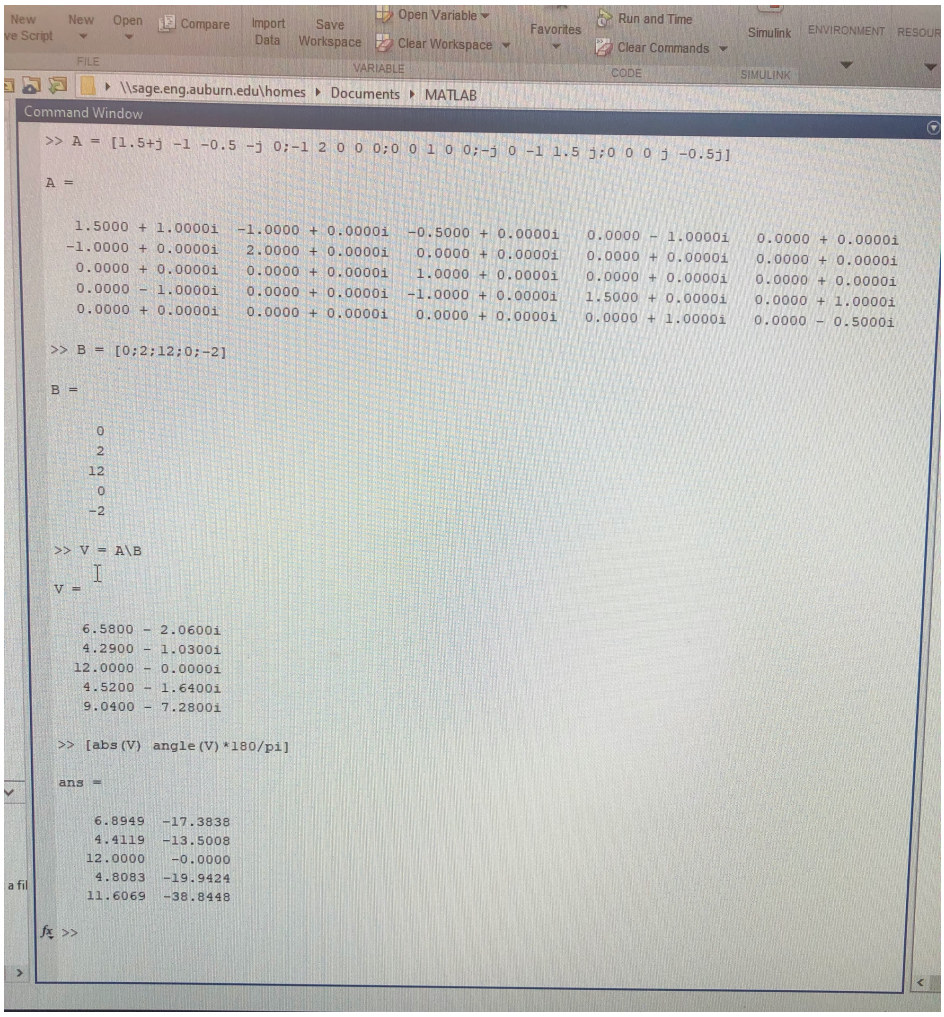


Circuit for exercise 5 (16)



(17)

Equations for exercise 5



(18)

Nodal equations MATLAB

Nodal Summary Table

	Vector	**Angle (degrees)**
V1	6.8949	-17.3838
V2	4.4119	-13.5008
V3	12.00	0
V4	4.8083	-19.9424
V5	11.6069	-38.8448

Conclusion

Nodal and Mesh analysis are tools critical for an electrical engineers' daily job. This lab is very helpful in learning to progress skills with these analysis methods, in AC circuits. AC circuit analysis is important since it is most common in the United States.

Bibliography

1. MATLAB equation to solve in exercise 1
2. MATLAB solution and solving
3. Circuit for exercise 2
4. Hand written equations exercise 2
5. Nodal equations exercise 2
6. Mesh equations exercise 2
7. Circuit for exercise 3
8. Hand written equations exercise 3
9. Nodal equations exercise 3
10. Mesh equations exercise 3
11. Circuit for exercise 4
12. Hand written equations exercise 4
13. Nodal equations exercise 4
14. Mesh equations exercise 4 part 1
15. Mesh equations exercise 4 part 2
16. Circuit for exercise 5
17. Hand written equations exercise 5
18. Nodal equations exercise 5