**ENED 1091: Homework #1**

**Due: Week of February 1st at beginning of Recitation**

**Problem 1:**  **Arithmetic Operations with Arrays**

Determine whether or not the following matrix operations are allowable or not. If the operation is not allowable, indicate this. Otherwise, provide the result. Do these by hand. *Note: Y and Z are just unknown numbers.*

(a)

(b)

(c) Operation not allowable

(d) =

(e)

**Problem 2:**  **Solving Systems of Linear Equations using Matrices**

Write each of the following systems of equations in matrix form: Ax = b. Then determine whether or not each of the following systems of linear equations has a unique solution. If there is a unique solution, find it. Include all MATLAB commands.

(a)

**Matrix Equation:** [

**Unique Solution? Why or why not?** No because the matrix has no inverse (det(A) = 0)

**If yes, find the solution. Provide MATLAB commands:**

(b)

**Matrix Equation:**

**Unique Solution? Why or why not?** Yes because the inverse of A exists (det(A) =/= 0)

**If yes, find the solution. Provide MATLAB commands:**

>> b\*inv(A)

ans =

-8.2000 4.9918 6.2685 -3.2219

**Problem 3: Resultant Force**

Consider the following three forces:

1. Resolve each force into an x-component and y-component. Fill in the table below. **Show your work!**

|  |  |  |
| --- | --- | --- |
| Force | x-component | y-component |
| F1 | 15\*cos(40) = 11.49N | 15\*sin(40) = 9.64N |
| F2 | 20\*cos(150) = -17.32N | 20\*sin(40) = 12.86N |
| F3 | 35\*cos(-135) = -24.75N | 35\*sin(-135) = -24.75N |

1. Calculate the resultant force in rectangular form and polar form. **Show your work and include units in your answers!**

Rectangular: Fx = 11.49 -17.32 – 24.75 = -30.58 Fy = 9.64 + 12.86 – 24.75 = -2.25N

Polar: magnitude = sqrt(Fx2 + Fy2) = 30.66 theta = 180 + arctan(-2.25/-30.58) = 184.21⁰

Resultant Force (Rectangular Form): Fx = -30.58 Fy = -2.25

Resultant Force (Polar Form): 30.66 @ 184.21⁰

(c) Plot the three individual forces and the resultant force in MATLAB (all on the same plot). Paste your plot and your MATLAB command(s) in the space below. *Hint: try this command in MATLAB* - plot([0 3],[0 5],'r-')

**Plot:**

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**MATLAB Command(s):**

figure(1)

plot([0 11.49],[0 9.64],'r-',[0 -17.32],[0 12.86],'r-',[0 -24.75],[0 - 24.75],'r-',[0 -30.58],[0 -2.25],'b-');

xlabel('Fx','FontSize',14);

ylabel('Fy','FontSize',14);

title('Resultant of Three Forces','FontSize',20);

**Problem 4: Statics**

Write the force balance equations for the diagram shown below that represents an object hanging from two wires. Then write the equations in matrix form (Ax = b) and use MATLAB to solve for the tension (T1 and T2) in the two wires. **Show your work and include units in your answers!**

25o 55o

T2

T1

W = 120 lbs.

**Force Balance Equations:**

0 = T1sin(25) – T2cos(35)

120 = T1cos(25) + T2sin(35)

**Matrix Equation:**

**Solutions:**

**T1 =** 141.7571N

**T2 =** 18.9283N

**MATLAB Commands:**

A = [sin(25) -cos(35); cos(25) sin(35)];

b = [0 120];

det(A)

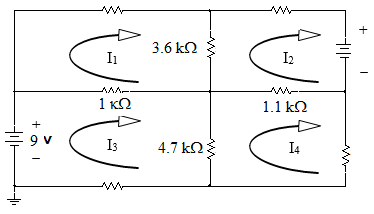
b\*inv(A)

**Problem 5: Mesh Analysis**

A student in a circuits class writes mesh equations for the circuit shown below and now must solve for the unknown currents (I1, I2, I3, and I4).

10 k

2.2 k



6.8 k

5.6 k

15 V

1. Write the equations in matrix form and use MATLAB to solve for all four currents. The units for the currents will be in milliamps (mA). Indicate the direction of the current (to the left or to the right). **Show all of your MATLAB commands and results.**

**Matrix Equation:**

**Solutions:**

**I1 =** -0.4679 mA (to the left)

**I2 =** -1.1187 mA (to the left)

**I3 =** 0.8456 mA (to the right)

**I4 =** 0.2178 mA (to the right)

**MATLAB Commands:**

A = [6.8 -3.6 -1 0; -3.6 14.7 0 -1.1; -1 0 11.3 -4.7; 0 -1.1 -4.7 12.6];

b = [0 -15 9 0];

det(A)

b\*inv(A)

1. Find the current through the 1.1 kΩ resistor and find the voltage drop across the 1.1 kΩ resistor. **Show your calculations and include units in your answers.**

Current through 1.1 kΩ resistor = (I2 – I4) = 1.3365 kΩ

Voltage drop = 1.1 kΩ \* 1.3365 mA = 1.47 V