Electric Circuits I
Laboratory 1: Vectors and Matrices MATLAB

Objective:

- In this laboratory you will learn how to represent and use vectors and matrices in MATLAB.

Background notes:

In MATLAB an MxN matrix is a rectangular array of numbers with M rows and N columns. It can be defined by typing the matrix elements between square brackets. Elements along a row are separated by commas, and rows are separated by semi colons.

In Lab 0 you used row vectors for values of the angle and time variable. A row vector is a matrix with M=1.

In MATLAB Help, go to the Mathematics chapter. The second section is "Matrices in MATLAB." Read the first four sections about creating, adding, and multiplying matrices.

Matrix Multiplication:

Create 2 x 2 matrices A and B are as follows:

A = [2,1; 3,2] and **B=[3,1; 2,2]**

Print A' and B', the transposes of these two matrices.

Compute the following 4 matrix products and print them. Are any the same? Which ones?

A1 = A * B, A2 = B * A, A3 = (A'* B')', A4 = (B' * A')'

Matrix Inverses:

Use "inv" to compute the following matrix inverses.

A1 = inv(A * B), A2 = inv(A) * inv(B), A3 = inv(B * A), A4 = inv(B) * inv(A).

Check the inverse values. Multiply A1*(A*B) and also multiply (A*B)*A1. What are the two products?

Solving Circuits with MATLAB:

The result of a KVL/KCL analysis of a circuit is the set of simultaneous equations:

$$\begin{aligned} V1 &+ & &+ V3 &= 10 \\ 3V1 &+ 3V2 &+ 4V3 &= 12 \\ 2V1 &+ 2V2 &+ 3V3 &= 5 \end{aligned}$$

which can be written using matrices as follows:

$$\begin{bmatrix} 1 & 0 & 1 \\ 3 & 3 & 4 \\ 2 & 2 & 3 \end{bmatrix} \cdot \begin{bmatrix} V1 \\ V2 \\ V3 \end{bmatrix} = \begin{bmatrix} 10 \\ 12 \\ 5 \end{bmatrix} = C \cdot V = S$$

$$C = \begin{bmatrix} 1 & 0 & 1 \\ 3 & 3 & 4 \\ 2 & 2 & 3 \end{bmatrix} \qquad V = \begin{bmatrix} V1 \\ V2 \\ V3 \end{bmatrix} \qquad S = \begin{bmatrix} 10 \\ 12 \\ 5 \end{bmatrix}$$

To solve this 3x3 system of equations we invert the coefficients matrix C and multiply it by the source matrix S.

Invert the matrix C and solve the system for the voltage matrix V. Then verify that the result is correct by multiplying C*V and compare the result with S.

More About Matrix Inverses:

Find the inverse of the matrix D shown below:
D = [2,4; 1,2]

a. Is there an inverse of D ?
b. If the answer is 'NO' then why not?

Products of Time Functions:

Given the following functions,

p(t) = 5cos (2*pi*3*t) and v(t) = 5*exp(-0.5*t)

plot p(t) and v(t) from t = 0 to t=10 using time steps of 0.01.

Create the point by point product function b(t) = p(t)v(t) using b=p.*v and plot it. Note that the **.*** operation multiplies the two vectors point by point rather than computing a matrix product.

Note: Please show all your work.