Green University

ASSIGNMENT SHEET

Section : DA-221

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Subject : MAT-105 Vector Analysis

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Question 1

Determine the coefficients of the given polynomial $P(x) = a_0 + a_1x + a_2x^2$ Whose graph passes through the points (1, 3), (2, Last digit of your ID) and (3,8). Also plot the function using MATLAB command (having proper title, x and y axis notation).

Solution:

Given that,

$$p(x) = a_0 + a_1x + a_2x^2$$

So,

$$p(1) = a_0 + a_1 + a_2$$
$$p(2) = a_0 + 2a_1 + 4a_2$$
$$p(3) = a_0 + 3a_1 + 9a_2$$

And,

$$a_0 + a_1 + a_2 = 3$$
$$a_0 + 2a_1 + 4a_2 = 3$$
$$a_0 + 3a_1 + 9a_2 = 8$$

The augmented matrix is :

$$\begin{pmatrix} 1 & 1 & 1 & | & 3 \\ 1 & 2 & 4 & | & 3 \\ 1 & 3 & 9 & | & 8 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 1 & 1 & | & 3 \\ 0 & -1 & -3 & | & 0 \\ 0 & -2 & -8 & | & -5 \end{pmatrix} \quad r_2' = -r_1 - r_2 , \ r_3' = r_1 - r_3$$

$$= \begin{pmatrix} 1 & 1 & 1 & | & 3 \\ 0 & -1 & -3 & | & 0 \\ 0 & 0 & 2 & | & 5 \end{pmatrix} \quad r_3' = 2r_2 - r_3$$

$$= \begin{pmatrix} 1 & 1 & 1 & | & 3 \\ 0 & 1 & 3 & | & 3 \\ 0 & 0 & 1 & | & -0.5 \end{pmatrix} \quad r_3' = \frac{1}{2}r_3$$

So, the reduced system is :

$$a_0 + a_1 + a_2 = 3$$
$$-a_1 - 3a_2 = 0$$
$$2a_2 = 5$$

$a_1 = -3 * (2.5) = -7.5$

$a_0 = -7.5 + 2.5 - 3 = -8$

Therefore,

$a_0 = -8$

$a_1 = -7.5$

$a_2 = 2.5$

Solution using MATLAB:

```matlab
% Set points for x-axis and y-axis
x = [1, 2, 3];
y = [3  3  8];                          % Last digit of ID:  3

coeffs = polyfit(x,y,2);                % Get the coefficients of polynomial function

plot(0:0.1:5,polyval(coeffs,0:0.1:5),'b-');  % Plot the polynomial values in graph

%build the graph with labels, titles etc.
hold on;                                % Hold to not replace the older plot
scatter(x,y,'filled');                  % Create a scatter with filled indicator
xlabel('x');                            % Set the label for x-axis
ylabel('y');                            % Set the label for y-axis
title('P(x) = a0 + a1x + a2x2');        % Set the title of the plot
legend('Points', 'Polynomial');         % Set legend for indicators
hold off;
```

Plot of the function:
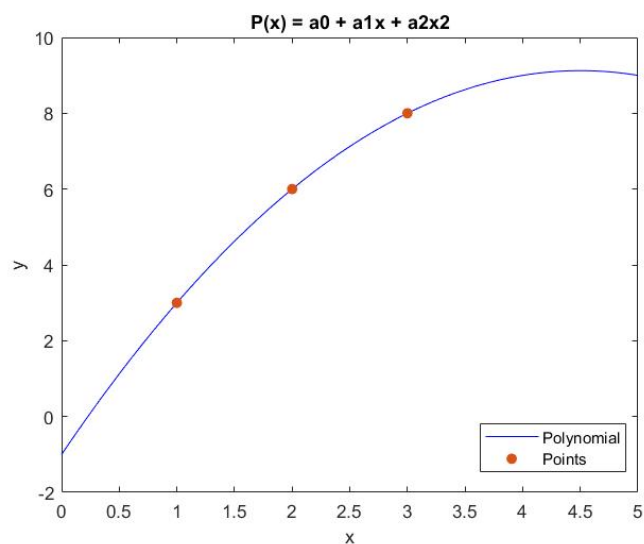
Using suitable command encode the message "ABBREVIATIONS" by using matrix A given below:

$$= \begin{bmatrix} 1 & -1 & 1 \\ 1 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

Solution:

Given message "ABBREVIATIONS" with the key $\quad A \begin{bmatrix} 1 & -1 & 1 \\ 1 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix}$

Where A = 1, B = 2, B = 2, R = 18, E = 5, V = 22, I = 9, A = 1, T =20, I= 9, O = 15, N = 14, S = 19

Forming matrices with the above numbers,

$$[1 \quad 2 \quad 2] \, [18 \quad 5 \quad 22] [9 \quad 1 \quad 20] [9 \quad 15 \quad 14] [19 \quad 0 \quad 0]$$

To encrypt

$$[1 \quad 2 \quad 2] \begin{bmatrix} 1 & -1 & 1 \\ 1 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix} = [1 + 2 + 2 \quad -1 + 2 + 4 \quad 1 + 0 + 2]$$

$$= [5 \quad 5 \quad 3]$$

$$[18 \quad 5 \quad 22] \begin{bmatrix} 1 & -1 & 1 \\ 1 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix} = [18 + 5 + 22 \quad -18 + 5 + 44 \quad 18 + 0 + 22]$$

$$= [45 \quad 31 \quad 40]$$

$$[9 \quad 1 \quad 20] \begin{bmatrix} 1 & -1 & 1 \\ 1 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix} = [9 + 1 + 20 \quad -19 + 1 + 40 \quad 9 + 0 + 20]$$

$$= [30 \quad 32 \quad 29]$$

$$[9 \quad 15 \quad 14] \begin{bmatrix} 1 & -1 & 1 \\ 1 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix} = [9 + 15 + 14 \quad -9 + 15 + 28 \quad 9 + 0 + 14]$$

$$= [38 \quad 34 \quad 23]$$

$$[19 \quad 0 \quad 0]\begin{bmatrix} 1 & -1 & 1 \\ 1 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix} = [19+0+0 \quad -19+0+0 \quad 19+0+0]$$

$$= [19 \quad -19 \quad 19]$$

So, we have the following encrypted message:

5   5   3   45   31   40   30   32   29   38   34   23   19   -19   19

Determine the currents for the electrical network shown in the following figure:
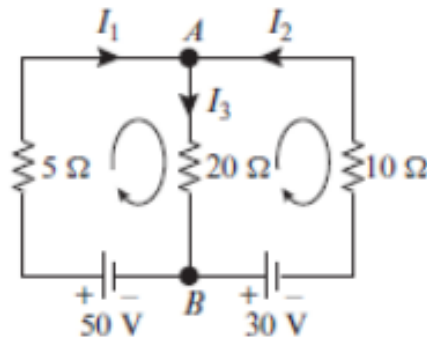
Also solve the system by using MATLAB or any other programming language.

Solution:

From Kirchhoff's 1st law,

$$I_1 + I_2 - I_3 = 0$$

From Kirchhoff's 2nd law,

$$5I_1 + 20I_3 = 50$$
$$- 10I_2 - 20I_3 = 30$$

So,

$$I_1 + I_2 - I_3 = 0$$
$$5I_1 + 0*I_2 + 20I_3 = 50$$
$$0*I_1 - 10I_2 - 20I_3 = 30$$

The augmented matrix is :

$$= \begin{pmatrix} 1 & 1 & -1 & | & 0 \\ 5 & 0 & 20 & | & 50 \\ 0 & -10 & -20 & | & 30 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 1 & -1 & | & 0 \\ 0 & -5 & 25 & | & 50 \\ 0 & -10 & -20 & | & 30 \end{pmatrix} \quad r_2' = -5r_1 + r_2$$

$$= \begin{pmatrix} 1 & 1 & -1 & \Big| & 0 \\ 0 & 1 & -5 & \Big| & -10 \\ 0 & -10 & -20 & \Big| & 30 \end{pmatrix} \quad r_2' = -\frac{1}{5}r_2$$

$$= \begin{pmatrix} 1 & 1 & -1 & \Big| & 0 \\ 0 & 1 & -5 & \Big| & -10 \\ 0 & 0 & -70 & \Big| & -70 \end{pmatrix} \quad r_3' = 10r_1 + r_3$$

$$= \begin{pmatrix} 1 & 1 & -1 & \Big| & 0 \\ 0 & 1 & -5 & \Big| & -10 \\ 0 & 0 & 1 & \Big| & 1 \end{pmatrix} \quad r_3' = -\frac{1}{70}r_3$$

So, the reduced system is :

$I1 + I2 - I3 = 0$

$I2 - 5I3 = -10$

$I3 = 1$

$I2 = -10 + 5*1 = -5$

$I1 = 1 - (-5) = 6$

Therefore,

$I1 = -5$

$I2 = 6$

$I3 = 1$

<u>Solution using MATLAB</u>

```matlab
% Define variables for values of the current
syms I1 I2 I3;

% Set the equations we have got according kirchhoff's law
eqn1 = I1 + I2 - I3 == 0;
eqn2 = 5*I1 + 0*I2 + 20*I3 == 50;
eqn3 = 0*I1 - 10*I2 - 20*I3 == 30;

% Get the solution using solve function for linear system
sol = solve([eqn1, eqn2, eqn3], [I1, I2,I3]);

% Display the solution for values of currents from the struct of sol
disp('The currents in the electronic networks are:');
disp(['I1 = ', char(sol.I1), ', I2 = ', char(sol.I2), ', I3 = ', char(sol.I3)]);
```

```
The currents in the electronic networks are:
I1 = 6, I2 = -5, I3 = 1
```