1) Solve the following equation

a) $x^2 + 2x - 15 = 0$

1. Posibility (factorized): $(x-3)(x+5) = 0$

$$x_1 = 3\,, x_2 = -5$$

2. Posibility (form): $x_1 = \frac{-2+\sqrt{2^2-4\cdot1\cdot(-15)}}{2\cdot1} = 3$

$$x_2 = \frac{-2-\sqrt{2^2-4\cdot1\cdot(-15)}}{2\cdot1} = -5$$

b) $3x - y = 7 \,/\cdot 3$ elimination

$\underline{2x + 3y = 1}$

$9x - 3y = 21$

$\underline{2x + 3y = 1}$

$11x = 22$

$x = \frac{22}{11} = 2$

$3x - y = 7$

$3 \cdot 2 - y = 7$

$y = -7 + 6 = -1$

c) $x^2 - y^2 = 10$ substitution

$2x + y = 1 \;\rightarrow\; y = 1 - 2x$

$x^2 - (1-2x)^2 = 10$

$-3x^2 + 4x - 11 = 0$

$x_1 = \frac{-4+\sqrt{4^2-4\cdot(-3)\cdot(-11)}}{2\cdot(-3)} = \frac{-4+\sqrt{-116}}{-6} = -\frac{2}{3} - \frac{i\sqrt{29}}{3}$

$x_2 = \frac{-4-\sqrt{4^2-4\cdot(-3)\cdot(-11)}}{2\cdot(-3)} = -\frac{2}{3} + \frac{i\sqrt{29}}{3}$

$y_1 = 1 - 2x_1 = \frac{7}{3} + \frac{2i\sqrt{29}}{3}$

$y_2 = 1 - 2x_2 = \frac{7}{3} - \frac{2i\sqrt{29}}{3}$

2) calculate the following matrix operations

a) $\begin{bmatrix} 1 & -2 & 0 \\ -4 & 2 & 3 \end{bmatrix} + \begin{bmatrix} -1 & 1 & 2 \\ 0 & -1 & 1 \end{bmatrix} = \begin{bmatrix} 1-1 & -2+1 & 0+2 \\ -4+0 & 2-1 & 3+1 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 2 \\ -4 & 1 & 4 \end{bmatrix}$

b) $2 \cdot \begin{bmatrix} 1 & -2 & 0 \\ -4 & 2 & 3 \end{bmatrix} = \begin{bmatrix} 2\cdot1 & 2\cdot-2 & 2\cdot0 \\ 2\cdot-4 & 2\cdot2 & 2\cdot3 \end{bmatrix} = \begin{bmatrix} 2 & -4 & 0 \\ -8 & 4 & 6 \end{bmatrix}$

c) $\begin{bmatrix} 1 & 2 & 0 \\ 4 & 2 & 3 \end{bmatrix} \cdot \begin{bmatrix} 3 & 4 & 1 \\ 5 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} = \begin{bmatrix} 1\cdot3+2\cdot5+0\cdot1 & 1\cdot4+2\cdot0+0\cdot1 & 1\cdot1+2\cdot1+0\cdot0 \\ 4\cdot3+2\cdot5+3\cdot1 & 4\cdot4+2\cdot0+3\cdot1 & 4\cdot1+2\cdot1+3\cdot0 \end{bmatrix} =$
$\begin{bmatrix} 13 & 4 & 3 \\ 25 & 19 & 6 \end{bmatrix}$

d) $\begin{bmatrix}-4 & -2 & | & 1 & 0\\ 5 & 5 & | & 0 & 1\end{bmatrix} \xrightarrow{R_1+R_2} \begin{bmatrix}1 & 3 & | & 1 & 1\\ 5 & 5 & | & 0 & 1\end{bmatrix} \xrightarrow{R_2-5R_1} \begin{bmatrix}1 & 3 & | & 1 & 1\\ 0 & -10 & | & -5 & -4\end{bmatrix} \xrightarrow{-\frac{1}{10}R_2} \begin{bmatrix}1 & 3 & | & 1 & 1\\ 0 & 1 & | & \frac{1}{2} & \frac{2}{5}\end{bmatrix}$

$\xrightarrow{R_1-3R_2} \begin{bmatrix}1 & 0 & | & -\frac{1}{2} & -\frac{1}{5}\\ 0 & 1 & | & \frac{1}{2} & \frac{2}{5}\end{bmatrix}$

e) $A = \begin{bmatrix}5 & -2 & 2 & 7\\ 1 & 0 & 0 & 3\\ -3 & 1 & 5 & 0\\ 3 & -1 & -9 & 4\end{bmatrix} = -\begin{bmatrix}\cancel{5} & -2 & 2 & 7\\ \cancel{1} & \cancel{0} & \cancel{0} & \cancel{3}\\ \cancel{-3} & 1 & 5 & 0\\ \cancel{3} & -1 & -9 & 4\end{bmatrix} + 3\begin{bmatrix}5 & -2 & 2 & \cancel{7}\\ \cancel{1} & \cancel{0} & \cancel{0} & \cancel{3}\\ -3 & 1 & 5 & \cancel{0}\\ 3 & -1 & -9 & \cancel{4}\end{bmatrix} = -\begin{bmatrix}-2 & 2 & 7\\ 1 & 5 & 0\\ -1 & -9 & 4\end{bmatrix} +$
$3\begin{bmatrix}5 & -2 & 2\\ -3 & 1 & 5\\ 3 & -1 & -9\end{bmatrix} = -\big((-2\cdot 5\cdot 4\ +\ 1\cdot -9\cdot 7\ +\ -1\cdot 2\cdot 0) - (7\cdot 5\cdot -1\ + 0\cdot -9\cdot -2\ + 4\cdot 2\cdot$
$1\,)\big) + 3\big((5\cdot 1\cdot -9\ +\ \ -3\cdot -1\cdot 2\ +\ 3\cdot -2\cdot 5) - (2\cdot 1\cdot 3\ +\ 5\cdot -1\cdot 5\ +\ -9\cdot -2\cdot -3)\big) =$
$-\big((-40-63+0)-(-35+0+8)\big)+3\big((-45+6-30)-(6-25-54)\big) = -(-103+27)+$
$3(-69+73) = -(-76)+3(4) = 88$

3) Matlab: Enter the following matrix and calculate the determinant

A=[16 3 2 13;5 10 11 8;9 6 7 12;4 15 1 1];

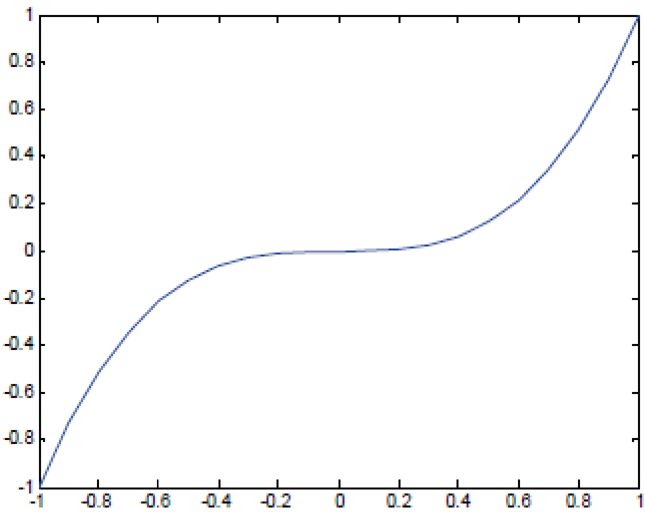
det(A);

4) Matlab: visualizethe functions for x in interval [-1 … 1] and draw a graph

x=-1:0.1:1; - defines the range of x

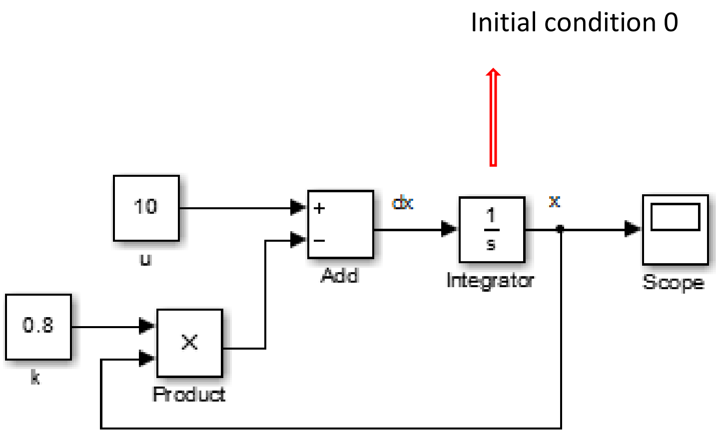
y=x.^3;   - raises each element in x to the third power

plot(x,y);   - plot y over x



5) Model the following system

$$\frac{dX}{dt} = u - k\cdot X$$
$$u = 10, k = 0.8, X(0) = 0$$


Initial condition 0
10
u
0.8
k
Product
+
−
Add
dx
1
s
Integrator
x
Scope