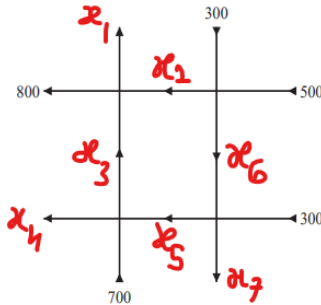


Engineering Mathematics (ES1032)

Exercise on System of Linear Equations

1.	Reduce the following matrix to echelon form and hence determine the rank. How many pivot elements are there? State the column numbers where you observed the pivot elements. $\begin{bmatrix} 1 & -1 & 2 & 4 \\ 1 & 0 & 1 & 6 \\ 2 & -3 & 5 & 4 \\ 3 & 2 & -1 & 1 \end{bmatrix}.$
2.	Reduce the following matrix to echelon form and hence determine the rank. $\begin{bmatrix} 3 & -1 & 1 & 2 & -2 \\ 1 & 2 & -1 & 1 & 1 \\ -1 & -3 & 2 & -4 & -6 \end{bmatrix}.$
3.	Determine real values of a so that the system of equations have non-trivial solution $x + 2y = ax$, $3x + y + 2z = ay$, and $2x + 3y + z = az$. Solve the system for this value of a. Draw the graph of above equations for this value of a using any free online graphical software and show the solution graphically.
4.	Determine the possible conditions on a, b, c and d so that the matrix $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is i) equivalent to $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ ii) equivalent to $\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$.
5.	Determine whether the following set of equations possesses non-trivial solution. Draw the graph of above equations using any free online graphical software and show the solution graphically. $x - 2y + 3z = 0, -2x - 3y - 4z = 0, 2x - 4y + 9z = 0.$
6.	i) Use any free graphical software to graph the following system. ii) Use the graphs to determine whether the system is consistent or not. iii) If the system is consistent, show the approximate solution graphically. iv) Solve the system algebraically also. v) Compare the solution obtained in step (iii) and step (iv). Write your conclusion. $-3x - y = 3, 6x + 2y = 1$ b) $2x - 8y = 3, x + 2y = 0$.
7.	The flow of cars passing per hour is mentioned in the following network. Find the flow pattern by modelling the it as the system of linear equations.  Further find the solution if $x_4 = 200 / hr$, $x_6 = 300 / hr$ and $x_7 = 100$.
8.	Apply Kirchhoff's laws and construct a mathematical model for the following circuit. Solve the model completely and calculate the currents I_1, I_2 and I_3.

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Exercise on System of Linear Equations

9.	Find the values of a, b and c such that the system of equations has i) exactly one solution ii) infinite solutions iii) no solution. $x + 5y + z = 0, x + 6y - z = 0, 2x + ay + bz = c.$ Draw the graph of above equations using any free online graphical software for each of the above situations.
10.	Determine the values of k such that the following system of equations does not have a unique solution. $x + y + kz = 3, x + ky + z = 2, kx + y + z = 1.$ Draw the graph of above equations using any free online graphical software and show the solution graphically
11.	Find the flow pattern for the network in the figure. Flow rates are in cars per half-hour. Build a mathematical model and solve it completely.
12.	Apply Kirchhoff's laws and construct a mathematical model for the following circuit. Solve the model completely and calculate the currents I_1, I_2 and I_3.
13.	Aqueous solution of Calcium Chloride CaCl_2 and Silver Nitrate AgNO_3 are mixed, a reaction takes place producing aqueous Calcium Nitrate $\text{Ca}(\text{NO}_3)_2$ and solid Silver Chloride AgCl. For each compound, construct a vector that list number of atoms for each of Silver, Calcium, Chlorine, Nitrogen and Oxygen. Constructing a system of linear equations for the number of molecules for each compound, balance the chemical equation.
14.	Investigate the values of λ and μ such that the system $x + y + z = 6, x + 2y + 3z = 10, x + 2y + \lambda z = \mu$ has i) No solution ii) A unique solution iii) An infinite number of solutions.

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Exercise on System of Linear Equations

15.	Investigate for consistency of the following equations and if possible find solutions: (i) $x + y + z = 6$; $x + y - 3z = -1$; $15x - 3y + 9z = 21$ (ii) $2x_1 + x_2 + 2x_3 + x_4 = 6$, $6x_1 - 6x_2 + 6x_3 + 12x_4 = 36$, (iii) $4x_1 + 3x_2 + 3x_3 - 3x_4 = -1$, $2x_1 + 2x_2 - x_3 + x_4 = 10$.
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