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Section = A

Class = B(E) Civil Engineering

Subject = Differential equation

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Question: 1

$$x + 3y + 5z + 2t = 2$$

$$-y + 3z + 4t = 0$$

$$2x + y + 9z + 6t = -3$$

$$3x + 2y + 4z + 8t = -1$$

Sol:- Using Gauss jordan method.

$$x + 3y + 5z + 2t = 2$$

$$-y + 3z + x = 0$$

$$2x + y + 9z + 6t = -3$$

$$3x + 2y + 4z + 8t = -1$$

writing system in matrix form

$$2t + x + 3y + 5z = 2$$

$$x - y + 3z = 0$$

$$6t + 2x + y + 9z = -3$$

$$8t + 3x + 2y + 4z = -1$$

$$= \left[\begin{array}{cccc|c} 2 & 1 & 3 & 5 & 2 \\ 0 & 1 & -1 & 3 & 0 \\ 6 & 2 & 1 & 9 & -3 \\ 8 & 3 & 2 & 4 & -1 \end{array} \right]$$

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$$\begin{array}{c}
 \left[\begin{array}{cccc|c}
 2 & 0 & 4 & 2 & 2 \\
 0 & 1 & -1 & 3 & 0 \\
 6 & 2 & 1 & 9 & -3 \\
 8 & 3 & 2 & 4 & -1
 \end{array} \right]
 \end{array}$$

Mult row 2 by -1 and add to row 1

$$\begin{array}{c}
 = \left[\begin{array}{cccc|c}
 2 & 0 & 4 & 2 & 2 \\
 0 & 1 & -1 & 3 & 0 \\
 6 & 0 & 3 & 3 & -3 \\
 8 & 3 & 2 & 4 & -1
 \end{array} \right]
 \end{array}$$

Mult row 2 by -2 and add it to row 3

rod.

$$\begin{array}{c}
 = \left[\begin{array}{cccc|c}
 2 & 0 & 4 & 2 & 2 \\
 0 & 1 & -1 & 3 & 0 \\
 6 & 0 & 3 & 3 & -3 \\
 8 & 0 & -5 & -5 & -1
 \end{array} \right]
 \end{array}$$

Mult row 2 by -3 and add it to row 4

$$\begin{array}{c}
 = \left[\begin{array}{cccc|c}
 1 & 0 & 2 & 1 & 1 \\
 0 & 1 & -1 & 3 & 0 \\
 6 & 0 & 3 & 3 & -3 \\
 8 & 0 & 5 & -5 & -1
 \end{array} \right]
 \end{array}$$

Divide the row 1 by 2

$$\begin{array}{c}
 = \left[\begin{array}{cccc|c}
 1 & 0 & 2 & 1 & 1 \\
 0 & 1 & -1 & 3 & 0 \\
 2 & 0 & 1 & 1 & -1 \\
 8 & 0 & 5 & -5 & -1
 \end{array} \right]
 \end{array}$$

Divide the row 3 by 3

$$= \left[\begin{array}{cccc|c} 1 & 0 & 2 & 1 & 1 \\ 0 & 1 & -1 & 3 & 0 \\ 0 & 0 & -3 & -1 & -3 \\ 8 & 0 & 5 & -5 & -1 \end{array} \right] \begin{array}{l} \text{Multi row 1 by 2} \\ \text{and add it to row 2} \end{array}$$

$$= \left[\begin{array}{cccc|c} 1 & 0 & 2 & 1 & 1 \\ 0 & 1 & -1 & 3 & 0 \\ 0 & 0 & -3 & -1 & -3 \\ 0 & 0 & -11 & -13 & -9 \end{array} \right] \begin{array}{l} \text{Multi row 1 by -8 and} \\ \text{add it to row 4} \end{array}$$

$$= \left[\begin{array}{cccc|c} 1 & 0 & 2 & 1 & 1 \\ 0 & 1 & -1 & 3 & 0 \\ 0 & 0 & 3 & 1 & 3 \\ 0 & 0 & -11 & -13 & 9 \end{array} \right] \begin{array}{l} \text{Multi the row 3 by -1} \end{array}$$

$$= \left[\begin{array}{cccc|c} 1 & 0 & 2 & 1 & 1 \\ 0 & 1 & -1 & 3 & 0 \\ 0 & 0 & 3 & 1 & 3 \\ 0 & 0 & 11 & 13 & 9 \end{array} \right] \begin{array}{l} \text{Multi the row 4 by} \\ -1 \end{array}$$

$$= \left[\begin{array}{cccc|c} 1 & 0 & -1 & 0 & -2 \\ 0 & 1 & -1 & 3 & 0 \\ 0 & 0 & 3 & 1 & 3 \\ 0 & 0 & 11 & 13 & 9 \end{array} \right] \begin{array}{l} \text{Multi row 3 by -1} \\ \text{and add it to row 1} \end{array}$$

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by 2
to row 3

$$\left[\begin{array}{cccc|c} 1 & 0 & -1 & 0 & -2 \\ 0 & 1 & -10 & 0 & -9 \\ 0 & 0 & 3 & 1 & 3 \\ 0 & 0 & 11 & 13 & 9 \end{array} \right]$$

Multi row 3 by -3 and
add it to row 2

-8 and
-4

$$\left[\begin{array}{cccc|c} 1 & 0 & -1 & 0 & -2 \\ 0 & 1 & -10 & 0 & -9 \\ 0 & 0 & 3 & 1 & 3 \\ 0 & 0 & -28 & 0 & -30 \end{array} \right]$$

Multi row 3 by -13
and add it to row 4

by -1

$$\left[\begin{array}{cccc|c} 1 & 0 & -1 & 0 & -2 \\ 0 & 1 & -10 & 0 & -9 \\ 0 & 0 & 3 & 1 & 3 \\ 0 & 0 & 1 & 0 & \frac{15}{14} \end{array} \right]$$

Divide row 4 by -28

row 4 by
-1

$$\left[\begin{array}{cccc|c} 1 & 0 & 0 & 0 & -\frac{13}{14} \\ 0 & 1 & -10 & 0 & -9 \\ 0 & 0 & 3 & 1 & 3 \\ 0 & 0 & 1 & 0 & \frac{15}{14} \end{array} \right]$$

Add row 4 to row 1

row 1

$$\left[\begin{array}{cccc|c} 1 & 0 & 0 & 0 & -\frac{13}{14} \\ 0 & 1 & 0 & 0 & -\frac{12}{7} \\ 0 & 0 & 3 & 1 & 3 \\ 0 & 0 & 1 & 0 & \frac{15}{14} \end{array} \right]$$

Multi row 4 by 10 and
add it to row 2

$$\begin{array}{c}
 \left[\begin{array}{cccc|c}
 1 & 0 & 0 & 0 & -13/14 \\
 0 & 1 & 0 & 0 & 12/7 \\
 0 & 0 & 0 & 1 & -3/14 \\
 0 & 0 & 1 & 0 & 15/14
 \end{array} \right]
 \end{array}$$

Multi row 4 by -3
and add it to row 3

Convert the augmented matrix into a system of linear equations

$$t = -13/14$$

$$x = 12/7$$

$$z = +3/14$$

$$y = 15/14$$

This possible solution of system is the ordered 4-tuple

$$(t, x, y, z) = \left(-13/14, 12/7, 15/14, +3/14\right)$$

Check if the given order 4-tuple is a solution of system of equations

5

y = -3
row 3

$$12/7 + 3x \cdot 15/14 + 5x(-3/14) + 2x(-13/14) = 2$$

$$-15/14 + 3x(-3/14) + 12/7 = 0$$

$$2x \cdot 12/7 + 15/14 + 9x(-3/14) + 6x(-13/14) = -3$$

$$3x \cdot 12/7 + 2x \cdot 15/14 + 4x(-3/14) + 8x(-13/14) = -1$$

Simplify the equalities

$$2 = 2$$

$$0 = 0$$

$$-3 = -3$$

$$-1 = -1$$

Since all the equalities are true so ordered 4 tuple is the solution of system.

$$(t, x, y, z) = (-13/14, 12/7, 15/14, -3/14)$$

Ans.