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15/ENG04C053

$I_1 + I_2 - 2I_3 + I_4 + 3I_5 - I_6 = 4$
$2I_1 - I_2 + I_3 + 2I_4 + I_5 - 3I_6 = 20$
$I_1 + 3I_2 - 3I_3 - I_4 + 2I_5 + I_6 = -15$
$5I_1 + 2I_2 - I_3 + I_4 + 2I_5 + I_6 = -3$
$-3I_1 - I_2 + 2I_3 + 3I_4 + I_5 + 3I_6 = 16$
$4I_1 + 3I_2 + I_3 - 6I_4 - 3I_5 - 2I_6 = -22$

$$\left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 2 & -1 & 1 & 2 & 1 & -3 & 20 \\ 1 & 3 & -3 & -1 & 2 & 1 & -15 \\ 5 & 2 & 4 & -1 & 2 & 1 & -3 \\ -3 & -1 & 2 & 3 & 1 & 3 & 16 \\ 4 & 3 & 1 & -6 & -3 & -2 & -22 \end{array}\right]$$

step

Forward elimination

$$\left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 2-(2/1)\times 1 & -1-(2/1)1 & 1-(2/1)\times(-2) & -2-(2/1)\times(1) & 1-(2/1)(3) & -3-(2/1)(1) & 20-(2/1)(4) \\ 1-(1/1)\times 1 & 3-(1/1)1 & -3-(1/1)(-2) & -1-(1/1)\times(1) & 2-(1/1)(3) & 1-(1/1)(-1) & -15-(1/1)(4) \\ 5-(5/1)\times 1 & 2-(5/1)1 & -1-(5/1)(-2) & -1-(5/1)(1) & 2-(5/1)(3) & 1-(5/1)(-1) & -3-(5/1)(4) \\ -3-(3/1)\times 1 & -1-(3/1)1 & 2-(3/1)(-2) & 3-(3/1)(1) & 1-(3/1)(3) & 3-(3/1)(-1) & 16-(3/1)(4) \\ 4-(4/1)\times 1 & 3-(4/1)1 & 1-(4/1)(-2) & -6-(4/1)(1) & -3-(4/1)(3) & -2-(4/1)(-1) & -22-(4/1)(4) \end{array}\right]$$

$$= \left[\begin{array}{cccccc|c} 1 & 1 & 2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 2 & -1 & -2 & -1 & 2 & -19 \\ 0 & -3 & 9 & -6 & -13 & 6 & -23 \\ 0 & 2 & -4 & 6 & 10 & 0 & 28 \\ 0 & -1 & 9 & -10 & -15 & 2 & -43 \end{array}\right]$$

$$\left[\begin{array}{cc} 0 & -3 \\ 0 & 2-(2/-3)-3 \end{array}\right]$$

Step 2:

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$$\begin{bmatrix} 1 & 1 & 2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 2-(\frac{2}{-3})(-3) & -1-(\frac{2}{-3})(5) & -2-(\frac{2}{-3})(0) & -1-(\frac{2}{-3})-5 & 2-(\frac{2}{-3})-1 & -19-(\frac{2}{-3})(12) \\ 0 & -3-(\frac{-3}{-3})(3) & 9-(\frac{-3}{-3})(5) & 6-(\frac{-3}{-3})0 & -13-(\frac{-3}{-3})(-5) & 6-(\frac{-3}{-3})(1) & -23-(\frac{-3}{-3})(12) \\ 0 & -2-(\frac{2}{-3})(3) & -4-(\frac{2}{-3})(5) & 6-(\frac{2}{-3})0 & 10-(\frac{2}{-3})(-5) & 0-(\frac{2}{-3})(-1) & 28-(\frac{2}{-3})(12) \\ 0 & 1-(\frac{1}{-3})-3) & 9-(\frac{1}{-3})5 & +0-(\frac{1}{-3})0 & -15-(\frac{1}{-3})(-3) & 2-(\frac{1}{-3})(-1) & -43-(\frac{1}{-3})(12) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 0 & 2.33 & -2 & -4.33 & 1.33 & -11 \\ 0 & 0 & 4 & -6 & -8 & 7 & -35 \\ 0 & 0 & -0.67 & 6 & 6.67 & -0.67 & 36 \\ 0 & 0 & 7.33 & 10 & -13.33 & 2.33 & -47 \end{bmatrix}$$

Step 3:

$$\begin{bmatrix} 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 0 & 2.33 & -2 & -4.33 & 1.33 & -11 \\ 0 & 0 & 4-(\frac{4}{2.33})(2.33) & -6-(\frac{4}{2.33})(-2) & -8-(\frac{4}{2.33})(-4.33) & 7-(\frac{4}{2.33})(1.33) & -35-(\frac{4}{2.33})(-11) \\ 0 & 0 & -0.67+(\frac{-0.67}{2.33})2.33 & 6-(\frac{-0.67}{2.33})(-2) & 6.67+(\frac{-0.67}{2.33})(-4.33) & -0.67+(\frac{-0.67}{2.33})(1.33) & 36-(\frac{-0.67}{2.33})(-11) \\ 0 & 0 & 7.33-(\frac{7.33}{2.33})2.33 & 10-(\frac{7.33}{2.33})(-2) & -13.33+(\frac{7.33}{2.33})(-4.33) & 2.33-(\frac{7.33}{2.33})(1.33) & -47-(\frac{7.33}{2.33})(-11) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 0 & 2.33 & 2 & -4.33 & 1.33 & -11 \\ 0 & 0 & 0 & -2.57 & -0.57 & 4.71 & -16.14 \\ 0 & 0 & 0 & 5.43 & 5.43 & -0.28 & 32.86 \\ 0 & 0 & 0 & -3.71 & 0.28 & -1.86 & -12.43 \end{bmatrix}$$

Step 4:

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 0 & 2.33 & 2 & -4.33 & 1.33 & -11 \\ 0 & 0 & 0 & -2.57 & -0.57 & 4.71 & -16.14 \\ 0 & 0 & 0 & 5.43-(\frac{5.43}{-2.57})(-2.57) & 5.43-(\frac{5.43}{-2.57})(-0.57) & -0.28-(\frac{5.43}{-2.57})4.71 & 32.86-(\frac{5.43}{-2.57})(-16.14) \\ 0 & 0 & 0 & -3.71-(\frac{-3.71}{-2.57})(-2.57) & 0.28-(\frac{-3.71}{-2.57})(-0.57) & -1.86-(\frac{-3.71}{-2.57})4.71 & -12.43-(\frac{-3.71}{-2.57})(-16.14) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 0 & 2.33 & -2 & -4.33 & 1.33 & -11 \\ 0 & 0 & 0 & -2.57 & -0.57 & 4.71 & -16.14 \\ 0 & 0 & 0 & 0 & 4.22 & 9.67 & -1.22 \\ 0 & 0 & 0 & 0 & 1.11 & -8.67 & -10.89 \end{bmatrix}$$

Step 5:

1	1	-2	1	3	-1	4
0	-3	5	0	-5	-1	12
0	0	2.33	-2	-4.33	1.33	-11
0	0	0	-2.57	-0.57	4.71	-16.14
0	0	0	0	4.22	9.67	-1.22
0	0	0	0	$1.11-\left(\frac{1.11}{4.22}\right)(4.22)$	$-8.67-\left(\frac{1.11}{4.22}\right)(9.67)$	$-10.89-\left(\frac{1.11}{4.22}\right)(-1.22)$

And.

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 0 & 2.33 & -2 & -4.33 & 1.33 & -11 \\ 0 & 0 & 0 & -2.57 & -0.57 & 4.71 & -16.14 \\ 0 & 0 & 0 & 0 & 4.22 & 9.67 & -1.22 \\ 0 & 0 & 0 & 0 & 0 & -11.21 & 11.21 \end{bmatrix}$$

multiplying by $\begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix}$

(Backward substitution)

we have:

$T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4$ ---①

$-3T_2 + 5T_3 - 5T_5 - T_6 = 12$ ---②

$2.33T_3 - 2T_4 - 4.33T_5 + 1.33T_6 = -11$ ---③

$-2.57T_4 - 0.57T_5 + 4.21T_6 = -16.14$ ---④

$4.22T_5 + 9.67T_6 = 1.22$ ---⑤

$-11.21T_6 = 11.21$ ---⑥

from equ ⑥.

$$T_6 = \frac{11.21}{-11.21}$$

$$= -1$$

from equ ⑤

$$T_5 = \frac{1.22 - 9.67(-1)}{4.22}$$

$$T_5 = 2$$

From equ ④

$$T_4 = \frac{-16.14 - 4.71(-1) + 0.57(2)}{-2.57}$$

$$T_4 = 4.$$

from equ ③

$$T_3 = \frac{-11.1.33(-1) + 4.33(2) + 2(4)}{2.33}$$

$$T_3 = 3$$

From equ ②

$$T_2 = \frac{12 + (-1) + 5(2) - 5(3)}{-3}$$

$$= -2$$

$$T_1 = \frac{-1 - (3)2 - (4) + 2(3) - (-2)}{1}$$

$$T_1 = 1$$

$\therefore T_1 = 1\,^\circ C$

$T_2 = -2\,^\circ C$

$T_3 = 3\,^\circ C$

$T_4 = 4\,^\circ C$

$T_5 = 2\,^\circ C$

$T_6 = -1\,^\circ C$