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16 / ENSD07 / 019

Petroleum Engineering

3006

$$\bar{T}_1 + \bar{T}_2 - 2\bar{T}_3 + \bar{T}_4 + 3\bar{T}_5 - \bar{T}_6 = 4$$

$$2\bar{T}_1 - \bar{T}_2 + \bar{T}_3 + 2\bar{T}_4 + \bar{T}_5 - 3\bar{T}_6 = 20$$

$$\bar{T}_1 + 3\bar{T}_2 - 3\bar{T}_3 - \bar{T}_4 + 2\bar{T}_5 + \bar{T}_6 = -15$$

$$5\bar{T}_1 + 2\bar{T}_2 - \bar{T}_3 - \bar{T}_4 - 2\bar{T}_5 + \bar{T}_6 = -3$$

$$-3\bar{T}_1 - \bar{T}_2 + 2\bar{T}_3 + 3\bar{T}_4 + \bar{T}_5 + 3\bar{T}_6 = 16$$

$$4\bar{T}_1 + 3\bar{T}_2 + \bar{T}_3 - 6\bar{T}_4 - 3\bar{T}_5 - 2\bar{T}_6 = -27$$

Solution

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 2 & -1 & 1 & 2 & 1 & -3 \\ 1 & 3 & -3 & -1 & 2 & 1 \\ 5 & 2 & -1 & -1 & 2 & 1 \\ -3 & -1 & 2 & 3 & 1 & 3 \\ 4 & 3 & 1 & 6 & -3 & -2 \end{bmatrix} \begin{bmatrix} \bar{T}_1 \\ \bar{T}_2 \\ \bar{T}_3 \\ \bar{T}_4 \\ \bar{T}_5 \\ \bar{T}_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 20 \\ -15 \\ -3 \\ 16 \\ -27 \end{bmatrix}$$

$$\bar{T}_1 = 2$$

$$\bar{T}_2 = 1$$

$$\bar{T}_3 = 5$$

$$\bar{T}_4 = -3$$

$$\bar{T}_5 = 4$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 2-2(1) & -1-2(1) & 1-2(-2) & 2-2(1) & 1-2(3) & -3-2(-1) \\ 1-1(1) & 3-1(1) & -3-1(-2) & -1-1(1) & 2-1(3) & 1-1(-1) \\ 5-5(1) & 2-5(1) & -1-5(-2) & -1-5(1) & 2-5(3) & 1-5(-1) \\ -3+3(1) & -1+3(1) & 2+3(-2) & 3+3(1) & 1+3(3) & 3+3(-1) \\ 4-4(1) & 3-4(1) & 1-4(-2) & -6-4(1) & 3-4(3) & -2-4(-1) \end{bmatrix} \begin{bmatrix} \bar{T}_1 \\ \bar{T}_2 \\ \bar{T}_3 \\ \bar{T}_4 \\ \bar{T}_5 \\ \bar{T}_6 \end{bmatrix}$$

$$= \begin{bmatrix} 1 \\ 20-2(-1) \\ -15-10(-1) \\ -3-6(-1) \\ 16+3(-1) \\ -23-4(-1) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 2 & -1 & -2 & -1 & 2 & -11 \\ 0 & -3 & 9 & -6 & -13 & 6 & -23 \\ 0 & 2 & -4 & 6 & 10 & 0 & 38 \\ 0 & -1 & 9 & 10 & -15 & 2 & -73 \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix}$$

$$\begin{aligned} T_1 &= -2/3 \\ T_2 &= -1 \\ T_3 &= -2/3 \\ T_4 &= 1/3 \end{aligned}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 2 + \frac{2}{3}(-2) & -1 + \frac{2}{3}(5) & -2 + \frac{2}{3}(0) & -1 + \frac{2}{3}(-5) & 2 + \frac{2}{3}(-1) & -11 \\ 0 & -3 - 1(-2) & 9 - 1(-1) & -6 - 1(0) & -13 - 1(-5) & 6 - 1(-1) & -23 \\ 0 & 2 + \frac{2}{3}(-2) & -4 + \frac{2}{3}(5) & 6 + \frac{2}{3}(0) & 10 + \frac{2}{3}(-5) & 0 + \frac{2}{3}(-1) & 38 \\ 0 & -1 - \frac{2}{3}(-2) & 9 - \frac{2}{3}(5) & 10 - \frac{2}{3}(0) & -15 - \frac{2}{3}(-5) & 2 - \frac{2}{3}(-1) & -73 \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & 12 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{17}{3} & \frac{4}{3} & -\frac{11}{3} \\ 0 & 0 & 1 & -6 & -8 & 7 & -35 \\ 0 & 0 & \frac{2}{3} & 6 & \frac{20}{3} & -\frac{2}{3} & 36 \\ 0 & 0 & \frac{20}{3} & -10 & -\frac{40}{3} & \frac{2}{3} & -\frac{17}{3} \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix}$$

$$F_1 = 12/4$$

$$F_2 = -2/3$$

$$F_3 = 20/3$$

1	1	-2	1	3	-1	T_1	4
0	-3	5	0	-5	-1	T_2	12
0	0	$7/3$	-2	$-1/3$	$7/3$	$T_3 =$	-11
0	0	$4 - 7/3(3)$	$-6 - 7/3(-2)$	$-8 - 7/3(-1/3)$	$7 - 7/3(7/3)$	T_4	$-35 - 7/3(11)$
0	0	$-7/3(7/3)$	$5 - 7/3(-2)$	$0 - 7/3(-1/3)$	$-7/3 + 7/3(7/3)$	T_5	$3 + 7/3(-11)$
0	0	$7/3 - 7/3(7/3)$	$-10 - 7/3(-2)$	$-7/3 - 7/3(-1/3)$	$7/3 - 7/3(7/3)$	T_6	$-11 - 7/3(11)$

1	1	-2	1	3	-1	T_1	4
0	-3	5	0	-5	-1	T_2	12
0	0	$7/3$	-2	$-1/3$	$7/3$	$T_3 =$	-11
0	0	0	$-10/3$	$-7/3$	$35/3$	T_4	$-11/3$
0	0	0	$35/3$	$20/3$	$-2/3$	T_5	$20/3$
0	0	0	$20/3$	$9/3$	$-17/3$	T_6	$-20/3$

$$F_1 = -19/9, F_2 = 3/9$$

1	1	-2	1	3	-1	T_1	4
0	-3	5	0	-5	-1	T_2	12
0	0	$7/3$	-2	$-1/3$	$7/3$	$T_3 =$	-11
0	0	0	$-10/3$	$-7/3$	$35/3$	T_4	$-11/3$
0	0	0	$20/3 + 10/3(-10/3)$	$35/3 + 7/3(-7/3)$	$-2/3 + 10/3(35/3)$	T_5	$20/3 - 10/3(11/3)$
0	0	0	$-20/3 - 10/3(-10/3)$	$0 - 10/3(-7/3)$	$-10/3 - 10/3(35/3)$	T_6	$-10/3 - 10/3(11/3)$

1	1	-2	1	3	-1	T_1	4
0	-3	5	0	-5	-1	T_2	12
0	0	$7/3$	-2	$-1/3$	$7/3$	$T_3 =$	-11
0	0	0	$-10/3$	$-7/3$	$35/3$	T_4	$-10/3$
0	0	0	0	$35/9$	$20/9$	T_5	$-11/9$
0	0	0	0	$10/9$	$20/9$	T_6	$20/9$

$$T_1 = 5/19$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -4/7 & -1/7 & 33/7 \\ 0 & 0 & 0 & 0 & 28/9 & 29/3 \\ 0 & 0 & 0 & 0 & 10/9 - 5/9(28/9) & -26/3 - 9/9(29/3) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ -11/9 \\ 98/9 - 9/9(-11/9) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 0 & 28/9 & 29/3 \\ 0 & 0 & 0 & 0 & 0 & -213/19 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ -11/9 \\ 213/19 \end{bmatrix}$$

$$-213/19 T_6 = 213/19$$

$$T_6 = 213/19 \times -19/213 = -1$$

$$28/9 T_5 + 29/3 T_6 = -11/9$$

$$T_5 = (-11/9 + 29/3) \times 9/28$$

$$T_4 = (-113/7 + 8/7 + 33/7) \times -7/18 = 4$$

$$T_3 = (-11 + 8 + 26/3 + 4/3) \times 3/7$$

$$T_2 = \frac{12 - 15 + 10}{-3} = -2$$

$$T_1 = 4 + 2 + 6 - 4 - 6 - 1 = 1$$

$$\therefore T_1 = 1, T_2 = -2, T_3 = 3, T_4 = 4, T_5 = 2, T_6 = -1$$