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DEPT: PETROLEUM ENG.

ASS. SOLN

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

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

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

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

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

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

Transforming the equation to matrix

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

using a factor of (-2) to multiply Row 1 and subtract 2

$2-(-2)(1)$, $-1-2(1)$; $1-(2)(-2)$; $2-(2)(1)$; $1-(2)(3)$, $-3-(2)(-1)$, $20-(2)(4)$

0, -3, 5, 0, -5, 1, 12

using a factor of (1) to multiply Row 1 and subtract Row 3

$1-(1)(1)$, $3-(1)(1)$, $-3-(1)(-2)$, $-1-(1)(1)$, $2-(1)(3)$, $1-(1)(-1)$, $-15-(1)(4)$

0, 2, -1, -2, -1, 2, -19

using a factor (5) to multiply Row 5 and subtract Row 4

$5-(5)(1)$, $2-(5)(1)$, $-1-(5)(-2)$, $-1-(5)(1)$, $2-(5)(3)$, $1-(5)(-1)$, $-3-(5)(4)$

0, -3, 9, -6, -13, 6, -24

using a factor (-3) to multiply Row 1 and subtract Row 6

$-3-(-3)(1)$, $-1-(-3)(1)$, $2-(-3)(-2)$, $3-(-3)(1)$, $1-(-3)(3)$, $3-(-3)(-1)$, $16-(-3)4$

0, 2, -4, 6, 10, 0, 26

using a factor (4) to multiply Row 1 and subtract Row 6

$4-(4)(1)$, $3-(4)(1)$, $1-(4)(-2)$, $-6-(4)(1)$, $-3-(4)(3)$, $-2-(4)(-1)$, $-27-(4)(4)$

0, -1, 9, -10, -15, 2, -43

the Matrix becomes

$$\begin{pmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 & -1 & -2 & -1 & 2 \\ 0 & -3 & 9 & -6 & -13 & 6 \\ 0 & 2 & -4 & 6 & 10 & 0 \\ 0 & 1 & 9 & -10 & -15 & 2 \end{pmatrix} \begin{pmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{pmatrix} = \begin{pmatrix} 4 \\ 12 \\ -19 \\ -23 \\ 28 \\ -43 \end{pmatrix}$$

using a factor of $(-2/3)$ to multiply Row 2 and subtract from Row 3

$2-(-2/3)(3)$, $-1-(-2/3)(5)$, $-2-(-2/3)(0)$, $-1-(-2/3)(-5)$, $2-(-2/3)(-1)$, $-19-(-2/3)(1)$

0 2.3333 −2 −4.3333 1.3333 −11

using a factor of (1) to multiply Row 2 and subtract Row 4

$-3-(1)(-3)$, $9-(1)(5)$, $-6-(1)(0)$, $-13-(1)(-5)$, $6-(1)(-1)$, $23-(1)(12)$

0 4 −6 −8 7 −35

using a factor of $(-2/3)$ to multiply Row 2 and subtract Row 5

$2-(-2/3)(-3)$, $-4-(-2/3)(5)$, $6-(-2/3)(0)$, $10-(-2/3)(-5)$, $6-(-2/3)(-1)$, $28-(-2/3)(12)$

0 −0.6666 6 6.6666 −0.6666 36

using a factor of $(1/3)$ to multiply Row 2 and subtract Row 7

$-1-(1/3)(-3)$, $-9-(1/3)(5)$, $-10-(1/3)(0)$, $-15-(1/3)(-5)$, $2-(1/3)(4)$, $-43-(1/3)(-1)$

0 9.9333 −10 −15.3333 2.3333 −47

The new matrix becomes

$$\begin{pmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.333 & -2 & -4.3333 & 1.3333 \\ 0 & 0 & 4 & 6 & -8 & 7 \\ 0 & 0 & -0.6666 & 6 & 6.666 & -0.6666 \\ 0 & 0 & 7.3333 & -10 & -13.3333 & 2.3333 \end{pmatrix} \begin{pmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{pmatrix} = \begin{pmatrix} 4 \\ 12 \\ -11 \\ -35 \\ -36 \\ -47 \end{pmatrix}$$

using a factor of 0.2856 to multiply Row 3 and subtract Row 6

$-0.6666-(-0.2856)(2.3333)$, $6-(-0.2856)(-2)$, $6.6666-(-0.2856)(-4.3333)$,

0 5.4285 5.4285

$-0.666-(0.2856)(1.3333)$, $36-(0.2856)(-11)$

−0.28571 32.8571

using a factor of $(7.3333/2.3333)$ to multiply Row 2 and subtract Row 6.

7.3333 − (3.1428)(2.3333), −10 − (3.1428)(−2), −13.3333 − (3.1428)(−4.3333),
0 −3.71429 0.2857

2.3333 − (3.1428)(1.3333), −47 − (3.1428)(−1)
−1.85714 −12.4286

The new matrix becomes

$$\begin{pmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.3333 & -2 & -4.3333 & 1.3333 \\ 0 & 0 & 0 & -2.571 & -0.5714 & 4.7142 \\ 0 & 0 & 0 & 5.4285 & 5.4285 & -0.2857 \\ 0 & 0 & 0 & -3.7142 & 0.2857 & -1.8571 \end{pmatrix} \begin{pmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{pmatrix} = \begin{pmatrix} 4 \\ 12 \\ -11 \\ -16.1429 \\ 32.8571 \\ -12.4285 \end{pmatrix}$$

Using a factor (5.4285/−2.571) to multiply Row 4 and Subtract from Row 5

5.4285 − (−2.1114)(−2.571), 5.4285 − (−2.1114)(−0.5714), −0.2857 − (−2.1114)(4.7142),
0 4.2223 9.6666

32.8571 − (−2.1114)(−16.1429)
1.2222

Using a factor of (−3.7142/−2.571) to multiply Row 5 and divide Row 6

−3.9142 − (1.4446)(−2.571), −0.2857 − (1.4446)(−0.5714), −1.8571 − (−1.4446)(4.7142),
0 1.1111 −8.6666

−12.4286 − (1.4446)(16.1429)
10.8888

The new matrix become

$$\begin{pmatrix} 1 & 1 & -2 & 1 & -3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.3333 & -2 & -4.3333 & 1.3333 \\ 0 & 0 & 0 & -2.5714 & -0.5714 & 4.7142 \\ 0 & 0 & 0 & 0 & 4.2222 & 9.6666 \\ 0 & 0 & 0 & 0 & 1.1111 & -8.6666 \end{pmatrix} \begin{pmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{pmatrix} = \begin{pmatrix} 4 \\ 12 \\ -11 \\ -16.1429 \\ -1.2222 \\ 10.8885 \end{pmatrix}$$

Using a factor of (1.1111/4.2222) to multiply Row 5 and Subtract from Row 6

1.1111 − (0.2631)(4.2222), −8.666 − (0.2631)(9.6666), 10.8888 − (0.2631)(−1.222),
0 −11.2105 11.2105

New matrix become

$$\begin{pmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.3333 & -2 & -4.3333 & 1.3333 \\ 0 & 0 & 0 & -2.5714 & -0.5714 & 4.7142 \\ 0 & 0 & 0 & 0 & 4.2222 & 9.6666 \\ 0 & 0 & 0 & 0 & 0 & -11.2105 \end{pmatrix} \begin{pmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{pmatrix} = \begin{pmatrix} 4 \\ 12 \\ -11 \\ -16.1424 \\ -1.2222 \\ 11.2105 \end{pmatrix}$$

Using backsubstitution

$-11.2105 T_6 = 11.2105$

$T_6 = \frac{11.2105}{-11.2105} = -1$

$4.2222 T_5 + 9.6666 T_6 = -1.2222$

$T_5 = \frac{-1.2222 - 9.6666(-1)}{4.2222} = 2$

$-2.5714 T_4 - 0.5714 T_5 + 4.7142 T_6 = -16.1429$

$T_4 = \frac{-16.1429 - 4.7142(-1) + 0.5714 \times 2}{-2.5714} = 4$

$2.3333 T_3 - 2 T_4 - 4.3333 T_5 + 1.3333 T_6 = -11$

$T_3 = \frac{-11 - 1.3333(-1) - 4.3333(2) + 2(4)}{2.3333} = 3$

$-3 T_2 + 5 T_3 + 6 T_4 - 5 T_5 - T_6 = 12$

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

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

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

Therefore

$T_1 = 1$

$T_2 = -2$

$T_3 = 3$

$T_4 = 4$

$T_5 = 2$

$T_6 = -1$