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16/ENG07/011
ENG 382
Petroleum Engineering
Assignment 3

$T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4$ --- (1)
$2T_1 - T_2 + T_3 + 2T_4 + T_5 - 3T_6 = 20$ --- (2)
$T_1 + 3T_2 - 3T_3 - T_4 + 2T_5 + T_6 = -15$ --- (3)
~~$5T_1 + 2T_2 - T_3 - T_4 + 2T_5 + T_6 = -3$~~ --- (4)
$-3T_1 + 2T_2 + 2T_3 + 3T_4 + T_5 + 3T_6 = 16$ --- (5)
$4T_1 + 3T_2 + T_3 - 6T_4 - 3T_5 - 2T_6 = -27$ --- (6)

∴ Equation (1) becomes the pivot equation

$2[T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4] = 2T_1 + 2T_2 - 4T_3 + 2T_4 + 6T_5 - 2T_6 = 8$

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

$5[T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4] = 5T_1 + 5T_2 - 10T_3 + 5T_4 + 15T_5 - 5T_6 = 20$

$-3[T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4] = -3T_1 - 3T_2 + 6T_3 - 3T_4 - 9T_5 + 3T_6 = -12$

$4[T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4] = 4T_1 + 4T_2 - 8T_3 + 4T_4 + 12T_5 - 4T_6 = 16$

Subtracting equations;

$2T_1 + 2T_2 - 4T_3 + 2T_4 + 6T_5 - 2T_6 = 8$
$-2T_1 - T_2 + T_3 + 2T_4 + T_5 - 3T_6 = 20$
$\Rightarrow 0 - 3T_2 + 5T_3 + 0 - 5T_5 - T_6 = 12$ --- (2)'

$T_1 + 3T_2 - 3T_3 - T_4 + 2T_5 + T_6 = -15$
$-T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4$
$\Rightarrow 0 + 2T_2 - T_3 - 2T_4 - T_5 + 2T_6 = -19$ --- (3)'

$$5T_1 + 2T_2 - T_3 - T_4 + 2T_5 + T_6 = -3$$
$$-5T_1 + 5T_2 - 10T_3 + 5T_4 + 15T_5 - 5T_6 = 20$$
$$0 - 3T_2 + 9T_3 - 6T_4 - 13T_5 + 6T_6 = -23 \quad \text{--- (4)'}$$

$$-3T_1 - T_2 + 2T_3 + 3T_4 + T_5 + 2T_6 = 16$$
$$-3T_1 - 3T_2 + 6T_3 - 3T_4 - 9T_5 + 3T_6 = -12$$
$$0 + 2T_2 - 4T_3 + 6T_4 + 10T_5 - 0T_6 = 28 \quad \text{--- (5)'}$$

$$4T_1 + 3T_2 + T_3 - 6T_4 - 3T_5 - 2T_6 = -27$$
$$-4T_1 + 4T_2 - 8T_3 + 4T_4 + 12T_5 - 4T_6 = 16$$
$$0 - T_2 + 7T_3 - 10T_4 - 15T_5 + 2T_6 = -43 \quad \text{--- (6)'}$$

Equation (2)' then becomes the pivot equation

$$2/-3\,[-T_2 + 5T_3 - 0T_4 - 5T_5 - T_6 = 12]$$
$$= 2T_2 - 10/3\,T_3 + 10/3\,T_5 + 2/3\,T_6 = -8$$

$$-3/-3\,[-3T_2 + 5T_3 - 5T_5 - T_6 = 12] = -3T_2 + 5T_3 - 5T_5 - T_6 = 12$$

$$2/-3\,[-3T_2 + 5T_3 - 5T_5 - T_6 = 12] = T_2 - 10/3\,T_3 + 10/3\,T_5 + 2/3\,T_6 = -8$$

$$-1/-3\,[-3T_2 + 5T_3 - 5T_5 - T_6 = 12] = -T_2 + 5/3\,T_3 - 5/3\,T_5 - 1/3\,T_6 = 4$$

Subtracting equations

$$2T_2 - T_3 - 2T_4 - T_5 + 2T_6 = -19$$
$$-2T_2 - 10/3\,T_3 + 0 + 10/3\,T_5 + 2/3\,T_6 = -8$$
$$0 + 7/3\,T_3 - 2T_4 - 13/3\,T_5 + 4/3\,T_6 = -8 \quad \text{--- (8)''}$$

$$-3T_2 + 9T_3 - 6T_4 - 13T_5 + 6T_6 = 23$$
$$-(-3T_2 + 5T_3 - 5T_5 - T_6 = 12)$$
$$4T_3 - 6T_4 - 8T_5 + 7T_6 = -35 \quad \text{--- (4)''}$$

$2T_2 - 4T_3 + 6T_4 + 10T_5 - 0T_6 = 28$

$-2T_2 - 10/3\,T_3 + 10/3\,T_5 + 2/3\,T_6 = -8$

$-2/3\,T_3 + 6T_4 + 20/3\,T_5 - 2/3\,T_6 = 36 \quad \text{---(5)}''$

$-T_2 + 9T_3 - 10T_4 - 15T_5 + 2T_6 = -43$

$-T_2 + 5/3\,T_3 + 0T_4 - 5/3\,T_5 - 1/3\,T_6 = 4$

$0 + 22/3\,T_3 - 10T_4 - 40/3\,T_5 + 7/3\,T_6 = -47 \quad \text{---(6)}''$

Equation (3)'' then becomes the pivot equation.

$12/7\,[7/3\,T_3 - 2T_4 - 13/3\,T_5 + 4/3\,T_6 = -11]$

$= 4T_3 - 24/7\,T_4 - 52/7\,T_5 + 16/7\,T_6 = -132/7$

$-2/7\,[7/3\,T_3 - 2T_4 - 13/3\,T_5 + 4/3\,T_6 = -11]$

$= -2/3\,T_3 + 4/7\,T_4 + 26/21\,T_5 - 8/21\,T_6 = 22/7$

$22/7\,[7/3\,T_3 - 2T_4 - 13/3\,T_5 + 4/3\,T_6 = 11]$

$= 22/3\,T_3 - 44/7\,T_4 - 286/21\,T_5 + 88/21\,T_6 = 242/7$

Subtracting equation,

$4T_3 - 6T_4 - 8T_5 + 7T_6 = -35$

$-\ 4T_3 - 24/7\,T_4 - 52/7\,T_5 + 16/7\,T_6 = -132/7$

$0 - 2.5714\,T_4 - 0.5714\,T_5 + 4.7142\,T_6 = -16.1429$

$\text{---(4)}''$

$2/3\,T_3 + 6T_4 + 20/3\,T_5 - 2/3\,T_6 = 36$

$-\ 2/3\,T_3 + 4/7\,T_4 + 26/21\,T_5 - 8/21\,T_6 = 22/7$

$0 + 5.4285\,T_4 + 5.4285\,T_5 - 0.2857\,T_6 = 32.8571 \quad \text{---(5)}'''$

$22/3\,T_3 - 10T_4 - 40/3\,T_5 + 7/3\,T_6 = -47$

$-\ 22/3\,T_3 - 44/7\,T_4 - 286/21\,T_5 + 88/21\,T_6 = -242/7$

$0 - 3.7143\,T_4 + 0.2857\,T_5 - 1.8571\,T_6 = -12.4286 \quad \text{---(6)}'''$

Equation (4)''' is then the pivot equation

$-2.1111[-2.57147_4 - 0.5714T_5 + 4.7142T_6 = -16.1429]$

$= 25.7285T_4 - 0.5714T_5 + 4.7142T_6 = 16.1429$

$= 5.42857T_4 + 1.2063T_5 - 9.9521T_6 = 34.0793$

$1.4444[-2.5714T_4 - 0.5714T_5 + 4.7142T_5 = 16.1429]$

$= -3.71429T_4 - 0.82536T_5 + 6.80947T_6 = 23.31977$

Subtracting equation

$5.42857T_4 + 5.42857T_5 - 0.2857T_6 = 32.8571$

$-[5.42857T_4 + 1.2063T_5 - 9.9321T_6 = 34.0793$

$0T_4 + 4.2223T_5 + 9.66639T_6 = -1.2222$ ---(5)'''

$-3.71429T_4 + 0.2837145_5 - 1.8571T_6 = -12.4286$

$-[3.71429T_4 - 0.82536T_5 + 6.8094T_6 = 23.3177]$

$0T_4 + 1.1111T_5 - 8.6667T_6 = 10.8887$ ---(6)''''

Equation 5''' then becomes the pivot equation

$0.2632[4.2223T_5 + 9.66639T_6 = -1.2222]$

$= 1.1111T_5 + 2.5442T_6 = -0.3218$

$\Rightarrow 1.1111T_5 - 8.6667T_6 = 10.887$

$-1.1111T_5 + 2.5442T_6 = -0.3218$

$= 0 - 11.2109T_6 = 11.2106$

$T_6 = \frac{11.2106}{-11.2109} = 0.99997 \approx -1.0$

$T_6 = -1.0$

$1.1111T_5 = 8.6667(-1) - 10.889$

$T_5 = \frac{10.889 - 8.667}{1.1111}$

$T_5 = 2$

$-3.7142T_4 + 0.285714(2) - 1.85714(-1) = -12.4286$

$T_4 = \frac{-12.4286 - 0.571428 - 1.85724}{-3.71429}$

$= 4$

$4T_3 - 6T_4 - 8T_5 + 7T_6 = -35$

$4T_3 - 6(4) - 8(2) + 7(4) = -35$

$4T_3 - 24 - 16 - 7 = -35$

$T_3 = \frac{-35 + 47}{4} = 3$

$T_3 = 3$

$2T_2 - 3T_3 - 2T_4 - T_5 + 2T_6 = -19$

$2T_2 - (3) - 2(4) - (2) + 2(-1) = -19$

$T_2 = \frac{-19 + 15}{2} = \frac{-4}{2} = -2$

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

$(T_1) + (-2) - 2(3) + (4) + 3(2) - (-1) = 4$

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

$T_1 = 4 - 3 = 1$

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