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Mechanical Engineering

16/ENG06/059

ENG 382

Soln

a) Using Jacob Iterative method
we make $M_1, M_2, \& M_3$ in eqn ① - ③

$$M_1 = \frac{2M_2 - M_3 + 9}{10}$$

$$M_1 = 0.2M_2 - 0.1M_3 + 0.9$$

$$M_2 = \frac{2M_1 + 2M_3 + 12}{10}$$

$$M_2 = 0.2M_1 + 0.2M_3 + 1.2$$

$$M_3 = \frac{2M_1 + 5M_2 + 18}{10}$$

$$M_3 = 0.2M_1 + 0.5M_2 + 1.8$$

Matrix rotation $Ax=b$

$$\begin{bmatrix} M_1^{(k)} \\ M_2^{(k)} \\ M_3^{(k)} \end{bmatrix} = \begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} M_1^{(k-1)} \\ M_2^{(k-1)} \\ M_3^{(k-1)} \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$

Initial; $M_0 = [0; 0; 0]$

$$M^{(0)} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

1st Interaction

$$\begin{bmatrix} M_1^{(1)} \\ M_2^{(1)} \\ M_3^{(1)} \end{bmatrix} = \begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix} = \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$

$$M^{(1)} = \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$

2nd Iteration:

$$\begin{bmatrix} M_1^{(2)} \\ M_2^{(2)} \\ M_3^{(2)} \end{bmatrix} = \begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$
$$= \begin{bmatrix} 0 + 0.24 - 0.18 \\ 0.18 + 0 + 0.36 \\ 0.18 + 0.6 + 0 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$
$$= \begin{bmatrix} 0.96 \\ 1.74 \\ 2.58 \end{bmatrix}$$

$$M^{(2)} = \begin{bmatrix} 0.96 \\ 1.74 \\ 2.58 \end{bmatrix}$$

3rd Iteration:

$$\begin{bmatrix} M_1^{(3)} \\ M_2^{(3)} \\ M_3^{(3)} \end{bmatrix} = \begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} 0.96 \\ 1.74 \\ 2.58 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$
$$= \begin{bmatrix} 0 + 0.348 - 0.258 \\ 0.192 + 0 + 0.516 \\ 0.192 + 0.87 + 0 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$
$$M^{(3)} = \begin{bmatrix} 0.99 \\ 1.91 \\ 2.86 \end{bmatrix}$$

b) In the attached MATLAB file.