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Mechanical Engineering

Eng 382

Assignment (4)

- 1a) Using an initial guess vector $m_0 = [0; 0; 0]$, determine the values of the variables in Equation (1) using Jacobi Iterative method manually showing only three iterations

$$10m_1 - 2m_2 + m_3 = 9 \quad (1)$$

$$-2m_1 + 10m_2 - 2m_3 = 12 \quad (2)$$

$$-2m_1 - 5m_2 + 10m_3 = 18 \quad (3)$$

first iteration

from equation (1) make m_1 subject of formula

$$m_1 = \frac{9 + 2m_2 - m_3}{10} \quad (a)$$

substitute $m_2 = 0$; $m_3 = 0$

$$m_1 = \frac{9}{10} = 0.9$$

from equation (2) make m_2 subject of formula

$$m_2 = \frac{12 + 2m_1 + 2m_3}{10} \quad (b)$$

substitute $m_1 = 0$; $m_3 = 0$

$$m_2 = \frac{12}{10} = 1.2$$

from equation (3) make m_3 subject of formula

$$m_3 = \frac{18 + 2m_1 + 5m_2}{10} \quad (c)$$

substitute $m_1 = 0$ $m_2 = 0$

$$m_3 = \frac{18}{10} = 1.8$$

Second iteration

$$m_1 = 0.9; m_2 = 1.2; m_3 = 1.8$$

Substitute $m_1 = 0.9; m_2 = 1.2, m_3 = 1.8$
into equations (a), (b), (c).

from (a)

$$m_1 = \frac{9 + 2m_2 - m_3}{10}$$

$$m_1 = \frac{9 + 2(1.2) - 1.8}{10} = 0.96$$

from (b)

$$m_2 = \frac{12 + 2m_1 + 2m_3}{10}$$

$$m_2 = \frac{12 + 2(0.9) + 2(1.8)}{10} = 1.74$$

from (c)

$$m_3 = \frac{18 + 2m_1 + 5m_2}{10}$$

$$m_3 = \frac{18 + 2(0.9) + 5(1.2)}{10}$$

$$m_3 = 2.58$$

Third iteration

$$m_1 = 0.96$$

$$m_2 = 1.74$$

$$m_3 = 2.58$$

Substitute $m_1 = 0.96, m_2 = 1.74; m_3 = 2.58$
into (a), (b), (c)

from (a)

$$m_1 = \frac{9 + 2m_2 - m_3}{10}$$

$$m_1 = \frac{9 + 2(1.74) - (2.58)}{10}$$

$$m_1 = 0.99$$

from (b)

$$m_2 = \frac{12 + 2m_1 + 2m_3}{10}$$

$$m_2 = \frac{12 + 2(0.96) + 2(2.98)}{10}$$

$$m_2 = 1.908$$

from c

$$m_3 = \frac{18 + 2m_1 + 5m_2}{10}$$

$$m_3 = \frac{18 + 2(0.96) + 5(1.74)}{10}$$

$$m_3 = 2.862$$