

Numerical Methods for Engineers | (5th Edition)

Step-by-step solution

Relative error is given by the formula below:

$$\text{Relative error} = \frac{|\text{true value} - \text{approximate value}|}{\text{true value}}$$

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Step 2 of 4

Consider the function:

$$f(x) = \frac{1}{(1 - 3x^2)^2}$$

Calculate the derivative of this function and get the equation:

$$f'(x) = \frac{6x}{(1 - 3x^2)^2}$$

Substitute $x = 0.577$ in the derivative:

$$\begin{aligned} f'(x) &= \frac{6 \times 0.577}{(1 - 3 \times 0.577^2)^2} \\ &= \frac{3.462}{(1 - 3 \times 0.332929)^2} \dots\dots (1) \\ &= \frac{3.462}{(1 - 0.998787)^2} \\ &= 2352911 \end{aligned}$$

There is no difficulty in to get the solution as the denominator does not come out to be zero in spite of being very close to it.

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Step 3 of 4

Now, consider the 3-digit chopping case. Reduce the equation (1) into 3-digit arithmetic:

$$\begin{aligned} &= \frac{3.46}{(1 - 3 \times 0.332)^2} \\ &= \frac{3.46}{(.004)^2} \\ &= \frac{3.46}{0.000004} \\ &= 216250 \end{aligned}$$

Hence, the solution in this case will come out as **216250**. Now, the percentage of relative error can be calculated as:

$$\begin{aligned} \varepsilon_r &= \frac{|2352911 - 216250|}{2352911} \\ &= 90.8\% \end{aligned}$$

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Step 4 of 4

Now, consider the 4-digit chopping case. Reduce the equation (1) into 4-digit arithmetic:

$$\begin{aligned} &= \frac{3.462}{(1 - 0.9987)^2} \\ &= \frac{3.462}{(.0013)^2} \\ &= \frac{3.462}{.00000169} \\ &= 2082521 \end{aligned}$$

Hence, the solution in this case will come out as **2048521**. Now, the percentage of relative error can be calculated as:

$$\begin{aligned} \varepsilon_r &= \frac{|2352911 - 2048521|}{2352911} \\ &= 12.9\% \end{aligned}$$

Thus, the required error is **12.9%**.

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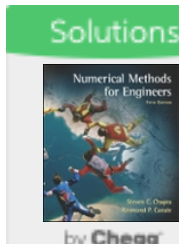
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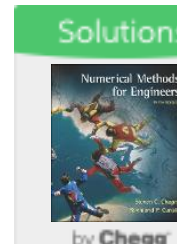
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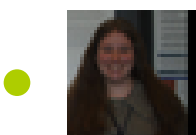


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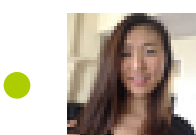
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$$K = \frac{c_c}{c_a^2 c_b}$$

Chapter 25, Solution 27P

Consider the following equation for the definite integral, This is identical to the solution for the differential equation...

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$$I = \int_a^b f(x) dx$$

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