

# 10.4.2.1.3

EE24BTECH11041 - Mohit

- 1) Find the roots of the following quadratic equations by factorisation.

$$\sqrt{2}x^2 + 7x + 5\sqrt{2} = 0 \quad (1.1)$$

## Theoretical Solution-

Checking roots of equation exist or not,

$$b^2 - 4ac \geq 0 \quad (1.2)$$

$$= 49 - 4(\sqrt{2})(5\sqrt{2}) \quad (1.3)$$

$$= 9 \quad (1.4)$$

This means roots of equation exist.

And its roots are given by

$$x = \frac{b - \sqrt{b^2 - 4ac}}{2a}, \frac{b + \sqrt{b^2 - 4ac}}{2a} \quad (1.5)$$

$$x = -\sqrt{2}, -\frac{5}{\sqrt{2}} \quad (1.6)$$

## CODING LOGIC:-

### Newton-Raphson Method

- a) Update Equation:

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)} \quad (1.7)$$

- b) Steps:

1. Start with an initial guess  $x_0$ .
2. Define the function  $f(x)$  and its derivative  $f'(x)$ .
3. Iterate using:

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)} \quad (1.8)$$

until convergence, i.e.,

$$|x_{n+1} - x_n| < \text{tolerance} \quad (1.9)$$

4. Stop if  $f'(x_n)$  is close to zero to avoid division by zero.

- c) Convergence Criteria: The method converges quadratically if the initial guess is sufficiently close to the root and  $f'(x) \neq 0$ .

### Secant Method

a) Update Formula:

$$x_{n+1} = x_n - f(x_n) \cdot \frac{x_n - x_{n-1}}{f(x_n) - f(x_{n-1})} \quad (1.10)$$

b) Steps:

1. Start with two initial guesses  $x_0$  and  $x_1$ .
2. Define the function  $f(x)$ .
3. Iterate using:

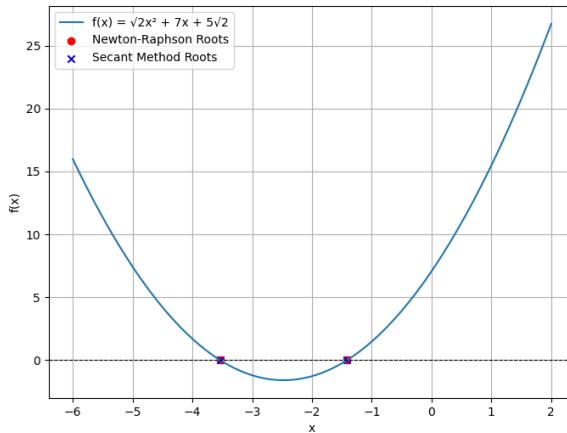
$$x_{n+1} = x_n - f(x_n) \cdot \frac{x_n - x_{n-1}}{f(x_n) - f(x_{n-1})} \quad (1.11)$$

until convergence, i.e.,

$$|x_{n+1} - x_n| < \text{tolerance}. \quad (1.12)$$

4. Stop if  $f(x_n) - f(x_{n-1})$  is close to zero to avoid division by zero.

c) Convergence Criteria: The method converges superlinearly and does not require the derivative  $f'(x)$ .



## CODING LOGIC FOR FINDING EIGENVALUES

a) Matrix Representation

The quadratic equation

$$\sqrt{2}x^2 + 7x + 5\sqrt{2} = 0 \quad (1.13)$$

is rewritten in matrix form:

$$\text{Matrix} = \begin{pmatrix} 0 & -\frac{c}{a} \\ 1 & -\frac{b}{a} \end{pmatrix} \quad (1.14)$$

$$a = \sqrt{2}, \quad b = 7, \quad c = 5\sqrt{2}. \quad (1.15)$$

Substituting the values of  $a, b$  and  $c$ , the matrix becomes:

$$\text{Matrix} = \begin{pmatrix} 0 & -5 \\ 1 & -\frac{7}{\sqrt{2}} \end{pmatrix} \quad (1.16)$$

b) Trace = sum of diagonal element

c) The discriminant is calculated as:

$$\text{Discriminant} = (\text{Trace})^2 - 4 \times (\text{Determinant}) \quad (1.17)$$

d) The value of  $\lambda$  will be given by

$$\lambda_1 = \frac{\text{Trace} + \sqrt{\text{Discriminant}}}{2}, \lambda_2 = \frac{\text{Trace} - \sqrt{\text{Discriminant}}}{2} \quad (1.18)$$

