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Course : CSE330

Section : 10

Assignment : 07

Ans: to the que no: Problem-A

Given,

$$\sin(x) = 2 - x^2$$

Here,  $f(x) = -x^2 + 2 - \sin(x) = 0$

$$\Rightarrow f'(x) = -2x - \cos(x)$$

$$f(0) = 2$$

$$f(1) = 0.15852$$

$$f(2) = -2.909297$$

Here  $f(1) \cdot f(2) < 0$

Root lies in (1) and (2),  $x_0 = \frac{3}{2} = 1.5$

$n$	$x_0$	$f(x_0)$	$f'(x_0)$	$x_1$	Update
1	1.5	-1.247495	-3.070737	1.093747	$x_0 = x_1$
2	1.093747	-0.084637	-2.646654	1.061768	$x_0 = x_1$
3	1.061768	-0.000571	-2.610866	1.06155	$x_0 = x_1$
4	1.06155	0	-2.610619	1.06155	$x_0 = x_1$

Therefore, the root is 1.06155 after 4 iteration

Ans: to the que no: Problem- B

1

Secant Method: The secant method is a root finding algorithm that uses a succession of roots of secant lines to better approximate a root of a function. It is considered to be the most effective approach to find the root of a non linear function.

The formula

$$x_{k+1} = x_k - f(x_k) \left( \frac{x_k - x_{k-1}}{f(x_k) - f(x_{k-1})} \right)$$

Secant Method Algorithm:

In the secant method, if  $x_0$  and  $x_1$  are the initial guesses the the next approximate

root  $x_2$  is obtained by the below formula

$$x_2 = x_1 - \frac{f(x_1)(x_1 - x_0)}{f(x_1) - f(x_0)}$$

Now, the algorithm of the method:

Step 01% Start

Step 02% finding  $x_0$  and  $x_1$  as ' $x_0 < x_1$ '

Step 03%

$$x_2 = x_1 - \frac{f(x_1)(x_1 - x_0)}{f(x_1) - f(x_0)}$$

Step 04%

IF  $f(x_2) = 0$  then  $x_2$  is exact root

Else  $x_0 = x_1$ ,  $x_1 = x_2$

Step 05%

Repeat 3, 4 until  ~~$f(x_k)$~~   $f(x_k) = 0$  or

$|f(x_k)| \leq \text{Error bound}$

2

Given,

$$f(x) = x^3 - x - 1$$

$$f(0) = -1$$

$$f(1) = -1$$

$$f(2) = 5$$

In this case,  $f(1) \cdot f(2) < 0$

1st iteration:

$$x_0 = 1$$

$$x_1 = 2$$

$$f(x_0) = -1$$

$$f(x_1) = 5$$

$$x_2 = x_1 - \frac{f(x_1)(x_1 - x_0)}{f(x_1) - f(x_0)}$$

$$= 2 - \frac{5 \cdot 1}{5 - (-1)}$$

$$= \frac{7}{6}$$

$$= 1.1667$$



2nd iteration:

$$x_1 = 2, \quad x_2 = 1.167$$

$$f(x_1) = 5, \quad f(x_2) = -0.579$$

$$x_3 = x_2 - \frac{(-0.579)(1.167 - 2)}{(-0.579) - (5)}$$

$$= 1.253$$

3rd iteration:

$$x_2 = 1.167; \quad x_3 = 1.253$$

$$f(x_3) = -0.285$$

$$x_4 = x_3 - \frac{f(x_3)(x_3 - x_2)}{f(x_3) - f(x_2)}$$

$$= 1.337$$

4th iteration:

$$x_3 = 1.253; \quad x_4 = 1.337; \quad f(x_4) = 0.054$$

$$x_5 = x_4 - \frac{f(x_4)(x_4 - x_3)}{f(x_4) - f(x_3)}$$

$$= 1.324$$

$$f(x_5) = -0.004$$

5th iteration

$$x_4 = 1.337, x_5 = 1.324$$

$$f(x_4) = 0.054, f(x_5) = -0.004$$

$$x_6 = x_5 - \frac{f(x_5)(x_5 - x_4)}{f(x_5) - f(x_4)}$$

$$= 1.325$$

$$\therefore f(x_6) = 0$$

$\therefore$  Using secant method in 5th iteration, the root is 1.325.