BRAC University (Department of Computer Science and Engineering)
CSE 330 (Numerical Methods) for Spring 2024 Semester
Quiz 2 [CO1]

Student ID:

Name:

Section: 08

Full Marks: 10
Duration:15 minutes

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1) Consider the following nodes:

Time (Sec)	Displacement (m)
10	35
20	40

a) State the number of nodes and no. of degree (n) for the above nodes. **[1]**
b) Using **Vandermonde Matrix** method, construct a polynomial that goes through the above nodes. You can use the following formulae for the function. **[3]**
c) Find the value of displacement if x(time)=12 sec using the above polynomial. **[1]**
d) If a new node **(25,55)** is added to the above nodes, then find a new polynomial of appropriate degree by using **Newton's Divided Difference** method. **[5]**

(a) no. of nodes = 2
$n = 1$

(b) $\begin{pmatrix} 1 & 10 \\ 1 & 20 \end{pmatrix} \begin{pmatrix} a_0 \\ a_1 \end{pmatrix} = \begin{pmatrix} 35 \\ 40 \end{pmatrix}$

$\begin{pmatrix} a_0 \\ a_1 \end{pmatrix} = \begin{pmatrix} 1 & 10 \\ 1 & 20 \end{pmatrix}^{-1} \begin{pmatrix} 35 \\ 40 \end{pmatrix}$ — (1)

$\begin{pmatrix} a_0 \\ a_1 \end{pmatrix} = \begin{pmatrix} 2 & -1 \\ -\frac{1}{10} & \frac{1}{10} \end{pmatrix} \begin{pmatrix} 35 \\ 40 \end{pmatrix} = \begin{bmatrix} 30 \\ 0.5 \end{bmatrix}$

— (2)

$$f(x) = a_0 + a_1 x$$

$$= 30 + 0.5x \quad -(1)$$

(c) $f(12) = 30 + 0.5(12)$

$= 36$ (Ans)

(d)

Layer 1

$x_0 = 10$ $\quad f[x_0] = 35$

$x_1 = 20$ $\quad f[x_1] = 40$

$x_2 = 25$ $\quad f[x_2] = 55$

Layer 2

$f[x_0, x_1] = \frac{40 - 35}{20 - 10} = 0.5$

$f[x_1, x_2] = \frac{55 - 40}{5} = 3.$

Layer 3

$f[x_0, x_1, x_2] = \frac{3 - 0.5}{25 - 10} = \frac{2.5}{15}$

$$f(x) = a_0 + a_1(x - x_0) + a_2(x - x_0)(x - x_1)$$

$$= 35 + 0.5(x - 10) + \frac{2.5}{15}(x - 10)(x - 20)$$

→ 1.5 mark each → 1 layer correct each.

→ 0.5 mark → f(x) correct