University of Asia Pacific

Admit Card

Final-Term Examination of Spring, 2021

Financial Clearance	PAID

Registration No : 18201043

Student Name : Shawon Barman

Program : Bachelor of Science in Computer Science and Engineering

SI.NO.	COURSE CODE	COURSE TITLE	CR.HR.	EXAM. SCHEDULE
1	CSE 313	Numerical Methods	3.00	
2	CSE 314	Numerical Methods Lab	0.75	
3	CSE 315	Peripheral & Interfacing	3.00	
4	CSE 316	Peripheral & Interfacing Lab	1.50	
5	CSE 317	Computer Architecture	3.00	
6	CSE 319	Computer Networks	3.00	
7	CSE 320	Computer Networks Lab	1.50	
8	CSE 321	Software Engineering	3.00	
9	CSE 322	Software Engineering Lab	0.75	

Total Credit: 19.50

1. Examinees are not allowed to enter the examination hall after 30 minutes of commencement of examination for mid semester examinations and 60 minutes for semester final examinations.

2. No examinees shall be allowed to submit their answer scripts before 50% of the allocated time of examination has elapsed.

3. No examinees would be allowed to go to washroom within the first 60 minutes of final examinations.

4. No student will be allowed to carry any books, bags, extra paper or cellular phone or objectionable items/incriminating paper in the examination hall.
Violators will be subjects to disciplinary action.

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Final Semester Examination, Spring-2021

Name : Shawon Barman   Registration ID: 18201093

Year : 3rd   Semester : 2nd

Course Code: CSE 313   Course Title: Numerical Methods

Section : A   Exam date: 17-11-2021

1 No Qus Ans (a)

Here, my roll number is 93

$\therefore 93 \times 0.1 = 9.3$

Given initial guess,

$$[x_1, x_2, x_3] = [0, 0, 0]$$

So,

$$\begin{bmatrix} 4 & 2 & -7 \\ 1 & -3 & -1 \\ 22 & -1 & 9.3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 7 \\ 5 \end{bmatrix}$$

Rewrite the equation,

$$x_1 = \frac{0 - 2x_2 + 7x_3}{4}$$

$$x_2 = \frac{7 - x_1 + x_3}{-3}$$

$$x_3 = \frac{5 - 22x_1 + x_2}{9.3}$$

Iteration -1:

Apply the initial guess and solve for x_i,

$$x_1 = \frac{0 - 2\times0 + 7\times0}{4} = 0$$

(P.T.O)

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$$x_2 = \frac{7-0+0}{-3} = -2.333$$

$$x_3 = \frac{5-22\times 0+0}{4.3} = 1.163$$

At the end of the first iteration,

$$[x_1, x_2, x_3] = [0, -2.333, 1.163]$$

Iteration-2:

Using $[x_1, x_2, x_3] = [0, -2.333, 1.163]$ from Iteration-1;

The values of x_i are found:

$$x_1 = \frac{0-2(-2.333)+7\times 1.163}{9}$$

$$= 3.202$$

$$x_2 = \frac{7-0+1.163}{-3}$$

$$= -2.721$$

$$x_3 = \frac{5-22\times 0+(-2.333)}{4.3}$$

$$= 0.620$$

At the end of the first iteration,

$$[x_1, x_2, x_3] = [3.202, -2.721, 0.620]$$

(P.T.O)

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Iteration-3:

Using $[x_1, x_2, x_3] = [3.202, -2.721, 0.620]$ from Iteration-2.

The values of x_i are found,

$$x_1 = \frac{0 - 2(-2.721) + 7 \times 0.620}{4}$$

$$= 2.996$$

$$x_2 = \frac{7 - 3.202 + 0.620}{-3}$$

$$= -1.473$$

$$x_3 = \frac{5 - 22 \times 3.202 + (-2.721)}{4.3}$$

$$= -15.852$$

At the end of the first iteration,

$$[x_1, x_2, x_3] = [2.996, -1.473, -15.852]$$

1 No Qus Ans (b)

A $n \times n$ square matrix $[A]$ is a diagonally dominant matrix if $|a_{ii}| \geq \sum_{\substack{j=1 \\ i \neq j}}^{n} |a_{ij}|$, for all $i = 1, 2, 3, \ldots, n$ and $|a_{ii}| > \sum_{\substack{j=1 \\ i \neq j}}^{n} |a_{ij}|$ for at least one i, that is, for each row, the absolute value of the diagonal element is greater than or equal to the sum of the absolute values of the rest of the elements

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of that row, and that the inequality is strictly greater that for at least one row. Diagonally dominant matrices are important in ensuring convergence in iterative schemes of solving simultaneous linear equation,

$$[A] = \begin{bmatrix} 4 & 2 & -7 \\ 1 & -3 & -1 \\ 22 & -1 & 4.3 \end{bmatrix}$$ is a diagonally dominant matrix as,

$|a_{11}| = |4| = 4 \leq |a_{12}| + |a_{13}| = |2| + |-7| = 2+7 = 9$

$|a_{22}| = |-3| = 3 \geq |a_{21}| + |a_{23}| = |1| + |-1| = 1 + 1 = 2$

$|a_{33}| = |4.3| = 4.3 \leq |a_{31}| + |a_{32}| = |22| + |-1| = 22 + 1 = 23$

There are at least one row is greater than. Therefore, the solution should coverge using the Gauss Seidel Method.

x

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2 No Qn Ans (a)

Here, my roll number is 43

$\therefore$ Find the velocity at $t = 43 + 3$

$= 46$

From the given table,

$t_0 = 3.5$ $\quad v(t_0) = 27.4$

$t_1 = 36.3$ $\quad v(t_1) = 64.5$

$t_2 = 59.75$ $\quad v(t_2) = 98.24$

The equation for quadratic interpolation is,

$$v(t) = b_0 + b_1(t - t_0) + b_2(t - t_0)(t - t_1) \quad \text{——— (1)}$$

We know,

$$b_0 = v(t_0) = 27.4$$

$$b_1 = \frac{v(t_1) - v(t_0)}{t_1 - t_0} = \frac{64.5 - 27.4}{36.3 - 3.5} = 1.131097$$

$$b_2 = \frac{\frac{v(t_2) - v(t_1)}{t_2 - t_1} - \frac{v(t_1) - v(t_0)}{t_1 - t_0}}{t_2 - t_0}$$

$$= \frac{\frac{98.24 - 64.5}{59.75 - 36.3} - \frac{64.5 - 27.4}{36.3 - 3.5}}{59.75 - 3.5}$$

$$= \frac{1.438806 - 1.131097}{56.25}$$

$$= 0.00547$$

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Now, putting the values in equation ①,

$$v(t) = 27.4 + 1.131097(t-3.5) + 0.00547(t-3.5)(t-36.3)$$

$$\therefore v(46) = 27.4 + 1.131097(46-3.5) + 0.00547(46-3.5)(46-36.3)$$

$$= 27.4 + 48.0716 + 2.255$$

$$= 77.7266 \text{ m/s} \quad \text{(Ans:)}$$

2 No Qus Ans ⓑ

From question 2ⓐ,

Find the velocity at $t = 46$

① From the given table,

$t_0 = 36.3$ $\quad$ $v(t_0) = 64.5$

$t_1 = 59.75$ $\quad$ $v(t_1) = 98.24$

The equation for linear interpolation is,

$$v(t) = b_0 + b_1(t-t_0)$$

We know,

$$b_0 = v(t_0) = 64.5$$

$$b_1 = \frac{v(t_1)-v(t_0)}{t_1-t_0} = \frac{98.24-64.5}{59.75-36.3}$$

$$= 1.4388$$

$$\therefore v(t) = 64.5 + 1.4388(t-36.3)$$

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$$\therefore v(46) = 64.5 + 1.4388(46 - 36.3)$$

$$= 64.5 + 13.95636$$

$$= 78.4564 \text{ m/s}$$

So, the absolute relative approximate error,

$$|\epsilon_a| = \left| \frac{77.7266 - 78.4564}{77.7266} \right| \times 100\%$$

$$= 0.00939 \times 100\%$$

$$= 0.939\%$$

(Ans) i)

3 No Qus Ans (a)

Given that,

$$I = \int_a^b \frac{dx}{2x+4}$$

Here, my roll number is 43

$$\therefore a = 43 \times 0.2 = 8.6$$

$$\therefore b = a + 5 = 8.6 + 5 = 13.6$$

So,

$$I = \int_{8.6}^{13.6} \frac{1}{2x+4} dx$$

$$\therefore f(x) = \frac{1}{2x+4}$$

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Here,

$$n = 4$$

$$\therefore h = \frac{b-a}{n} = \frac{13.6 - 8.6}{4}$$

$$= 1.25$$

So,

$$f(x_0) = f(8.6)$$

$$f(x_1) = f(8.6 + 1.25) = f(9.85)$$

$$f(x_2) = f(9.85 + 1.25) = f(11.1)$$

$$f(x_3) = f(11.1 + 1.25) = f(12.35)$$

$$f(x_4) = f(12.35 + 1.25) = f(13.6)$$

We know,

$$x = \frac{b-a}{3n}\left[f(x_0) + 4\sum_{\substack{i=1\\ i=odd}}^{n-1} f(x_i) + 2\sum_{\substack{i=2\\ i=even}}^{n-2} f(x_i) + f(x_n)\right]$$

$$= \frac{13.6-8.6}{3\times 4}\left[f(x_0) + 4\sum_{\substack{i=1\\ i=odd}}^{3} f(x_i) + 2\sum_{\substack{i=2\\ i=even}}^{2} f(x_i) + f(x_4)\right]$$

$$= \frac{5}{12}\left[f(x_0) + 4f(x_1) + 4f(x_3) + 2f(x_2) + f(x_4)\right]$$

$$= \frac{5}{12}\left[f(8.6) + 4f(9.85) + 4f(12.35) + 2f(11.1) + f(13.6)\right]$$

Here,

$$f(8.6) = \frac{1}{2\times 8.6 + 4} = 0.0471698$$

$$f(9.85) = \frac{1}{2\times 9.85 + 4} = 0.0421941$$

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$f(11.1) = \frac{1}{2\times11.1+4} = 0.0381679$

$f(12.35) = \frac{1}{2\times12.35+4} = 0.0348432$

$f(13.6) = \frac{1}{2\times13.6+4} = 0.0320513$

$\therefore x = \frac{5}{12}\left[0.0471698+4\times0.0421941+4\times0.0348432+2\times0.0381679+0.0320513\right]$

$= \frac{5}{12}\times0.4637061$

$= 0.193211$ m (Ans:)

3 No Qus Ans (b)

Here, true value $= \int_{8.6}^{13.6}\frac{1}{2x+4}\,dx$

$= 0.19320846$ m

From question 3 (a),

approximate value $= 0.193211$ m

We know,

true error, E_t = true value − approximate value

$= 0.19320846 - 0.193211$

$= -0.00000254$ m

(Ans:)

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The absolute relative true error,

$$|\epsilon_t| = \left| \frac{\text{true error}}{\text{true value}} \right| \times 100\%$$

$$= \left| \frac{-0.00000259}{0.19320816} \right| \times 100\%$$

$$= 0.0013196\ \% \quad \text{(Ans:)}$$

4 No Qus Ans OR (b)

Here, my roll number is 93

Given that,

The function to be maximized is $f(x) = 120x - x^2$.

Iteration-1:

The values for the boundaries of $x_l = 0$ and $x_u = \frac{93 \times 0.2}{2} = 9.3$ we can calculate the initial intermediate points as follows:

$$x_1 = x_l + \frac{\sqrt{5}-1}{2}(x_u - x_l)$$

$$= 0 + \frac{\sqrt{5}-1}{2}(9.3 - 0)$$

$$= 2.6575$$

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$$x_2 = x_u - \frac{\sqrt{5}-1}{2}(x_u - x_l)$$

$$= 4.3 - \frac{\sqrt{5}-1}{2}(4.3-0)$$

$$= 1.6421$$

So,

$$f(x_1) = f(2.6575) = 120 \times 2.6575 - (2.6575)^2$$

$$= 311.838$$

$$f(x_2) = f(1.6421) = 120 \times 1.6421 - (1.6421)^2$$

$$= 194.391$$

Hence, $f(x_2) < f(x_1)$. So,

$$x_l = x_2 = 1.6421$$

$$x_2 = x_1 = 2.6575$$

$$x_u = 4.3$$

$$\therefore x_1 = x_l + \frac{\sqrt{5}-1}{2}(x_u - x_l)$$

$$= 1.6421 + \frac{\sqrt{5}-1}{2}(4.3 - 1.6421)$$

$$= 3.2849$$

Iteration-2:

From Iteration-1,

$$x_l = 1.6421$$

$$x_u = 4.3$$

$$x_1 = 3.2849$$

$$x_2 = 2.6575$$

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So,

$$f(x_1) = f(3.2899) = 120 \times 3.2899 - (3.2899)^2$$

$$= 383.397$$

$$f(x_2) = f(2.6575) = 120 \times 2.6575 - (2.6575)^2$$

$$= 311.838$$

Hence, $f(x_1) > f(x_2)$. So,

$$x_l = x_2 = 2.6575$$

$$x_2 = x_1 = 3.2899$$

$$x_u = 4.3$$

$$\therefore x_1 = x_l + \frac{\sqrt{5}-1}{2}(x_u - x_l)$$

$$= 2.6575 + \frac{\sqrt{5}-1}{2}(4.3 - 2.6575)$$

$$\cancel{3.27}$$

$$= 3.6726$$

Hence, $\frac{x_u + x_l}{2} = \frac{4.3 + 2.6575}{2} = 3.4787$

$$\therefore f(3.4787) = 120 \times 3.4787 - (3.4787)^2$$

$$= 405.3426$$

$\therefore$ The theoretically optimal solution to the problem happens at exactly 3.4787 and gives a maximum

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cross sectional area of 905.3426

9 No Qus Ans of (b)

Equal Interval Search Method is one of the simplest methods of finding the local maximum or local minimum. An interval of ε over which we assume the maximum occurs. Then we can compute,

$$f\left(\frac{a+b}{2}+\frac{\varepsilon}{2}\right) \text{ and } f\left(\frac{a+b}{2}-\frac{\varepsilon}{2}\right)$$

If $f\left(\frac{a+b}{2}+\frac{\varepsilon}{2}\right) \geq f\left(\frac{a+b}{2}-\frac{\varepsilon}{2}\right)$ then the interval in which the maximum occurs is $\left[\frac{a+b}{2}-\frac{\varepsilon}{2}, b\right]$, otherwise it occurs ~~in~~ is $\left[a, \frac{a+b}{2}+\frac{\varepsilon}{2}\right]$.

This reduces the interval in which the local maximum occurs.

Equal Interval Search Method is somewhat inefficient because if the interval is a small number it can take a long time to find the maximum of a function. That's why golden search method is suggested.

x