Mutalib

North East University Bangladesh
Department of Computer Science and Engineering
Program: BSc(Engg) in CSE
Mid Semester Examination, Fall - 2021

Course Code: MAT 201 Course Title: Numerical Methods
Time: 1.5 hours Maximum Marks: 30

Square bracketed numbers in the margin indicate marks for each part of a question.
Boxed numbers in the margin indicate total marks of the question.

(Answer all of the following questions)

Question 1 ..... Total Marks on Question 1 is: 8

Answer **any 2 questions** from the following:

(a) Find the second order Taylor polynomial for the following function over $x_0 = 0$: [4]

$$f(x) = xe^x + x$$

(b) Find the Newton-Raphson iteration formula for the following equation. Simplify the formula up to the point that it cannot be simplified any further: [4]

$$f(x) = x - \sqrt{4 + x}$$

(c) Consider you are given two vectors: $A = [2\ 1\ 4]$ and $B = [1\ 0\ -1]^T$. Now find:

i. AB [2]

ii. BA [2]

If either of the product is not possible, explain why not.

Question 2 ..... Total Marks on Question 2 is: 14

Answer **any 2 questions** from the following. For each system of linear equations, determine and show whether they produce singular or non-singular matrix (**writing answer only carries no marks**). If the matrix is non-singular, then also find the value of unknowns (x, y, z, and t) using the **Gaussian Elimination** Algorithm.

(a)

$$\begin{cases} x + 3y - 2z = -1 \\ 5x - 2y + z = 0 \\ 7x - 13y = -13 \end{cases}$$ [7]

(b)

$$\begin{cases} x + 3y - 2z = -1 \\ 5x - 2y + z = 0 \\ 7x - 13y + 8z = 3 \end{cases}$$ [7]

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1 3 -2
5 -2 1
7 -13 8

(c) [7]

$$\begin{cases} 5t + x + 3y + 3z = 1 \\ 3t \quad\quad\quad + 4z = 2 \\ 7t \quad\quad\quad + \ z = 3 \\ t \quad\quad\quad\quad = 4 \end{cases}$$

Question 3 ..... Total Marks on Question 3 is: [8]

Using the Bisection method, find root of the following equation

$$f(x) = e^x - 3x = 0$$

in the interval $[0, 1]$ until the backward error falls under 5%. To calculate the backward error, you can use the following formula:

$$E_b = \left| \frac{newMidPoint - oldMidPoint}{newMidPoint} \right| \times 100\%$$