BMTE-144

ASSIGNMENT BOOKLET

NUMERICAL ANALYSIS

Valid from 1st January, 2025 to 31st Dec, 2025

School of Sciences
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New Delhi-110068
(2025)

Dear Student,

Please read the section on assignments in the Programme Guide for B.Sc. that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet, and it consists of three parts, Part A, Part B, Part C. The maximum marks of all the parts are 100, of which 35% are needed to pass it.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO.: ……

NAME: ……

ADDRESS: ……

……

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COURSE CODE: …….

COURSE TITLE: …….

ASSIGNMENT NO.: ……..…

STUDY CENTRE: ……..….. **DATE:** …….……...

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3) Leave 4 cm margin on the left, top and bottom of your answer sheet.

4) Your answers should be precise.

5) While solving problems, clearly indicate which part of which question is being solved.

6) This assignment is **valid from 1st Jan, 2025 to 31st Dec, 2025**. If you have failed in this assignment or fail to submit it by Dec, 2025, then you need to get the assignment for the year 2026, and submit it as per the instructions given in the Programme Guide.

7) **You cannot fill the examination form for this course** until you have submitted this assignment.

We strongly suggest that you retain a copy of your answer sheets.

We wish you good luck.

ASSIGNMENT

Course Code: BMTE-144
Assignment Code: BMTE-144/TMA/2025
Maximum Marks: 100

1. Which of the following statements are true and which are false? Give a short proof or a counter-example in support of your answer: (10)

   i) The equation $x^3 - 4x - 16 = 0$ has a root in the interval [3, 4].

   ii) The order of convergence of the secant method is 0.62.

   iii) For the system of linear equations:

$$\begin{aligned} 5x + y + 2z &= 34 \\ 4y - 3z &= 12 \\ 10x - 2y + z &= -4 \end{aligned}$$

   the matrix is diagonally dominant.

   iv) The numerical method:

$$y_{n+1} = \left(1 + \lambda h + \frac{\lambda^2 h^2}{2}\right) y_n, \lambda > 0, n \geq 0$$

   is relatively stable.

   v) The method:

$$x_{n+1} = \frac{x_n}{2} + \frac{9}{8x_n}$$

   converges to 1.5 for any choice of initial approximation.

2. a) Using Newton-Rapshson method, find an iterative formula to compute the reciprocal of a natural number N. (5)

   b) Calculate the nth divided difference of $\frac{1}{x}$, on the nodal points $x_0, x_1, ..., x_n$. (5)

3. a) Find the inverse of the matrix: (5)

$$A = \begin{bmatrix} 3 & 2 & 1 \\ 2 & 3 & 2 \\ 1 & 2 & 2 \end{bmatrix}$$

   using LU decomposition method with $u_{11} = u_{22} = u_{33} = 1$.

b) Use secant method to determine the root of the equation $\cos x - xe^x = 0$. Take the initial approximation as $x_0 = 0, x_1 = 1$ and perform two iterations of the method. (5)

4. a) Using the data sin (0.1) = 0.09983 and sin (0.2) = 0.19867, find an approximate value of sin (0.15) by Lagrange's interpolation. Also obtain a bound on the truncation error. (5)

b) Use the Euler's method to solve numerically the initial value problem: (5)

$$y' = -2xy^2,\ y(0) = 1$$

with $h = 0.2$ on the interval [0, 1].

5. a) Using Runge-Kutta fourth order method with $h = 0.1$, find an approximation value of y(0.1) for the initial value problem: (5)

$$y' = xy + y^2,\ \ y(0) = 1.$$

b) Evaluate the integral:

$$\int_{0.2}^{1.4} (\sin x - \log_e x + e^x)\, dx$$

using composite trapezoidal rule with $h = 0.2$, compare with the exact value. (5)

6. a) Given the data:

$$f(3) = 168,$$
$$f(7) = 120$$
and $$f(9) = 72$$

If $f(k)$ is estimated as 138 using the Newton's form of the interpolating polynomial, then find the value of k. (5)

b) Solve the system of equations:

$$x + 2y + z = 3$$
$$3x - 2y - 4z = -2$$
$$2x + 3y - z = -6$$

using Gauss-Elimination method. (5)

7. a) Using synthetic division method, check whether $\alpha = 3$ is a root of the polynomial equation: (4)

$$x^4 + x^3 - 13x^2 - x + 12 = 0$$

b) Find the first term of the series whose second and subsequent terms are $8, 3, 0, -1, 0$ using difference table. (6)

8. a) Estimate the eigen values of the matrix: (6)

$$A = \begin{bmatrix} 1 & 2 & -1 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$$

using the Gerschgorin bounds. Also, draw the rough sketch of the region in which the eigen values lie.

b) If (4)

$$f(x) = e^{\alpha x},$$

show that

$$\Delta^n f(x) = (e^{\alpha h} - 1)^n e^{\alpha x}$$

9. a) From the following data, calculate the population in the year 1985: (5)

Year	**Population (in '000)**
1971	12
1981	15
1991	20
2001	27
2011	49

b) Using the third order Taylor's series method, find the solution of the initial value problem: (5)

$$y' = x - y,\ y(0) = 1$$

at $x = 0.1$ taking $h = 0.1$.

10. a) How many terms n be chosen in Maclaurin's expansion for e^x with an error less than $10^{-5}, -1 \le x \le 1$? (5)

b) Find one root of the equation: (5)

$$x^3 - 2x - 5 = 0$$

in the interval $[2, 3]$ using Birge-Vieta method. Perform only one iteration.