

Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering - SEMESTER - III EXAMINATION - WINTER 2025

Subject Code: BE03026041

Date: 22-12-2025

Subject Name: Numerical Methods in Rubber Technology

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions

- 1. Attempt all questions.**
- 2. Make suitable assumptions wherever necessary.**
- 3. Figures to the right indicate full marks.**
- 4. Simple and non-programmable scientific calculators are allowed.**

	Marks
Q.1 (a) Define Round-off Error and Truncation Error in the context of numerical methods, and state one key difference between them.	03
(b) A numerical simulation for material modeling predicts a Material Property value of 50.5 units, while the true value is known to be 50.0 units. Calculate the Absolute Error and the Relative Error.	04
(c) Analyze the importance of Numerical Accuracy in the Process Simulation of a rubber molding operation, considering its impact on Component Design and Cost/Resource Optimization.	07
Q.2 (a) Find the percentage error if 625.483 is approximated to three significant figures.	03
(b) Round off the numbers 865250 and 37.46235 to four significant figures and compute Ea, Er, Ep in each case.	04
(c) Find the approximate value of the root of the following equation graphically. (i) $x^3 - 6x^2 + 9x - 3 = 0$	07

OR

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|---|-----------|
| (c) Find the approximate value of the root of the following equations graphically.
(i) $\tan x = 1.2 x$ | 07 |
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| Q.3 (a) Distinguish between Bracketing Methods and Open-end Methods based on their requirement for initial approximations and how they ensure the convergence to a root. | 03 |
| (b) Find the root of the equation $\cos x = xe^x$ using the bisection method correct to four decimal places. | 04 |
| (c) From the following table, estimate the number of students who obtained marks between 40 and 45: Newton's forward interpolation | 07 |

Marks	30-40	40-50	50-60	60-70	70-80
Number of Students	31	42	51	35	31

OR

- (a) List the two main categories of iterative methods and name two methods belonging to each category 03
- (b) Find the root of the following polynomial function using the bisection method: $x^3 - 4$ 04
- (c) Using Newton's forward formula, find the value of $f(1.6)$, if 07

x:	1	1.4	1.8	2.2
f(x) :	3.49	4.82	5.96	6.5

- Q.4** (a) State the primary difference between Interpolation with equal intervals and Interpolation with unequal intervals in terms of the data arrangement and name one specific method for each case. 03
- (b) Find the real root of equation $x^2 - 5x + 2 = 0$ by Newton Raphson's method. 04
- (c) Find a root of the equation $x^3 - 4x - 9 = 0$, using the bisection method correct to three decimal places. 07

OR

- (a) Distinguish between the applications of Newton's Forward Difference Formula and Newton's Backward Difference Formula when interpolating data in rubber technology. 03
- (b) Find the real root of equation $x^2 - 5x + 2 = 0$ by Secant method. 04
- (c) Find by Newton's method, the real root of the equation $3x = \cos x + 1$, correct to four decimal places. 07

- Q.5** (a) Differentiate between Explicit Methods and Implicit Methods for solving ODEs in terms of how the next time step solution is calculated. 03
- (b) Apply the Runge-Kutta fourth order method to find an approximate value of y when $x = 0.2$ given that $dy/dx = x + y$ and $y = 1$ when $x = 0$. 04
- (c) Using Euler's method, find an approximate value of y corresponding to $x = 1$, given that $dy/dx = x + y$ and $y = 1$ when $x = 0$. 07

OR

- (a) State two Python libraries that are commonly used for Plotting and Visualization of numerical results in engineering, such as the cooling curve of a rubber component. 03
- (b) State the fundamental difference between an Initial Value Problem (IVP) and a Boundary Value Problem (BVP) in the context of solving an Ordinary Differential Equation. 04
- (c) Apply the Runge-Kutta method to find the approximate value of y for $x = 0.2$, in steps of 0.1, if $dy/dx = x + y^2$, $y = 1$ where $x = 0$. 07
