Enrolment No/Seat No.: ____________________

R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT

(An Autonomous Institute U/s UGC Act 1956)

IMSc-IT SEMESTER-III, SEMESTER END EXAMINATION – WINTER 2025

SUBJECT CODE: 1BS301 **DATE: 16-12-2025**
SUBJECT NAME: NUMERICAL METHODS
TIME: 11:00 AM to 02:00 PM **TOTAL MARKS: 70**

Instructions

1. It is **compulsory** for students to write **Enrolment No. /Seat No.** on the question paper.
2. Write answers of **Section A** and **Section B** in **separate answer books**.
3. Attempt all questions from both **Section A** and **Section B**.
4. Each section carries **35 marks**, with a total of **70 marks** for the examination.
5. The figures to the right of each question indicate full marks, make suitable assumptions with justification.
6. BL - Cognitive Level (As per Revised Bloom's Taxonomy) (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

SECTION A

Marks **BL** **CO**

Q.1 **(a)** Perform three iteration of Gauss Jacobi method to solve the system of equations: **03** **A** **6**

$$10x + y + z = 6$$
$$x + 10y + z = 6$$
$$x + y + 10z = 6$$

(b) Solve the following system of equations, by the Gauss–Seidel method: **04** **A** **6**

$$5x + y - z = 10$$
$$2x + 4y + z = 14$$
$$x + 5y + 8z = 20$$

Q.2 **(a)** Certain corresponding values of x and $\log_{10} x$ are $(300, 2.4771)$, $(304, 2.4829)$, $(305, 2.4843)$ and $(307, 2.4871)$. Find. $\log_{10} 301$ **03** **A** **3**

(b) Find the value of $\tan\ 0.26$ by using Newton's backward interpolation formula for the following table: **04** **A** **3**

x	0.10	0.15	0.20	0.25	0.30
$y = \tan x$	0.1003	0.1511	0.2027	0.2553	0.3093

(c) By Lagrange's interpolation formula, find the value of y when $x = 10$ from the following table: **07** **A** **3**

x	5	6	9	11
y	12	13	14	16

OR

Q.2 **(a)** Construct the divided difference table with the arguments 2, 4, 9, 10 of the function $f(x) = x^3 - 2x$. **03** **A** **3**

(b) Find the cubic polynomial and find the value of $y(8)$ from the following data: **04** **A** **3**

x	1	3	5	7
y	24	120	336	720

(c) Find the Lagrange interpolating polynomial from the following data: **07** **A** **3**

x	0	1	4	5
y	1	3	24	39

Q.3 **(a)** Use Euler's method to solve $\frac{dy}{dx} = -y$ with $y(0) = 1$ at $x = 0.3$ **03** **A** **5**

(b) Given the differential equation $y' = 1 + xy$ with the initial condition $y(0) = 1$, Obtain the Taylor's series for $y(x)$ and compute $y(0.2)$ correct up to four decimal places. **04** **A** **5**

(c) Apply Runge-Kutta method of order two to calculate $y(0.1)$ and $y(0.2)$, given that $\frac{dy}{dx} = y - x$ with $y(0) = 2$ taking step size $h = 0.1$. **07** **A** **5**

OR

Q.3 **(a)** Using modified Euler's method, find $y(0.1)$ from the initial value problem $y' = xy$, $y(0) = 1$ by taking step size $h = 0.1$ **03** **A** **5**

(b) Solve $y'' - xy - y = 0$ with the condition $y(0) = 1$ and $y'(0) = 0$ using Taylor's series method. Also determine the value of $y(0.1)$. **04** **A** **5**

(c) Using Runge-Kutta method of forth order, solve $\frac{dy}{dx} = x + \sqrt{y}$ where $y(0) = 4$ at $x = 0.1$ taking step size $h = 0.1$. **07** **A** **5**

SECTION B

Marks BL CO

Q.4 (a) Apply least square method fit the best straight line to the data: **03 A 1**

x	1	2	3	4	5
y	2	3	5	7	8

(b) A company launched a marketing campaign and observed the number of logins over the next few days. Fit a curve of the form $y = ae^{bx}$: **04 A 1**

Day	1	2	3	4	5	6	7
Numbers of Login	200	300	440	600	810	1080	1450

Q.5 (a) Derive iteration formula for $\sqrt{N}$ and hence find $\sqrt{3}$ by Newton-Raphson method. **03 A 2**

(b) Find a real root of the equation $2x - \log_{10} x = 7$ by regula falsi method. **04 A 2**

(c) Find the positive root of $x^3 - 2x - 5$, correct up to two decimal places by bisection method. **07 A 2**

OR

Q.5 (a) Perform the three iterations of the bisection method to obtain a root of the equation $f(x) = x^3 - x - 1 = 0$. **03 A 2**

(b) Find a real root of the equation $x^4 - x^3 + 10x + 7 = 0$, correct up to three decimal places between –2 and –1 by the Newton–Raphson method. **04 A 2**

(c) Solve $xe^x - 1 = 0$ correct up to three decimal places between 0 and 1 by secant method. **07 A 2**

Q.6 (a) What is numerical differentiation? State the Newton's Forward Difference Formula for the first derivative$(\frac{dy}{dx})$ and second derivative$(\frac{d^2y}{dx^2})$. **03 R 4**

(b) The distances (x cm) traversed by a particle at different times (t seconds) are given below: **04 A 4**

x	0.0	0.1	0.2	0.3	0.4	0.5	0.6
y	3.01	3.16	3.29	3.36	3.40	3.38	3.31

Find the velocity and acceleration of the particle at $t = 0.3$ second.

(c) Evaluate **07 A 4**

$$\int_0^1 e^x \, dx$$

by using Trapezoidal rule and Simpson's $\frac{1}{3^{rd}}$ rule(take h=0.1)

OR

Q.6 (a) Write formula of the following: **03 R 4**

i) Trapezoidal rule

ii) Simpson’s 1/3 rule
iii) Simpson’s 3/8 rule

(b) In computer systems, the performance of a processor can be measured by its execution time (in seconds) for processing a given data size (in MB): **04** **A** **4**

Data size x (MB)	10	20	30	40	50
Execution Time t(s)	2.0	2.9	4.1	5.6	7.5

We want to find how fast the execution time is increasing with respect to the data size $i.e.$ the rate of change of execution time ($\frac{dt}{dx}$) at the beginning for $x = 10$ MB data.

(c) Evaluate **07** **A** **4**

$$\int_0^1 \frac{1}{1+x^2}dx$$

by using Trapezoidal rule and Simpson’s $\frac{3}{8}$ rule by taking $h = \frac{1}{6}$.

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