

R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT
(An Autonomous College U/s UGC Act 1956)

B.Tech. SEMESTER-II, SEMESTER END EXAMINATION – WINTER 2025

SUBJECT CODE: 1SH202

DATE: 06-01-2026

**SUBJECT NAME: NUMERICAL METHODS IN CHEMICAL
ENGINEERING**

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 - Bloom's Taxonomy Levels (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

SECTION A

Marks BL CO

Q.1 Multiple-Choice Questions

[05]

(a) Regression line of x on y is

1 R 1

(i) $x - \bar{x} = b_{yx} (y - \bar{y})$

(ii) $x - \bar{x} = b_{xy} (y + \bar{y})$

(iii) $x - \bar{x} = b_{xy} (y - \bar{y})$

(iv) $y - \bar{y} = b_{yx} (x - \bar{x})$

(b) Regula falsi method is also known as method of

1 R 1

(i) tangents

(ii) chords

(iii) false position method

(iv) None of there

(c) Which of the following is true about the Secant method?

1 R 5

(i) It requires the derivative of the function

(ii) It is not applicable to nonlinear equations.

(iii) It uses two initial approximations.

(iv) None of these

(d) A random variable X is said to follow binomial distribution if the probability of x is given by _____

1 R 5

(i) $p(x) = {}^n C_x p^x q^x$

(ii) $p(x) = {}^n C_x p^n q^{n-x}$

(iii) $p(x) = {}^n C_x p^x q^{n-x}$

(iv) $p(x) = {}^n C_x p^n q^n$

(e) In terms of coefficient of regression, coefficient of correlation is

1 R 5

(i) $r = \sqrt{b_{yx} / b_{xy}}$

(ii) $r = \sqrt{b_{yx} + b_{xy}}$

(iii) $r = \sqrt{b_{yx} b_{xy}}$

(iv) $r = \sqrt{b_{yx} - b_{xy}}$

Q.2 Attempt Any Two

[10]

(a) Find the negative root of $x^3 - 7x + 3$ by the bisection method up to three decimal places. 5 A 1

(b) Find the root between 0 and 1 of the equation $e^x \sin x = 1$, correct up to four decimal places using Newton-Raphson method. 5 A 1

(c) Solve $xe^x - 1 = 0$, correct up to three decimal places between 0 and 1. 5 A 1

Q.3 Attempt Any Two

[10]

(a) Fit a straight line to the following data. Also, estimate the value of y at $x=70$ 5 A 3

x	0	1	2	3	4
y	1	1.8	3.3	4.5	6.3

(b) Fit a second degree polynomial using least square method to the following data 5 A 3

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

(c) Fit a curve of the form $y=ab^x$ to the following data by the method of least squares 5 A 3

x	1	2	3	4	5	6	7
y	87	97	113	129	202	195	193

Q.4 Attempt Any Two

[10]

(a) If a Poisson distribution is such that $\frac{3}{2}P(X = 1) = P(X = 3)$, find 5 A 5

(i) $P(X \geq 1)$, (ii) $P(X \leq 3)$ and (iii) $P(2 \leq X \leq 5)$.

(b) Seven unbiased coins are tossed 128 times and the number of heads obtained is noted as given below 5 A 5

No. of heads	0	1	2	3	4	5	6	7
Frequency	7	6	19	35	30	23	7	1

Fit a binomial distribution to the data.

(c) A continuous random variable has probability density function 5 A 5

$$f(x) = \begin{cases} kxe^{-\lambda x} & x \geq 0, \lambda > 0 \\ 0 & \text{otherwise} \end{cases}$$

Determine (i)k, (ii)mean and (iii) variance

SECTION B

Marks BL CO

Q.5 Multiple-Choice Questions

[05]

- (a) Lagrange’s interpolation formula can be used _____.
- | | |
|---|--|
| <p>(i) only for equally spaced intervals</p> <p>(iii) for both equally and unequally spaced intervals</p> | <p>(ii) only for unequally spaced intervals</p> <p>(iv) for unequally spaced intervals</p> |
|---|--|
- (b) Which method can be used for both equal intervals?
- | | |
|---|---|
| <p>(i) Newton’s method</p> <p>(iii) Lagrange’s Method</p> | <p>(ii) Cubic spline method</p> <p>(iv) None of the above</p> |
|---|---|
- (c) Interpolation provides a mean for estimating functions_____.
- | | |
|--|--|
| <p>(i) at the beginning points</p> <p>(iii) at the ending points</p> | <p>(ii) at the intermediate points</p> <p>(iv) none of the above</p> |
|--|--|
- (d) _____ Method is commonly used to approximate solutions to ordinary differential equations by expanding the solution as a Taylor series.
- | | |
|---|--|
| <p>(i) Euler’s Method</p> <p>(iii) Taylor’s Series Method</p> | <p>(ii) Modified Euler’s Method</p> <p>(iv) Runge - Kutta Method</p> |
|---|--|
- (e) _____ Method is also known as the “improved” Euler method for solving ordinary differential equations.
- | | |
|---|--|
| <p>(i) Euler’s Method</p> <p>(iii) Taylor’s Series Method</p> | <p>(ii) Runge-Kutta Method</p> <p>(iv) Modified Euler’s Method</p> |
|---|--|

Q.6 Attempt Any Two

[10]

- (a) Using Newton’s forward interpolation formula, find the value of $f(1.3)$.

x	1	2	3	4
$f(x)$	1.1	4.2	9.3	16.4

- (b) Consider the following tabular values:

x	50	100	150	200	250
y	618	724	805	906	1032

Determine $y(300)$ using an appropriate Newton’s interpolation formula

- (c) Using Lagrange's interpolation formula, find the value of $f(2)$ 5 A 2

x	-1	0	1	3
y	2	1	0	-1

Q.7 Attempt Any Two [10]

- (a) Calculate $\int_0^1 2e^x dx$ with $n=10$ using trapezoidal rule. 5 A 4

- (b) A river is 80 metres wide. The depth ' d ' in metres at a distance x metres from one bank is given by the following table. Calculate the area of cross section of the river using Simpson's 1/3 rule. 5 A 4

x	0	10	20	30	40	50	60	70	80
y	0	4	7	9	12	15	14	8	7

- (c) Evaluate $\int_0^3 \frac{dx}{1+x}$ with $n = 6$ by using Simpson's 3/8 rule. 5 A 4

Q.8 Attempt Any Two [10]

- (a) Using the Taylor's series method, find correct up to four decimal places, the value of $y(0.1)$, given $\frac{dy}{dx} = x^2 + y^2$ and $y(0)=1$. 5 A 4

- (b) Given $\frac{dy}{dx} = \frac{y-x}{y+x}$ with the initial condition $y=1$ at $x=0$. Find y at $x=0.1$ in five steps by using Euler's method 5 A 4

- (c) Use the second-order Runge-Kutta method to find an approximate value of y given that $\frac{dy}{dx} = 3x + y$ and $y(1) = 1.3$ at $x=1.1$ taking $h=0.1$. 5 A 4
