Enrolment No/Seat No.: _____

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

(An Autonomous College U/s UGC Act 1956)

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

Subject Code: 1SH201 **Date: 17-05-2025**

Subject Name: NUMERICAL METHODS IN CHEMCIAL ENGINEERING

Time: 11:00 PM 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)	Which relation between the operators is correct?	**1**	**R**	**1**
	(i) (1/E)–1=∇ **(ii)** 1+E=Δ			
	(iii) E–1=Δ **(iv)** 1+(1/E)=∇			
(b)	Which method can be used for both equal and unequal intervals?	**1**	**R**	**1**
	(i) Lagrange's Method **(ii)** Divided difference method			
	(iii) Both (i) & (ii) **(iv)** None of there			
(c)	Regression line of *x* on *y* is	**1**	**R**	**5**
	(i) $x-\bar{x}=b_{yx}\left(y-\bar{y}\right)$ **(ii)** $x-\bar{x}=b_{xy}\left(y+\bar{y}\right)$			
	(iii) $x-\bar{x}=b_{xy}\left(y-\bar{y}\right)$ **(iv)** $y-\bar{y}=b_{yx}\left(x-\bar{x}\right)$			
(d)	A random variable *X* is said to follow Poisson distribution if the probability of *x* is given by_____	**1**	**R**	**5**
	(i) $p(x)=\frac{e^{-\lambda}x^{\lambda}}{x!}$ **(ii)** $p(x)=\frac{e^{-x}\lambda^{x}}{x!}$			
	(iii) $p(x)=\frac{e^{-\lambda}\lambda^{x}}{x!}$ **(iv)** $p(x)=\frac{e^{-\lambda}\lambda^{x}}{\lambda!}$			

(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	71	68	73	69	67	65	66	67
y	69	72	70	70	68	67	68	64

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

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

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

(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) If a Poisson distribution is such that $\frac{3}{2}P(X=1) = P(X=3)$, find *(i)* $P(X \geq 1)$, *(ii)* $P(X \leq 3)$ and *(iii)* $P(2 \leq X \leq 5)$. **5** **A** **5**

SECTION B

		Marks	BL	CO
Q.5	**Multiple-Choice Questions**	**[05]**		
(a)	Interpolation provides a mean for estimating functions	**1**	**1**	**2**
	(i) At the beginning points **(ii)** At the ending points			
	(iii) At the intermediate points **(iv)** None of the mentioned			
(b)	$\nabla \log x =$ _____	**1**	**1**	**2**
	(i) $\log \frac{x}{x-h}$ **(ii)** $\log \frac{x-h}{x}$			
	(iii) $\log \frac{x}{x+h}$ **(iv)** $\log(x-h)$			
(c)	What is the order of the Euler's method for solving ODEs?	**1**	**1**	**4**
	(i) 0 **(ii)** 1			
	(iii) 2 **(iv)** 3			
(d)	What method is commonly used to approximate solutions to ordinary differential equations by expanding the solution as a Taylor series?	**1**	**1**	**4**
	(i) Euler's Method **(ii)** Modified Euler's Method			
	(iii) Taylor's Series Method **(iv)** Runge-Kutta Method			
(e)	Which method is also known as the "improved" Euler method for solving ordinary differential equations?	**1**	**1**	**4**
	(i) Euler's Method **(ii)** Modified Euler's Method			
	(iii) Taylor's Series Method **(iv)** Runge-Kutta Method			
Q.6	**Attempt Any Two**	**[10]**		
(a)	By using Newton's forward difference interpolation formula, find a polynomial of degree 2 which takes the following values:	**5**	**3**	**2**

x	0	1	2	3	4	5	6	7
y	1	2	4	7	11	16	22	29

(b)	Consider the following tabular values:	**5**	**3**	**2**

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

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

(c)	Evaluate $f(4)$ by using Lagrange's interpolation method from the following data:	**5**	**3**	**2**

x	2	3	5	7
$f(x)$	0.1506	0.3001	0.4517	0.6259

Q.7 Attempt Any Two **[10]**

(a) Compute $f(9)$ from the following values using Newton's divided difference formula: **5 3 2**

x	5	7	11	13	17
$f(x)$	150	392	1452	2366	5202

(b) Evaluate $\int_0^1 e^{-x^2} dx$ with *n=10* using trapezoidal rule **5 3 4**

(c) Evaluate $\int_0^1 \frac{dx}{1+x^2} dx$ taking $h = \frac{1}{6}$ using Simpson's 3/8 rule **5 3 4**

Q.8 Attempt Any Two **[10]**

(a) Solve $\frac{dy}{dx} = 2y + 3e^x$ with initial conditions $x_0 = 0, y_0 = 1$ by Taylor's series method. Find approximate value of *y* for *x=0.1* **5 3 4**

(b) Using Euler's method, find y(0.2) given $\frac{dy}{dx} = y - \frac{2x}{y}$, $y(0) = 1$ with *h=0.1*. **5 3 4**

(c) Using fourth order Runge-Kutta method, find *y* at *x=0.1* for differential equation $\frac{dy}{dx} = 3e^x + 2y, y(0) = 0$ by taking *h=0.1* **5 3 4**

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