Enrolment No/Seat No.: ____________________

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

(An Autonomous College U/s UGC Act 1956)

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

SUBJECT CODE: 1SH101 **DATE: 15-12-2025**

SUBJECT NAME: ENGINEERING MATHEMATICS

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) If $z = x^2 - y^2$, then $\frac{\partial z}{\partial x} =$______.	**1**	**A**	**2**
	(i) *2y* **(ii)**0 ***(iii)****2x* ***(iv)*** *2z*			
	(b) If $x^3 + y^3 + 3xy = 0$ is an implicit function, then $\frac{dy}{dx} =$_____ .	**1**	**R**	**2**
	(i) $\frac{x^2 - y}{y^2 - x}$ **(ii)** $\frac{x^2 + y}{y - x}$ **(iii)** $-\frac{x^2 + y}{y^2 + x}$ **(iv)** $-\frac{x^2 - y}{y^2 - x}$			
	(c) If $L\{f(t)\} = \bar{f}(s)$, then $L\{e^{-at} f(t)\}$ is______.	**1**	**A**	**4**
	(i) $\bar{f}(s-a)$ **(ii)** $\bar{f}(s+a)$ **(iii)** $\frac{\bar{f}(s-a)}{a}$ **(iv)** $\frac{\bar{f}(s+a)}{a}$			
	(d) $L^{-1}\left\{\frac{1}{(s^2 + a^2)}\right\} =$_____ .	**1**	**A**	**4**

(i) $\frac{\sin at}{a}$ (ii) $\frac{\sinh at}{a}$

(iii) $\cosh at$ (iv) $\cos at$

(e) Which of the following is an odd function? **1** **R** **5**

(i) $\cos x$ (ii) e^{x}

(iii) $\sin x$ (iv) $\pi^{2}-x^{3}$

Q.2 Attempt Any Two **[10]**

(a) Find the equations of the tangent plane and normal lines to the surface $x^2 + y^2 + z^2 = 3$ at the point $(1,1,1)$. **5** **A** **2**

(b) If $u = f(x^2-y^2, y^2-z^2, z^2-x^2)$, then show that $\frac{1}{x}\frac{\partial u}{\partial x}+\frac{1}{y}\frac{\partial u}{\partial y}+\frac{1}{z}\frac{\partial u}{\partial z}=0$. **5** **A** **2**

(c) Find the extreme values of $3x^2 - y^2 + x^3$. **5** **A** **2**

Q.3 Attempt Any Two **[10]**

(a) Find the inverse Laplace transform of $\frac{s+7}{s^2+8s+25}$. **5** **A** **4**

(b) Find the Laplace transform of $t\cos^2 t)$. **5** **A** **4**

(c) Solve the initial value problem Solve $y''+4y'+8y=1,\ y(0)=0,\ y'(0)=1$, using Laplace transform. **5** **A** **4**

Q.4 Attempt Any Two **[10]**

(a) Find the half-range cosine series of $f(x)=e^{-x}$ in the interval $(0,\pi)$. **5** **A** **5**

(b) Find the Fourier series of $f(x)=x$ in the interval $(-\pi,\pi)$. **5** **A** **5**

(c) Find the Fourier cosine integral of $f(x)=\frac{\pi}{2}e^{-x}$, where $x \geq 0$. **5** **A** **5**

SECTION B

		Marks	BL	CO
Q.5	**Multiple-Choice Questions**	**[05]**		
	(a) The rank of a matrix $A = \begin{bmatrix} 1 & 1 \\ 0 & 2 \end{bmatrix}$ is ______ . **(i)** 0 **(ii)** 1 **(iii)** 2 **(iv)** none of these	**1**	**U**	**1**
	(b) The eigen value of the matrix is $\begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 4 & 1 \end{bmatrix}$ is _____ . **(i)** 1,1,1 **(ii)** 1,2,1 **(iii)** 1,2,2 **(iv)** 1,2,3	**1**	**U**	**1**
	(c) The order and degree of $\frac{d^2y}{dx^2} - \left(\frac{dy}{dx}\right)^2 + 1 = 0$ is ______. **(i)** 2,2 **(ii)** 2,1 **(iii)** 1,2 **(iv)** 2,3	**1**	**U**	**3**
	(d) The equation $M(x,y)dx + N(x,y)dy = 0$ is exact if ______. **(i)** $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$ **(ii)** $\frac{\partial M}{\partial x} = -\frac{\partial N}{\partial y}$ **(iii)** $\frac{\partial M}{\partial y} = -\frac{\partial N}{\partial x}$ **(iv)** $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$	**1**	**R**	**3**
	(e) The Wronskian of $y_1 = \cos x, y_2 = \sin x$ is ______. **(i)** -1 **(ii)** 1 **(iii)** 2 **(iv)** 0	**1**	**U**	**3**
Q.6	**Attempt Any Two**	**[10]**		
	(a) Reduce the matrix into row echelon form $\begin{bmatrix} 1 & 2 & 3 & -1 \\ -2 & -1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$ and hence it's rank.	**5**	**A**	**1**

	(b) Solve the following system of equations by Gauss Jordan method : $$\begin{aligned} 3x+6y-3z&=-2\\ 6x+6y+3z&=5\\ -2y+3z&=1 \end{aligned}$$	**5**	**A**	**1**
	(c) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$.	**5**	**A**	**1**
Q.7	**Attempt Any Two**	**[10]**		
	(a) Form the differential equation by eliminating arbitrary constants from $y = a\cos x + b\sin x$.	**5**	**A**	**3**
	(b) Solve $(\cos x - xcoxy)dy - (\sin y + y\sin x)dx = 0$.	**5**	**A**	**3**
	(c) Solve $\frac{dy}{dx} + y = x$.	**5**	**A**	**3**
Q.8	**Attempt Any Two**	**[10]**		
	(a) Solve $(D^4 - 2D^3 + D^2)y = 0$.	**5**	**A**	**3**
	(b) Using the method of variation of parameters solve $y'' + 9y = \sec 3x$.	**5**	**A**	**3**
	(c) Using the method of undetermined coefficients, solve the equations $y'' - 5y' + 6y = 3e^{-2x}$.	**5**	**A**	**3**

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