Enrolment No/Seat No.: _____

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

(An Autonomous Institute U/s UGC Act 1956)

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

SUBJECT CODE: 2SH101 **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 - 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)**	Solve $\frac{dy}{dx}+2y\tan x=\sin x$.	**03**	**A**	**3**
	(b)	Solve $(x^2+y^2+3)\,dx-2xy\,dy=0$.	**04**	**A**	**3**
Q.2	**(a)**	Find the equations of tangent plane and normal lines at the point $(1,-1,2)$ on the surface $2xz^2-3xy-4x=7$.	**03**	**A**	**2**
	(b)	If $u=\cos^{-1}\left(\frac{x^3+y^3}{x+y}\right)$, prove that (i) $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=-2\cot u$, (ii) $x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}=2\cot u\,(1-2\cos ec^2 u)$.	**04**	**A**	**2**
	(c)	Find a point on the plane $2x+3y-z=5$ which is nearest to the origin.	**07**	**A**	**2**
		OR			
Q.2	**(a)**	If $z=x+y^x$, prove that $\frac{\partial^2 z}{\partial x\partial y}=\frac{\partial^2 z}{\partial y\partial x}$.	**03**	**A**	**2**
	(b)	If $u=f(x-y,y-z,z-x)$, prove that $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}=0$.	**04**	**A**	**2**

	(c)	Find all the stationary points of the function $f(x,y)=x^3+3xy^2-15x^2-15y^2+72x$ after examining whether the function is maximum or minimum at those points.	**07**	**A**	**2**
Q.3	**(a)**	Find the Laplace transform of $\sin^3 2t$.	**03**	**A**	**5**
	(b)	Find $L\left\{\int_0^t e^t.\frac{\sin t}{t}\,dt\right\}$.	**04**	**A**	**5**
	(c)	Use Laplace transform method to solve $y''+6y'=1.\ y(0)=2, y'(0)=0.$	**07**	**A**	**5**

OR

Q.3	**(a)**	Find the Laplace transform of $e^{-3t}\cosh 4t.\sin 3t$.	**03**	**A**	**5**
	(b)	Find the inverse Laplace transform of $\frac{s}{(s^2+1)(s^2+4)}$.	**04**	**A**	**5**
	(c)	Use Laplace transform to solve $\frac{dy}{dt}+y=\cos 2t,\ y(0)=1.$	**07**	**A**	**5**

SECTION B

			Marks	BL	CO
Q.4	**(a)**	Find the Fourier cosine integral of $f(x)=e^{-kx}$, where $x>0, k>0$.	**03**	**A**	**6**
	(b)	Find the Fourier series of $f(x)=x^2$ in the interval $(-\pi,\pi)$. Hence deduce that $\frac{\pi^2}{12}=\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-...$	**04**	**A**	**6**
Q.5	**(a)**	Find the rank of the matrix $\begin{bmatrix}1 & 4 & 3 & -1\\ 2 & 0 & 3 & 1\\ 4 & 8 & 9 & -1\end{bmatrix}$.	**03**	**A**	**1**
	(b)	Find the inverse of the matrix $\begin{bmatrix}1 & 2 & 3\\ 2 & 5 & 3\\ 1 & 0 & 8\end{bmatrix}$ by Gauss Jordan method	**04**	**A**	**1**
	(c)	Investigate for what values of λ and μ the equations $x+2y+z=8$ $2x+2y+2z=13$ $3x+4y+\lambda z=\mu$ have (i) no solution (ii) a unique solution, and (iii) many solutions.	**07**	**A**	**1**
		OR			
Q.5	**(a)**	Find the rank of the matrix $\begin{bmatrix}0 & 6 & 7\\ -5 & 4 & 2\\ 1 & -2 & 0\end{bmatrix}$ by using reduced row echelon form.	**03**	**A**	**1**
	(b)	Solve the following system of equations by Gauss Jordan method $-2y+3z=1$ $3x+6y-3z=-2$ $6x+6y+3z=5$	**04**	**A**	**1**
	(c)	Find the eigen values and eigen vectors of the matrix $\begin{bmatrix}1 & 2 & 2\\ 0 & 2 & 1\\ -1 & 2 & 2\end{bmatrix}$.	**07**	**A**	**1**
Q.6	**(a)**	Solve $\left(D^3+1\right)y=0$.	**03**	**A**	**4**

	(b)	Solve $\left(D^2-4D+4\right)y=e^{2x}+\cos 2x$.	**04**	**A**	**4**
	(c)	Using variation of parameters, solve the following equations $\frac{d^2y}{dx^2}+9y=\tan 3x$.	**07**	**A**	**4**
		OR			
Q.6	**(a)**	Find the particular integral for $\left(D^2-1\right)y=xe^x$.	**03**	**A**	**4**
	(b)	Solve $y''-3y'+2y=e^x$ by the method of variation of parameters.	**04**	**A**	**4**
	(c)	Using the method of undetermined coefficients, solve the following equations $y''-2y'+5y=25x^2+12$.	**07**	**A**	**4**

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