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: 2SH103 **DATE: 15-12-2025**

SUBJECT NAME: CALCULUS

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 $\frac{dy}{dx}+y\sin x=e^{\cos x}$.	**03**	**A**	**3**
	(b)	Solve $y\left(xy+2x^2y^2\right)dx+x\left(xy-x^2y^2\right)dy=0$.	**04**	**A**	**3**
Q.2	**(a)**	Find $\frac{dy}{dx}$ if $x^3+y^3=3axy$.	**03**	**A**	**2**
	(b)	Find the equation of tangent plane and the normal line to the surface $2x^2+y^2+2z=3$ at the point $(2,1,-3)$.	**04**	**A**	**2**
	(c)	Find the extreme values of the function $x^3+y^3-63(x+y)+12xy$.	**07**	**A**	**2**
		OR			
Q.2	**(a)**	If $u=x^3y+e^{xy^2}$ then prove that $\frac{\partial^2u}{\partial x\partial y}=\frac{\partial^2u}{\partial y\partial x}$.	**03**	**A**	**2**
	(b)	If $u=\sin^{-1}\left(\frac{x^{1/4}+y^{1/4}}{x^{1/5}+y^{1/5}}\right)$, prove that $x^2\frac{\partial^2u}{\partial x^2}+2xy\frac{\partial^2u}{\partial x\partial y}+y^2\frac{\partial^2u}{\partial y^2}=\frac{1}{144}\tan u[\tan^2u-19]$.	**04**	**A**	**2**
	(c)	Find a point on the plane $2x+3y-z=5$ which is nearest to the origin.	**07**	**A**	**2**

Q.3	**(a)**	Form a partial differential equation from $z=(x-2)^2+(y-3)^2$.	**03**	**A**	**5**
	(b)	Solve $yp=2yx+\log q$.	**04**	**A**	**5**
	(c)	Solve $(z-y)p+(x-z)q=y-x$.	**07**	**A**	**5**

OR

Q.3	**(a)**	Solve $p+q^2=1$.	**03**	**A**	**5**
	(b)	Form a partial differential equation by eliminating ϕ from $\phi(xy+z^2, x+y+z)$.	**04**	**A**	**5**
	(c)	Solve $x^2p+y^2q=(x+y)z$.	**07**	**A**	**5**

SECTION B

			Marks	BL	CO
Q.4	**(a)**	Find directional derivative of $\phi = xy^2 + yz^2$ at the point (2,-1,1) in the direction of the vector $\hat{i} + 2\hat{j} + 2\hat{k}$.	**03**	**A**	**6**
	(b)	Prove that the vector $\bar{F} = (3x + 2y + 4z)\hat{i} + (2x + 5y + 4z)\hat{j} + (4x + 4y - 8z)\hat{k}$ is both solenoidal and irrotational.	**04**	**A**	**6**
Q.5	**(a)**	Find Eigen values of the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$.	**03**	**A**	**1**
	(b)	Find rank of the matrix $\begin{bmatrix} 3 & -2 & 0 & -1 \\ 0 & 2 & 2 & 1 \\ 1 & -2 & -3 & 2 \\ 0 & 1 & 2 & 1 \end{bmatrix}$.	**04**	**A**	**1**
	(c)	Solve the following system of equations by Gauss elimination method $\begin{aligned} 3x + y - 4z &= 13 \\ 2x - 3y + 7z &= 5 \\ 2x + 19y - 47z &= 32 \end{aligned}$.	**07**	**A**	**1**
		OR			
Q.5	**(a)**	Reduce the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 6 & 8 \\ 3 & 4 & 5 \end{bmatrix}$ in row echelon form.	**03**	**A**	**1**
	(b)	Solve the following system of equations by Gauss Jordan method $\begin{aligned} x + y + z &= 6 \\ x + 2y + 3z &= 14 \\ 2x + 4y + 7z &= 30 \end{aligned}$.	**04**	**A**	**1**
	(c)	Find eigen values and eigen vectors of the following matrix $\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$.	**07**	**A**	**1**

Q.6	**(a)**	Solve $\left(D^2+9\right)y=\cos 4x$.	**03**	**A**	**4**
	(b)	Solve $y'''-3y''+3y'-y=4e^t$.	**04**	**A**	**4**
	(c)	Using variation of parameters, solve the following equations $y''+a^2y=\tan ax$.	**07**	**A**	**4**

OR

Q.6	**(a)**	Solve $\left(D^4-1\right)y=0$.	**03**	**A**	**4**
	(b)	Solve $\left(D^2+2D+3\right)y=2x^2$.	**04**	**A**	**4**
	(c)	Using method of undetermined coefficients, solve the following equations $y''+4y=8x^2$.	**07**	**A**	**4**

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