Reg. No. | | | | | | | | |

G. VENKATASWAMY NAIDU COLLEGE (AUTONOMOUS), KOVILPATTI – 628 502.

UG DEGREE END SEMESTER EXAMINATIONS - APRIL 2025.
(For those admitted in June 2023 and later)

PROGRAMME AND BRANCH: B.Sc., MATHEMATICS

SEM	CATEGORY	COMPONENT	COURSE CODE	COURSE TITLE
I	PART - III	CORE - 2	U23MA102	DIFFERENTIAL CALCULUS

Date & Session:26.04.2025/AN **Time : 3 hours** **Maximum: 75 Marks**

Course Outcome	Bloom's K-level	Q. No.	**SECTION – A (10 X 1 = 10 Marks)** Answer ALL Questions.
CO1	K1	1.	Choose the nth derivative of $y = (ax + b)^n$ with respect to x. a) n! a^n b) n a^n c) n! a d) (n – 1)! a
CO1	K2	2.	If $y = e^{-x} \cos 2$, write the value of $\frac{d^4y}{dx^4}$ a) - 4y b) 4y c) 0 d) 4
CO2	K1	3.	If $u = \frac{xy}{x+y}$, what is the value of $\frac{\partial u}{\partial x}$? a) $\frac{y}{x+y}$ b) $\frac{y^2}{x+y}$ c) $\frac{y^2}{(x+y)^2}$ d) $\frac{x^2}{(x+y)^2}$
CO2	K2	4.	Select the total differential of u from the following: a) $\partial u = \frac{\partial u}{\partial x} dx + \frac{\partial u}{\partial z} dz$ b) $du = \frac{\partial u}{\partial x} dx + \frac{\partial u}{\partial y} dy$ c) $\partial u = \frac{\partial u}{\partial x} dx - \frac{\partial u}{\partial z} dz$ d) $du = \frac{\partial u}{\partial x} dx - \frac{\partial u}{\partial y} dy$
CO3	K1	5.	Which one of the following homogeneous function have degree 2? a) $u = x^3 + y^3 + 3xyz$ b) $u = tan^{-1}\left(\frac{x^3+y^3}{x-y}\right)$ c) $u = sin^{-1}\left(\frac{x^2+y^2}{x+y}\right)$ d) $u = sin^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$
CO3	K2	6.	Estimate the condition for the saddle points. a) $rt – s^2 > 0$ b) $rt – s^2 = 0$ c) $rt – s^2 < 0$ d) $rt – s^2 \neq 0$
CO4	K1	7.	What is the envelope of the family of curves $y = mx + \frac{a}{m}$ (m is a parameter)? a) y = 4x b) yx = a c) x = y d) y^2 = 4 a x
CO4	K2	8.	Estimate the envelope for $(x - a)^2 + y^2 = 2a$. a) $y^2 = 2x - 1$ b) $y^2 = 2x + 1$ c) $y^2 = 2x^2 - 1$ d) $y^2 = 2x^2 + 1$
CO5	K1	9.	Discover the radius of curvature for the curve $y = e^x$ at the point where it crosses the y-axis. a) $2\sqrt{2}$ b) $\sqrt{2}$ c) 2 d) 1
CO5	K2	10.	Trace the radius of curvature of the curve $r = a \sin n\theta$. a) $\frac{a}{2}$ b) na c) 2 d) $\frac{na}{2}$

Course Outcome	Bloom's K-level	Q. No.	**SECTION – B (5 X 5 = 25 Marks)** Answer ALL Questions choosing either (a) or (b)
CO1	K3	11a.	Find the nth differential coefficient of y = $\frac{x^2}{(x-1)^2(x+2)}$ **(OR)**
CO1	K3	11b.	Determine if y = sin (m sin $^{-1}$ x), then $(1-x^2) y_2 - xy_1 + m^2y = 0$.

CO2	K3	12a.	Compute the value of $u = \frac{xy}{x+y}$ as $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = u$ **(OR)**
CO2	K3	12b.	Construct $\frac{dy}{dx}$ for $x^3 + y^3 + 3axy$.
CO3	K4	13a.	Analyse Euler's Theorem when $u = x^3 + y^3 + z^3 + 3xyz$. **(OR)**
CO3	K4	13b.	If $z = f(x,y)$ and $x = r\cos\theta$, $y = r\sin\theta$, conclude that $\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2}\left(\frac{\partial z}{\partial \theta}\right)^2$
CO4	K4	14a.	Discover the envelope of the family of a straight line $y + tx = 2at + at^3$, where 't' is the parameter. **(OR)**
CO4	K4	14b.	Discover the envelope of the family of curves $(x - a)^2 + (y - a)^2 = 4a$, where 'a' is the parameter.
CO5	K5	15a.	Evaluate the radius of curvature of the curve $x^4 + y^4 = 2$ at the point (1, 1). **(OR)**
CO5	K5	15b.	Evaluate ρ for the curve $x = a(\cos t + \sin t)$, $y = a(\cos t - \sin t)$.

Course Outcome	Bloom's K-level	Q. No.	**SECTION – C (5 X 8 = 40 Marks)** **Answer ALL Questions choosing either (a) or (b)**
CO1	K3	16a.	Find the nth differential coefficient of $\cos^5\theta \sin^7\theta$. **(OR)**
CO1	K3	16b.	Make use of Leibnitz's theorem, for y = sin (m $\sin^{-1}$ x) and estimate the n^{th} derivative for y as $(1-x^2)\, y_{n+2} - (2n+1)\, xy_{n+1} + (m^2 - n^2)\, y_n = 0$.
CO2	K4	17a.	Analyse the value of $u = \tan^{-1}\frac{x^3+y^3}{x-y}$ and discover $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \sin 2u$ **(OR)**
CO2	K4	17b.	Differentiate $u = x^2 + y^2 + z^2$, where $x = e^t, y = e^t \sin t$ and $z = e^t \cos t$.
CO3	K4	18a.	Illustrate the maxima and minima of the function $x^3y^2(6 - x - y)$ **(OR)**
CO3	K4	18b.	A tent having the form of a cylinder surmounted by a cone is to contain a given volume. If the canvass required is minimum, examine the altitude of the cone is twice that of the cylinder.
CO4	K5	19a.	Evaluate the envelope of the circles drawn on the radius vectors of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ as diameter. **(OR)**
CO4	K5	19b.	Deduct the envelope of the straight lines $\frac{x}{a} + \frac{y}{b} = 1$, where the parameters are related by the equation $a^2 + b^2 = c^2$, *where 'c' is a constant*.
CO5	K5	20a.	Predict the radius of curvature as $4a\cos\frac{\theta}{2}$ at any point of the cycloid $x = a(\theta + \sin\theta)$ and $y = a(1 - \cos\theta)$. **(OR)**
CO5	K5	20b.	Prove that the radius of curvature of the curve $r^n = a^n \cos n\theta$ is $\frac{a^n r^{1-n}}{n+1}$.