

CBCS SCHEME

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1BMATC101

First Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026 Differential Calculus and Linear Algebra : CV Stream

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks, L: Bloom's level, C: Course outcomes.
3. VTU Handbook is permitted.

Module – 1				M	L	C
Q.1	a.	With usual notations, prove that $\tan \phi = r \frac{d\theta}{dr}$.		6	L2	CO1
	b.	Find the angle of intersection of the curves $r^2 \sin 2\theta = 4$ and $r^2 = 16 \sin 2\theta$		7	L2	CO1
	c.	Show that for the curve $r(1 - \cos \theta) = 2a$, ρ^2 varies as r^3 .		7	L2	CO1
OR						
Q.2	a.	With usual notations, prove that $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4} \left(\frac{dr}{d\theta} \right)^2$.		6	L2	CO1
	b.	Find the pedal equation of the polar curve $r^m = a^m (\cos m\theta + \sin m\theta)$		7	L2	CO1
	c.	Show that the radius of curvature at (a,0) on the curve $y^2 = \frac{4a^2(2a-x)}{x}$ is 'a'.		7	L2	CO1
Module – 2						
Q.3	a.	Expand $\log(\sec x + \tan x)$ in powers of x as far as the term in x^5 .		6	L2	CO1
	b.	If $u = f\left\{\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right\}$ then show that $\sum x \frac{\partial u}{\partial x} = 0$		7	L2	CO1
	c.	If $u = \frac{yz}{x}$, $v = \frac{xz}{y}$, $w = \frac{xy}{z}$, show that $\frac{(u,v,w)}{(x,y,z)} = 4$.		7	L2	CO1
OR						
Q.4	a.	Evaluate i) $\lim_{x \rightarrow 0} \left[\frac{a^x + b^x + c^x}{3} \right]^{\frac{1}{x}}$ ii) $\lim_{x \rightarrow 0} \left[\frac{\sin x}{x} \right]^{\frac{1}{x^2}}$		6	L2	CO1
	b.	If $u = f(y-z, z-x, x-y)$ then show that $\sum \frac{\partial u}{\partial x} = 0$		7	L2	CO1
	c.	Find the extreme value of the function $f = x^4 + y^4 - 2(x - y)^2$		7	L2	CO1
Module – 3						
Q.5	a.	Solve $\frac{dy}{dx} + \frac{y \cos x + \sin y + y}{\sin x + x \cos y + x} = 0$		6	L2	CO1
	b.	$[4xy + 3y^2 - x]dx + x(x + 2y)dy = 0$		7	L2	CO1
	c.	A bacterial culture growing exponentially increases from 100 to 400 grams in 10 hours. How much was present after 1 hour		7	L3	CO1

OR					
Q.6	a.	Solve $xy(1+xy^2)\frac{dy}{dx} = 1$	6	L2	CO1
	b.	Find the Orthogonal trajectories of the family of curve $r = a(1 + \sin\theta)$	7	L2	CO1
	c.	In a certain chemical reaction the rate of conversion of a substance at time 't' is proportional to the quantity of the substance still untransformed at that instant. At end of 1hour 60grams remains and at the end of 4hours 21grams.how many grams of the first substance was there initially	7	L3	CO1
Module – 4					
Q.7	a.	Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 25y = e^{2x} + \sin x + x$	6	L2	CO1
	b.	Solve by variation of parameter method $\frac{d^2y}{dx^2} + 4y = \tan 2x$	7	L2	CO1
	c.	Solve $(x+1)^2 \frac{d^2y}{dx^2} + (x+1) \frac{dy}{dx} + y = 2\sin\{\log(1+x)\}$	7	L2	CO1
OR					
Q.8	a.	Solve $\frac{d^3y}{dx^3} - 2\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 8y = 0$	6	L2	CO1
	b.	Solve $x^2 \frac{d^2y}{dx^2} - 4x \frac{dy}{dx} + 6y = x$	7	L2	CO1
	c.	Solve by variation of parameter method $\frac{d^2y}{dx^2} + y = \sec x$	7	L2	CO1
Module – 5					
Q.9	a.	Find the rank of the matrix $\begin{bmatrix} 4 & 0 & 2 & 1 \\ 2 & 1 & 3 & 4 \\ 2 & 3 & 4 & 7 \\ 2 & 3 & 1 & 4 \end{bmatrix}$	6	L2	CO2
	b.	Solve the following system of equation by Gauss elimination method $x - 2y + 3z = 2$, $3x - y + 4z = 4$, $2x + y - 2z = 10$.	7	L3	CO2
	c.	Find the Eigen values and Eigen vectors of the following matrix by using Rayleigh's power method. $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$	7	L2	CO2
OR					
Q.10	a.	Investigate the values of λ and μ such that $2x + y + 4z = 12$, $x + 2y + 3z = 10$, $x + 2y + \lambda z = \mu$. (i) Unique Solution (ii) Infinite Solution (iii) No Solution	6	L3	CO2
	b.	Solve by Gauss-seidel iteration method: $83x + 11y - 4z = 9$, $3x + 8y + 29z = 71$, $7x + 52y + 13z = 104$	7	L3	CO2
	c.	Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} -19 & 7 \\ -42 & 16 \end{bmatrix}$	7	L2	CO2
