

**VIT**

Vellore Institute of Technology

SCHOOL OF ADVANCED SCIENCES
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2025-2026

REG.NO.:

SLOT: B2+TB2

Programme Name & Branch : B.Tech & All the Branches
 Course Code and Course Name: BAMAT101,

Multivariable Calculus and Differential Equations

Class Number(s) : Common to B2 slot

Date of Examination : 06-10-2025

Exam Duration : 90 minutes

Maximum Marks: 50

General instruction(s): Answer All Questions Open Text Book / Open Note Book mode

- M - Max mark; CO - Course Outcome; BL - Blooms Taxonomy Level (1 - Remember, 2 - Understand, 3 - Apply, 4 - Analyse, 5 - Evaluate, 6 - Create)
- Course Outcomes
- CO2. Solve multiple integrals in cartesian, polar, cylindrical and spherical coordinates.
- CO3. Understand gradient, directional derivatives, divergence, curl, Green's, Stokes and Gauss Divergence theorems.
- CO4. Utilize different solution methods to obtain the solution for second-order ordinary differential equations.

Q. No	Question	M	CO	BL
1.	Evaluate the double integral $\iint_R \sqrt{9-x^2-y^2} dA$, where R is the region bounded by the circle $x^2 + y^2 = 9$ by converting the integral into polar co-ordinates.	10	2	2
2.	Evaluate the triple integral $\iiint_V (x^2 + y^2) dV$ by converting to cylindrical coordinates, where V is the region given by $V = (x, y, z) : x^2 + y^2 \leq 4; 0 \leq z \leq 3$.	10	2	3
3.	a) Find the directional derivative of the function $f = xy^2 + yz^2 + zx^2$ along the tangent to the curve $x=t, y=t^2, z=t^3$ at the point $(1, 1, 1)$.	5	3	2
	b) In robotics path planning, a robot is moving in a 3-dimensional environment modeled by the potential field $\vec{F} = (y^2 \cos x + z^3)\vec{i} + (2y \sin x - 4)\vec{j} + 3xz^2\vec{k}$. Show that this field represents a conservative artificial potential field, and compute the scalar potential function that the robot would use for energy-efficient navigation.	5		
4.	a) A virtual reality (VR) haptic device applies a force to a user's hand, modeled by the vector field $\vec{F} = (x^2 - y^2 + x)\vec{i} - (2xy + y)\vec{j}$, where (x, y) represents the position of the hand in meters in a 2D plane. If the user moves their hand along the straight line path from point $A(0,0)$ to point $B(1,1)$. Find the work done by the force along path $y^2 = x$.	5	3	3
	b) Using Green's theorem evaluate, $\int_C (y - \sin x)dx + \cos x dy$, where C is the plane triangle bounded by the lines $y=0, x=\frac{\pi}{2}, y=\left(\frac{2}{\pi}\right)x$.	5		
5.	An electric circuit consists of $R = 40\Omega, L = 1H, C = 16 \times 10^{-4} F$. The electrical oscillations in the circuit are free. If the initial charge and current are both zero. Determine the charge and current at time.	10	4	3