

**VIT**Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)**SCHOOL OF ADVANCED SCIENCES
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2026-2027****SLOT: B2+TB2**

Programme Name & Branch : B.Tech
Course Code : BAMAT101
Course Name : Multivariable Calculus and Differential Equations
Faculty Name(s) : Common Question Paper
Class Number(s) : Common
Date of Examination : 28.09.2026
Exam Duration : 90 minutes

Maximum Marks: 50**General instruction(s):**

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

Q.No.	Question	M	CO	BL
1.	Calculate the volume under the surface $z = 3 + x^2 - 2y$ over the region D defined by $0 \leq x \leq 1$ and $-x \leq y \leq x$ by converting into polar coordinates.	10	2	2
2.	Riya's snow cone can be visualized as a solid bounded above by the sphere $x^2 + y^2 + z^2 = 9$ and bounded below by the cone $z = \sqrt{x^2 + y^2}$. Evaluate $\iiint_V \sqrt{x^2 + y^2 + z^2} \, dx \, dy \, dz$ over the volume of the snow-cone using spherical coordinates.	10	2	2
3.	A nanoparticle used for targeted drug delivery moves through a 3D tissue environment under the artificial potential field $\vec{F} = (2xy + z^2)\vec{i} + (x^2 + 3y^2)\vec{j} + 2xz\vec{k}$. Show that this field represents conservative artificial potential vector field and compute the scalar potential function that can be used for energy-efficient navigation of the drug delivery nanoparticle.	10	3	3
4.	Verify Green's theorem for $\int_C (x^2 - xy^3)dx + (y^2 - 2xy)dy$ where C is a square with the vertices (0,0), (2,0), (2,2), (0,2).	10	3	2
5.	A biosensor circuit used to detect small electrical signals from a biological sample is modeled as a series RLC circuit. The circuit consists of a resistance of $20 \, \Omega$, an inductance of $0.5 \, \text{H}$, and a capacitance of $0.01 \, \text{F}$. The applied voltage generated by the biosensor is $E(t) = 100 \sin(10t)$. If $q(t)$ represents the electric charge stored in the capacitor and $I(t) = \frac{dq}{dt}$ is the current, then the circuit is governed by $L \frac{d^2q}{dt^2} + R \frac{dq}{dt} + \frac{q}{C} = E(t)$. Find the charge and current at any time t , given that current and charge are zero when $t = 0$ by method of undetermined coefficients.	10	4	3
