VIT®
Vellore Institute of Technology

Final Assessment Test – November 2025

Course: BAMAT101 - Multivariable Calculus and Differential Equations

Class NBR(s): 5461 / 5467 / 5488 / 5490 / 5492 / 5494 / 5496 / 5498 / 5523 / 5525

Slot: E1+TE1

Time: Three Hours

Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Evaluate partial derivatives and solve optimization problems involving several variables with or without constraints.
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.
CO5	Demonstrate proficiency in solving linear and nonlinear first-order partial differential equations.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

1. Verify whether the functions $u=\frac{x}{y-z}$, $v=\frac{y}{z-x}$ and $w=\frac{z}{x-y}$ are functionally dependent. If u, v and w are functionally dependent, then obtain the relation among them. **CO1 BL2**

2. Let the profit function be $P(x, y)=(\sin x)(\sin y)\sin(x+y)$, where $0<x<\frac{\pi}{2}$ and $0<y<\frac{\pi}{2}$. Then obtain the point where the maximum profit occurs. **CO1 BL3**

3. Evaluate $\int_0^3 \int_1^{\sqrt{4-y}} (x+y)\,dx\,dy$ by changing the order of integration. **CO2 BL3**

4.a) Apply cylindrical polar coordinates to evaluate $\int_{x=0}^{1} \int_{y=0}^{\sqrt{1-x^2}} \int_{z=0}^{2xy} (x^2+y^2)\,dz\,dy\,dx$. **CO2 BL3**

OR

4.b) Apply the spherical polar coordinates to evaluate $\iiint_E (x^2+y^2)\,dV$, where E is the portion of $x^2+y^2+z^2=4$ with $y\geq 0$. **CO2 BL3**

5.	Find the constants a, b, c such that the vector field $\vec{f}=(x+2y+az)\vec{i}+(bx-3y-z)\vec{j}+(4x+cy+2z)\vec{k}$ is irrotational. Then find its scalar potential.	CO3	BL3	
6.a)	If $\vec{f}=(2x^2-3z)\vec{i}-2xy\vec{j}-4x\vec{k}$, evaluate $\int_V$ curl $\vec{f}\,dV$, where V is the volume of the region bounded by the planes $x=0,\ y=0,\ z=0$ and $2x+2y+z=4$.	CO3	BL3	
	OR			
6.b)	Verify Green's Theorem for $\oint_C [(x^2-xy^3)dx+(y^2-2xy)dy]$, where C is the square with vertices $(0, 0), (2, 0), (2, 2), (0, 2)$.	CO4	BL3	
7.	Solve $x^2y''+10xy'+8y=x^2$ using the method of variation of parameters, where $x>0$.	CO4	BL2	
8.	An LCR circuit connected in series has $R=10$ ohms, $C=10^{-2}$ farad, $L=\frac{1}{2}$ henry and an applied voltage $E(t)=12$ volts. At $t=0$, the charge on the capacitor and the current in the circuit are zero. Find the charge on the capacitor at any time t.	CO5	BL2	
9.	Solve $(x^2-yz)p+(y^2-zx)q=z^2-xy$.	CO5	BL3	
10.	Solve $3\frac{\partial u}{\partial x}+2\frac{\partial u}{\partial t}=0$ with $u(x,0)=4e^{-x}$ using the method of separation of variables.			

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