

# Daffodil International University

B. Sc. in Civil Engineering

Midterm Examination, Spring 2025

Course Code: MAT 201

Course Title: Vector Analysis and Statistics

Section: BN1, BN2

Level-Term: 2-1

Teacher's Initial: PD

Full Marks: 25

Date: March 19, 2025

Time: 1.5 Hours

*Note: There are five sets of questions in total. Answer all of them. Right hand margin indicates full marks.*

1. a) Construct position vectors and rectangular unit vectors with examples? [CO1, C3] [02]  
b) Construct the unit vector perpendicular to the plane of  $\vec{A} = 2\hat{i} - 6\hat{j} - 3\hat{k}$  and  $\vec{B} = 4\hat{i} + 3\hat{j} - \hat{k}$  also build the dot product between them. [CO1, C3] [03]
2. Build an equation for the plane determined by the points  $p_1(3, -1, 2)$ ,  $p_2(1, -1, -3)$ ,  $p_3(4, -3, 1)$ . [CO2, C3] [05]
3. A particle moves along a curve whose parametric equations are  $x = e^{-2t}$ ,  $y = 5t^2 \cos 3t$ ,  $z = \frac{5 \sin 3t}{6(t+1)}$ . [CO3, C3]  
a) Identify its velocity and acceleration at any time  $t$ . [03]  
b) Also, calculate the magnitude of velocity and acceleration at  $t=5$  sec. [02]
4. a) Compute the directional derivatives of  $\phi$  at  $p_1(-1, 2, 1)$  in the direction  $5\hat{i} - 7\hat{j} - 9\hat{k}$ , where  $\phi(x, y, z) = 2x^2y^3z - 4x^4y^2z$ . [CO3, C3] [03]  
b) Compute the constant  $a$  so that the vector  $\vec{v} = (x + 3y)\hat{i} + (3y - 2z)\hat{j} + (y + 2a)\hat{k}$  is solenoidal. [CO3, C3] [02]
5. a) Solve that,  $\nabla^2\left(\frac{1}{r}\right) = 0$ . [CO3, C3] [03]  
b) Build curl  $\vec{A}$ , if  $\vec{A} = x^2y\hat{i} - 2xz\hat{j} + 2yz\hat{k}$ . [CO3, C3] [02]