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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 $\bar{A} = 2\hat{\imath} - 6\hat{\jmath} - 3\hat{k}$ and $\bar{B} = 4\hat{\imath} + 3\hat{\jmath} - \hat{k}$ 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 $x = e^{-2t}$, $y = 5t^2\cos 3t$, $z = \dfrac{5\sin 3t}{6(t+1)}$. *[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 ϕ at $p_1(-1, 2, 1)$ in the direction $5\hat{\imath} - 7\hat{\jmath} - 9\hat{k}$, where $\phi(x,y,z) = 2x^2y^3z - 4x^4y^2z$. *[CO3, C3]* [03]

   b) Compute the constant a so that the vector $\bar{v} = (x+3y)\hat{\imath} + (3y-2z)\hat{\jmath} + (y+2a)\hat{k}$ is solenoidal. *[CO3, C3]* [02]

5. a) Solve that, $\nabla^2\left(\dfrac{1}{r}\right) = 0$. *[CO3, C3]* [03]

   b) Build curl $\bar{A}$, if $\bar{A} = x^2y\hat{\imath} - 2xz\hat{\jmath} + 2yz\hat{k}$. *[CO3, C3]* [02]