



NATIONAL OPEN UNIVERSITY OF NIGERIA
University Village Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi, Abuja

FACULTY OF SCIENCES
DEPARTMENT OF MATHEMATICS
2021_2 Examinations

Course Code: MTH303
Course Title: **VECTORS AND TENSORS ANALYSIS**
Time Allowed: 3 Hours
Total: 70 Marks
Instruction: Answer Question One (1) and Any Other 4 Questions

- 1
 - a
 - i Define dot product of two vectors? **(4 marks)**
 - ii. What is scalar product of $4i + 3j - 5k$ and $4i - 7j - 5k$? **(6 marks)**
 - b. IF $\bar{a} = -2i + 3j + 2k$, $\bar{b} = 2i + 5k$
 What is (i) $\bar{a} + 2\bar{b}$ (ii) $2\bar{a} - 3\bar{b}$ **(6 marks)**
 - c. Define Divergence theorem. **(6 marks)**
- 2
 - a. Given that $\underline{Q} = \cos 3ti + \sin 3tj$. **(4 marks)**
 Evaluate $\left| \frac{dQ}{dt} \right|$.
 - b. Define gradient of a function **(4 marks)**
 - c. Given that $\phi(n, y, z) = 2n^2yz^2$, obtain $\nabla\phi$. **(4 marks)**
- 3
 - a. Given that $\phi A = 2n^3yz^2i + n^2y^2zj - n^3y^3zk$, Obtain the $\nabla \cdot (\phi A)$ at point (1, 1, 1) **(4 marks)**
 - b. Show that $\frac{\partial x^p}{\partial x^q} = \int_q^p$ **(4 marks)**
 - c.
 - i. Define the product of two tensor. **(2 marks)**
 - ii. Define contraction **(2 marks)**
- 4
 - a. What is the volume of $x^2 - y^3$ at evaluated at points (0,2) and (2,4). **(4 marks)**
 - b. When is vector said to be continuous. **(4 marks)**
 - c. A particle moves along the curve $n = 3t^2, y = t - 4t^2, z = 3t - 15$ where t is the time. Find the component of its velocity and acceleration at $t=1$. **(4 marks)**

- 5 a. **Define** Stokes's Theorem (4 marks)
b. What is work done by a force field on a particle along a curve? (4 marks)
c. Determine if $\underline{C} = (2x^2 + 8x^2yz, 9x^3y - 3ny, 2x^3y^2)$ is solenoidal. (4 marks)
- 6 a. Define Greens theorem. (4 marks)
b. Define integral of the tangential component (4 marks)
c. If $\phi(n, y, z) = xyz$ and $\underline{A} = nzi - ny^2i + yn^2k$ (4 marks)

find $\frac{\partial^3 \phi}{\partial n^2 \partial z}$ at point $(1, -1, 1)$