



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 $\underline{\phi A} = 2n^3yz^2i + n^2y^2zj - n^3y^3zk$, 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 $(1, -1, 1)$