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

FACULTY OF SCIENCES
DEPARTMENT OF MATHEMATICS
2021_1 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 scalar product. **(6 marks)**

(ii) What is scalar product of $6i + 3j - 5k$ and $9i - 7j - 5k$? **(4 marks)**

b. Find the curl of $\underline{A}$. If $\underline{A} = 9n^3yi + y^2z^2j + nyzk$ **(6 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. **(6 marks)**

2. **a.** Define vector product. **(3 marks)**

b. Find the dot product of $\bar{a}$ and $\bar{b}$ and angle between them.

If $\bar{a} = i + 2j + 3k$ and $\bar{b} = i - 3j - 2k$ **(4 marks)**

c. If $\emptyset(n, y, z) = ny^2z$ and $\underline{A} = nzi - ny^2i + yn^2k$ **(5 marks)**

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

3. **a**. Define triple products. **(4 marks)**

b. Find the work done if a particle is moved in a force field by **(4 marks)**

$\underline{F} = 3xyi + y^2j$ along the curve $y = 2x^2$ in the $xy - plane$ from (0,0) to (1,2)

c. Write $d\emptyset = \frac{\partial y}{\partial x^1}dx^1 + \frac{\partial y}{\partial x^2}dx^2 + \cdots + \frac{\partial y}{\partial x^n}dx^n$ summation convention **(4 marks)**

4. a. Define Grad of function$\emptyset$. **(4 marks)**

b. Determine if $\underline{C} = (2x^2 + 8x^2yz, 9x^3y - 3ny, 2x^3y^2)$ is solenoidal. **(4 marks)**

c. Find ∇V if $V = 2x^2yz^3$ **(4 marks)**

5. a. i. Define Divergence Theorem. Ii. Define Stokes's Theorem **(4 marks)**

b. if $Q = \cos 4t\ i + t\ j$ find $\left|\frac{dQ}{dt}\right|$ **(4 marks)**

c. If $V_1 = (i - 2j + k)\ and\ V_2 =. (i - 2j - k)$ whats the angle between the two vectors? **(4 marks)**

6. a. Define Greens Theorem **(4 marks)**

b. find the divergence of the vector **(4 marks)**
$B = (y^2 - 2xyz^3, +3 + 2xy - x^2z^3, 6z^3 - 3x^2yz^2$

c. If F $= n^2i + zj + yzk$. Evaluate $\iint F \cdot ds = \iiint \triangle F \cdot dr$ where V is the volume enclosed by the cube given by $0 \leq n \leq 1{,}0 \leq y \leq 1$ **(4 marks)**