NATIONAL OPEN UNIVERSITY OF NIGERIA
University Village, Plot 91, Cadastral Zone, Nnamdi Azikwe Express Way, Jabi-Abuja

FACULTY OF SCIENCES
April\May, 2019 Examinations

Course Code: **MTH303**
Course Title: **Vector and Tensor**
Credit Unit: **3**
Time Allowed: **3 Hours**
Total: **70 Marks**
Instruction: **Answer Question One and Any Other 4 Questions**

1. (a) Let $A = A_1 i + A_2 j + A_3 k$ and $B = B_1 i + B_2 j + B_3 k$, then prove that
   (i) $\nabla(AB) = A\nabla B + B\nabla A$ **(4 marks)**
   (ii) $\nabla \cdot (A + B) = \nabla \cdot A + \nabla \cdot B$ **(6 marks)**
   (iii) $\nabla \times (\mathrm{A} + \mathrm{B}) = \nabla \times \mathrm{A} + \nabla \times \mathrm{B}$ **(6 marks)**

   (b) If $A = xz^3 i - 2x^2 yzj + 2yz^4 k$, find $\nabla \times A$ at point (1, -1, 1) **(6 marks)**

2. (a) Prove that, for every field A; $\nabla \cdot (\nabla \times A) = 0$ **(6 marks)**

   (b) If $\phi(x, y, z) = xy^2$ and $A = xzi - xy^2 j + yz^2 k$, find $\frac{\partial^3}{\partial x^2 \partial z}(\phi A)$at point (2, -1, 1) **(6 marks)**

3. (a) If $A = 3i - j + 2k$, $B = 2i + j - k$ and $C = i - 2j + 2k$, find $(A \times B) \times C$ **(6 marks)**

   (b) A particle moves along the curve $A = (t^3 - 4t)i + (t^2 + 4t)j + (8t^2 - 3t^3)k$, where t is the time.

   Find the magnitude of the tangential components of its acceleration at $t = 2$. **(6 marks)**

4. (a) If $A(t) = (t - t^2)i + 2t^3 j - 3k$, find $\int_1^2 A(t)dt$ **(6 marks)**

   (b) Let $A = 3xi + x^2 j + (x + 2)k$ and $B = 2xi - 3xj + (x - 2)k$, evaluate $\int_0^2 (A \times B)dx$ **(6 marks)**

5. (a) If $\phi = 3x^2 y - y^3 z^2$; find grad ϕ at point (1, -2,-1) **(5 marks)**

   (b) Find the divergence and curl of $A = (xyz)i + (2x^2 y)j + (xz^2 - y^2 z)k$ at (2, -1, 1) **(7 marks)**

6 (a) If A_r^{pq} and B_r^{pq} are tensor. Prove that their sum and difference are tensor **(6 marks)**

   (b) If $A = 2i - j + k$, $B = i + 3 - 2k$, $C = -2i + j - 3k$ and $D = 3i + 2j + 5k$.

   Find scalar p, q and r such that $D = pA + qB + rC$ **(6 marks)**