



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

FACULTY OF SCIENCES
November, 2018 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 $A = A_1i + A_2j + A_3k$ and $B = B_1i + B_2j + B_3k$, 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) $\nabla \times (A + B) = \nabla \times A + \nabla \times B$ (6 marks)
- (b) If $A = xz^3i - 2x^2yzj + 2yz^4k$, find $\nabla \times A$ at point (1, -1, 1) (6 marks)
2. (a) If $A(t) = x(t)i + y(t)j + z(t)k$, where x, y and z are differentiable functions of a scalar t , prove that $\frac{dA}{dt} = \frac{dx}{dt}i + \frac{dy}{dt}j + \frac{dz}{dt}k$ (6 marks)
- (b) If $\phi(x, y, z) = xy^2$ and $A = xzi - xy^2j + yz^2k$, 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) Find the total work done in moving a particle in a force field given by $F = 3xyi - 5zj + 10xk$ along the curve $x = t^2 + 1$, $y = 2t^2$, $z = t^3$ from $t = 1$ to $t = 2$. (6 marks)
4. (a) If $A(t) = (t - t^2)i + 2t^3j - 3k$, find $\int_1^2 A(t)dt$ (6marks)
- (b) Let $A = 3xi + x^2j + (x + 2)k$ and $B = 2xi - 3xj + (x - 2)k$, evaluate $\int_0^2 (A \times B)dx$ (6 marks)

5. If $A = (3x^2 + 6y)i - 14yzj + 20xz^2k$, evaluate $\int_C A \cdot dr$ from $(0, 0, 0)$ to $(1, 1, 1)$

along the following path C:

(a) $x = t, y = t^2, z = t^3$. **(6 marks)**

(b) the straight lines from $(0, 0, 0)$ to $(1, 0, 0)$, then to $(1, 1, 0)$ and $(1, 1, 1)$. **(6 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)**