Course Code: MTH 303
Course Title: Vector and Tenor Analysis
Credit Unit: 3
Time Allowed: 3 Hours
Total: 70 Marks
Instruction: Answer Question One (1) and Any Other 3 Questions

(1ai.) State the Scalar product of two vectors. (3 marks)
(ii.) Why is the magnitude of a vector always scalar? (2 marks)
(iii.) State the Laws of Scalar products. (2 marks)
(iv.) State the law of triple products. (3 marks)
(bi.) State the Vector Product law. (5 marks)
(ii.) Write down two differences between scalar and vector quantities. (3 marks)
(iii.) Do scalar quantities depend upon the frame of reference? (2 marks)
(Ci.) Find the Scalar and vector quantity from the given list;
Force, Speed, Electric field, Angular Momentum, Magnetic Moment, Temperature,
Linear Momentum, Average Velocity. (3 marks)
(ii.) State 3 characteristics of Vectors. (2 marks)

(2ai.) Explain the term Vector Calculus. (3 marks)
(ii.) Define the Divergence of a Vector field. (2 marks)
(iii.) Determine the divergence of a vector field in two dimensions: $F(x, y) = 6x^2i + 4yj$. (2 marks)
(bi.) Define the Curl of a Vector field. (2 marks)
(ii.) Find the curl of the vector field $F(x, y, z) = y^3i + xyj - zk$. (3 marks)
(iii.) Define the Gradient of a vector. (3 marks)

(3ai.) Give a clear definition of Line integral. (3 marks)
(ii.) List five (5) areas in which Line integral can be applied. (3 marks)
(iii.) Evaluate the line integral $\int_C F. dr$ where $F(x, y, z) = [P(x, y, z), Q(x, y, z), R(x, y, z)] = (z, x, y)$, and C is defined by the parametric equations, $x = t^2$, $y = t^3$ and $z = t^2$, $0 \leq t \leq 1$. (5 marks)
(bi.) Define the Surface integral. (2 marks)
(ii.) What is a Volume integral? (2 marks)

(4ai.) What do you understand by Green's theorem? (3 marks)
(ii.) Solve $\oint_c y^3 dx - x^3 dy$ where c is a circle of radius 2 centred in origin. (5 marks)
(bi.) State the divergence theorem. (3 ½ marks)
(ii.) State the Stoke's theorem. (3 ½ marks)

(5ai.) Define Cartesian Tensor. (4 marks)
(ii.) Explain when a Tensor is Symmetric and Skew Symmetric respectively. (4 marks)
(bi.) Evaluate (i) $\int_q^p A_s^{qr}$ (ii) Show that $\frac{dx^p}{dx^q} = \int_q^p$ (4 marks)
(ii.) Define Outer Multiplication. (3 marks)

(6ai.) Explain the Addition and Subtraction of two or more Tensors. (3 marks)
(ii.) if A_r^{pq} and B_r^{pq} are tensor. Prove that their sum and difference are tensor. (3 marks)
(iii.) Define Internal Multiplication. (3 marks)
(bi.) Define the Single Dot Product of 2 Tensors. (2 ½ marks)
(ii) Define Dot Product of a Tensor and a Vector. (2 marks)