

Course Code: MATH325
Course Title: Vector and Tensor Analysis
Credit Hours: (3 0 3)
Pre-requisite(s): MATH212

Course Objectives:

The objectives of this course are:

- To learn about vector quantities and algebra of vector addition and multiplication.
- To understand differentiation and integration of vector valued functions and there applications.
- To learn about tensor quantities and algebra of tensor addition and multiplication.
- To understand differentiation of tensors fields.

Reading list:

1. D.E. Bourne , P.C Kendall , “Vector Analysis and Cartesian Tensors”, 3rd edition,
Stanley Thornes, 1999.
2. G.D. Smith, “Vector Analysis”, Oxford University Press, Oxford 1999.
3. M.R. Spiegel, “Vector Analysis & Introduction to Tensor Analysis”, McGraw Hill,
New York 2009.
4. M.R. Spiegel, “Vector Analysis”, 2nd edition, McGraw Hill New York, 2009.
5. J.G. Simmonds, ”A Brief on Tensor Analysis”, [Springer-Verlag](#), 2012.

Lecture-wise distribution of the Contents

Lecture #	Topic
L1-L3	Introduction to the course ,Vectors , scalars ,Addition of vectors , Multiplication of a vector by a scalar , Algebra of vector addition and scalar multiplication ,Unit vector ,Components of a vector ,Scalar and Vector fields, Tensors.
L4-L6	Dot Product and Cross product of vectors, Properties and applications of dot and Cross product.
L7-L8	Scalar and vector triple product ,Properties and applications of triple product
L9-L11	Derivatives of vector valued functions of scalar variable, Differentiation formulas Continuity and differentiability, Partial derivatives of vector functions
L12	Space curves ,unit tangent ,Principal normal , Bi-normal
L13-L15	Gradient, Divergence ,Curl , Formulas involving gradient, Divergence and Curl
L16-L18	Integration of vector valued functions, Line integral, Work done by a variable force, conservative vector field, scalar potential, Path independence ,Work done around a closed path
L19-L21	Surface integrals, Volume integrals, Limit of sum definition and evaluation technique
L22-L23	Transformation of coordinates, curvilinear coordinate , orthogonal curvilinear coordinate, Unit vectors in curvilinear systems
L24	MID EXAM

L25-L26	Contra-variant and covariant components of a vector, Gradient, Divergence and Curl in curvilinear coordinate system
L27-L29	Special orthogonal coordinate systems , Cylindrical Coordinate, spherical Coordinates, Parabolic Cylindrical Coordinates, Paraboloidal Coordinates
L30-L32	Co-vector, Scalar product of vector and co-vector, Linear operators, Bilinear and quadratic forms, Dual Bilinear forms, Einstein summation convention ,General definition of tensors.
L33-L35	Dot product and metric tensor, Tensors addition and multiplication by a scalar, Tensor product
L36-L38	Contraction, Kronecker symbol, Levi-Civita symbol, Tensor fields in Cartesian coordinates
L39-L41	Change of Cartesian coordinate system, Differentiation of tensor fields
L42-L44	Gradient, divergence, and curl, Laplace and d'Alambert operators
L45-L46	Tensor fields in curvilinear coordinate
L47-L48	Moving frame of curvilinear coordinates, Christoffel symbols