Vector Calculus

Code	Credit Hours
MATH-243	3-0

Course Description:

The course introduces Analytical Geometry in 3-space. Important quadric surfaces are included while students also become familiar with 3-dimensional cylindrical and spherical coordinate systems. Parametric equations of curves and the concept of directional derivative are also part of this course. Double and triple integration are included with applications to find areas and volumes. In the second part advanced topics in vector analysis like calculus of del operator, gradient, curl and divergence along with their physical interpretations are covered. Moreover, partial differential equations are included in the course to provide students strong mathematical tools to solve Engineering/Technology problems.

Text Books:

1. Thomas's Calculus (14th Edition) George B. Thomas, Jr.
2. Calculus (8th Edition) James Stewert.
3. Advanced Engineering Mathematics (10th Edition) Ervin Kreyszig

Reference Books:

1. Calculus (6th Edition) Swokowski, Olinick and Pence Borisenko & Taranov
2. Vector and Tensor Analysis with Applications.

Prerequisites:

MATH-101 (Calculus and Analytical Geometry)

ASSESSMENT SYSTEM

Quizzes	10-15%
Assignments	5-10%
Mid Terms	25-35%
ESE	40-50%

Teaching Plan:

Week No	Topics	Learning Outcomes
1	Introduction	Course Outline, objectives, teaching plan, assessment method, Analytical Geometry in 3-space,
2	Quadric Surfaces, Cylindrical and Spherical Coordinates	Quadric Surfaces. Derivation of transformations from cylindrical to rectangular, rectangular to cylindrical, spherical to rectangular, rectangular to spherical, spherical to cylindrical and cylindrical to spherical, Different surfaces in cylindrical, spherical and rectangular form.
3-4	Parametric curves. Gradient of a Scalar Field, Directional Derivatives	Parametric representation of curves, Arc length Curvature & Torsion, Gradient of a Scalar Field. Directional derivative of a function of two variables, Gradient of real valued function, Significance of gradient vector. Using gradient to find tangent to a level curve, Calculating directional derivatives and gradient vector in 3D.
5-6	Divergence and Curl of a Vector Field	Divergence formula, Curl formula, Conservative vector field via using properties of curl and divergence, Rotational and irrotational vector fields, Divergence free, positive and negative divergence.
7-8	Line Integrals	Line integral, integration around closed curves. Application of double integrals, Green's theorem.
9	**Mid Semester Exam**	
10-13	Surface Integrals	Surface Integrals. Triple integrals and divergence theorem of Gauss. Stokes' Theorem.
14-15	Introduction to PDEs	Partial differential equations (PDEs) solvable as ODEs (separation of variables). Modeling a Vibrating String, Derivation of Wave Equation.
16-17	Applications of Fourier Series	Solution by the Method of Separation of Variables using Fourier Series. Heat Equation; its Solution by Fourier Series.
18	**End Semester Exam**	