Gokaraju Rangaraju Institute of Engineering and Technology
(Autonomous)

ADVANCED CALCULUS

Sub. Code: GR14A1002 **L T P C**
I Year I Sem 2 1 0 3

Prerequisites: Analytical 2-D and 3-D geometry, differential and integral calculus

Course objectives
1. To introduce the techniques of tracing a curve using its geometrical properties.
2. To visualize multivariable functions in the context of function optimization.
3. To learn the skill of performing integration in 2-D and 3-D and apply them to estimate characteristics of vector fields.

Course outcomes: At the end of the course, the student will be able to
1. Apply the knowledge of curve tracing and geometry to precisely estimate areas and volumes
2. Solve problems on function optimization with and without constraints
3. Apply the knowledge of multiple integrals in solving problems in vector fields

Unit-I Differential Calculus of functions of several variables and Function Optimization: Partial differentiation - Hessian matrix-Total differentiation-Jacobians. Optimization of functions of several variables without constraints- Constrained optimization of functions of several variables with equality constraints-The Lagrange's multiplier method.

Unit-II Curve tracing principles and Applications of integration: Basic principles of tracing Cartesian, polar and parametric curves -Applications of the definite integral to evaluate arc lengths, surface areas of revolution and volumes of revolution.

Unit-III Multiple integrals and applications: Evaluation of Double integrals in Cartesian and polar coordinates-Changing the order of integration- Change of variables - Evaluation of triple integrals in Cartesian, cylindrical and spherical polar coordinates. Application of multiple integrals to evaluate plane areas and volumes of solids.

Unit-IV Vector Calculus: Vector differentiation in Cartesian coordinates-Gradient, Divergence and Curl and their physical interpretation-Directional derivatives-Angle between surfaces, Vector Identities, Irrotational fields and scalar potentials. Vector integration-Evaluation of line integrals-Work done by conservative fields-Surface integrals.

Unit-V Vector Field theorems: Green's theorem in the plane-Divergence theorem of Gauss-Stoke's theorem (Without Proofs).

Teaching methodologies
1. Tutorial sheets uploaded in website
2. NPTEL video lectures
3. MATLAB exercises for visualization

Text Books
1. Advanced Engineering Mathematics: R.K.Jain and S.R.K.Iyengar- Narosa Publishing House
2. Schaum's outline series on Vector Analysis
3. Higher Engineering Mathematics: B.S.Grewal-Khanna Publications

References
1. Advanced Engineering Mathematics: Erwin Kreyszig-Wiley
2. Calculus and Analytical Geometry-Thomas & Finney-Narosa
3. Higher Engineering Mathematics: B.S.Grewal-Khanna Publications