Course Title: Advanced Calculus
Course Code: MATH 104
Credit Hours: 3

Course Description:
The course is designed to provide additional mathematical skills for students in various branches of engineering. It covers topics in coordinate systems, derivatives of functions with several variables, multiple integrals, beta and gamma functions, vector functions and Fourier series.

Course Contents:

Unit 1: Coordinates Systems
Polar coordinates, Graphs of polar equations, polar equations of conics and other curves, polar integrals. Cylindrical coordinate, Spherical Coordinates, Equations relating Cartesian and cylindrical coordinates, Equations relating Cartesian and cylindrical coordinates to spherical.

Unit 2: Functions of Several Variables and their Derivatives
Functions of two or more variables, Limits and continuity, Partial derivatives, Derivatives of composite and implicit functions, Chain rules, Non-independent variables, Gradients, Directional derivatives and tangent planes, Higher order derivatives, Maxima, Minima and saddle points, Lagrange multipliers, Exact differentials

Unit 3: Multiple Integrals
Introduction, Double integrals, Area, Changing Cartesian integral to polar integrals, Triple integrals in rectangular, cylindrical and spherical coordinates and their relations, Surface area, Change of order of integration

Unit 4: Beta and Gamma Functions
Beta and Gamma functions, Properties of the functions, Transformations of Gamma functions, Relation between the functions

Unit 5: Applications of the Theory of Integration
Area of curves in Cartesian coordinates, Area between two Cartesian curves, Area of the curves in polar coordinates, Volume of solid of revolutions, Surface of solids of revolutions

Unit 6: Vector Functions and their Derivatives
Introduction of scalar and vector functions, parametric representations, Continuity and differentiability of vector functions, Tangent vectors, Motion of a body or particle on a curve, Unit tangent vector, Unit normal vector and components, Arc length for space curves, Curvature, Derivatives of vector products

Unit 7: Vector Integral Calculus
Vector fields, Surface integrals, Line integrals and work, Two-dimensional fields, Flux across a plane curve, Greens theorem, Gauss's theorems, Stoke's theorem and their verifications

Unit 8: Fourier Series and Integrals

Periodic functions, Trigonometric series, Fourier series, Euler's formulae, Convergence theorem (proof not required), Functions having arbitrary period, even and odd functions, Half-range expansions, Fourier integral, Fourier transform

References:

1. G. B. Thomas and R. L. Finney, *Calculus and Analytic Geometry*, 9th Edition, Pearson Education
2. E. Kreyszig, *Advanced Engineering Mathematics*, Wiley Eastern Ltd.
3. H. K. Das, *Advanced Engineering Mathematics*, S. Chand, New Delhi.
4. S. M. Maskey, *Calculus*, Ratna Pustak Bhandar
5. D. V. Wider, *Advanced Calculus*, Prentice Hall of India.
6. S. S. Sastry, *Engineering Mathematics*, 4th Edition, Prentice Hall of India.
7. Jain and Iyenger, *Advanced Engineering Mathematics*, Narosa Publishing House
8. Potter and Goldberg, *Mathematical Methods*, Prentice Hall of India