Kathmandu University
Course of study

Course Title: Advanced Calculus
Course Code: MATH 104
Level: Undergraduate
Credit: 3

Group(s): BE, BTech (I Year - II Semester)

Total Lecture Hours: 45

Course Description:

Systematic study of polar coordinates, partial derivatives, multiple integrals, Beta-Gamma functions, vector functions, vector integral calculus and Fourier series.

Objectives:

- To provide the knowledge of advanced calculus with reasonable explanations.
- To enable the critical thinking abilities and skills needed for solving engineering and science related problems.

Course Contents

Unit 1: Coordinates Systems [8]

1.1 Polar Coordinates

1.2 Graphing Polar Coordinate Equations

1.3 Polar Equations for Lines, Circles and Other Curves

1.4 Polar Integrals, Area in the Plane

1.5 Cylindrical and Spherical Coordinates

1.6 Equations relating Cartesian and Cylindrical Coordinates

1.7 Equations relating Spherical Coordinates to Cartesian and Cylindrical Coordinates

Unit 2: Partial Derivatives [8]

2.1 Functions of Several Variables

2.2 Limits and continuity in Higher Dimensions

2.3 Partial Derivatives, Mixed Derivative Theorem

2.4 Chain Rule

2.5 Directional Derivatives and Gradient Vectors

2.6 Tangent Planes and Normal Lines, Linearization, Differentials

2.7 Extreme Values and Saddle Points, Absolute Maxima and Minima

2.8 Lagrange Multipliers, Constrained Maxima and Minima

Unit 3: Multiple Integrals [5]

3.1 Double Integrals over Rectangles and General Regions

3.2 Fubini's Theorems

3.3 Change of Order of Integration

3.4 Changing Cartesian Integrals to Polar Integrals

3.5 Triple Integrals in Rectangular, Cylindrical and Spherical Coordinates

3.6 Substitution in Multiple Integrals

Unit 4: Beta and Gamma Functions [4]

4.1 Beta-Gamma Functions and Their Properties

4.2 Transformations of Gamma Functions

4.3 Relation between the Functions

Unit 5: Vector Functions and Their Derivatives [6]

5.1 Vector Functions, Parametric Representaions

5.2 Limits, Continuity of Vector Functions

5.3 Derivatives and Motion, Integrals of Vector Functions

5.4 Arc Length Along a Smooth Curve, Speed on a Smooth Curve

5.5 Unit tangent vector, Curvature, Principal Unit Normal Vector

5.6 Circle of Curvature, Binormal and Torsion

5.7 Tangential and Normal Components of Acceleration

Unit 6: Vector Integral Calculus [10]

6.1 Line Integrals of Scalar Functions

6.2 Vector Fields, Line Integrals of Vector Fields, Work, Flow, Circulation and Flux

6.3 Path Independence, Conservative Fields, Potential Functions and Exact Differential Forms

6.4 Circulation Density and Divergence of Vector Field

6.5 Green's Theorem in the Plane and its Verification

6.6 Parametrization of Surfaces, Implicit Surfaces, Surface Area and Surface Integrals

6.7 Flux and Divergence in Three Dimensions

6.8 Stokes' Theorem, Divergence Theorem and Their Verifications

Unit 7: Fourier Series [4]

7.1 Periodic Functions, Odd and Even Functions

7.2 Trigonometric Series, Fourier Series, Euler's Formulae

7.3 Convergence Theorem (proof not required)

7.4 Functions having Arbitrary Periods

7.5 Half-Range Expansions

Text Books

1. Thomas, G. B., Hass, J., Heil, C. & Weir, M. D., Thomas' Calculus, Pearson Education
2. E. Kreyszig, Advanced engineering Mathematics, Wiley Eastern Ltd.

Reference Books

1. J. Stewart, Calculus Early Transcendentals, Thomson Brooks/Cole
2. H. K. Dass, Advanced Engineering Mathematics, S. Chand, New Delhi
3. S. M. Maskey, Calculus, Ratna Pustak Bhandar
4. D. V. Wider, Advanced Calculus, Prentice Hall of India
5. S. S. Sastry, Engineering Mathematics, 4th Edition, Prentice Hall of India