Tribhuvan University
Institute of Science and Technology
Course of Study for Four Year Mathematics

Course Title: Calculus
Course No. : MAT 101
Level : B.Sc.
Nature of Course: Theory

Full Marks: 75
Pass Mark: 26.25
Year: I
Lecture: 150 Hrs.

Course Description
This course is designed for first year of Four years B.Sc. program. The main aim of this course is to provide knowledge of Calculus.

Course Objectives: The objective of this course is to acquaint students with the concepts of Calculus and differential equations and their applications. It aims at enabling students to build knowledgebase in Calculus.

Course Contents

Unit 0. Review of Elementary Calculus: Functions, Graphs, Evaluations of limits, Continuity, Discontinuity, Test of continuity and properties of continuous functions. [10 Lectures]

Unit 1. Tangents and Normals: Tangents and normals, Subtangents, Subnormal and their lengths, Derivatives of arc length, Polar equations of subtangents and subnormal, Angle between radius vector and tangent, Length of perpendicular from pole on tangent, Pedal equations and Angle between two curves.
[10 Lectures]

Unit 2. Higher Order Derivatives and Mean Value Theorems: Higher order derivatives, Following theorems (without proofs): Rolle's theorem, Langrange's theorem Cauchy Mean Value theorem, Maclaurin's theorem and Taylor's theorem and their applications in solving problems. [15 Lectures]

Unit 3. Application of Derivatives: Indeterminate forms, L'Hospital's rule (without proof), Asymptotes, Types of asymptotes, Asymptotes of algebraic curves, Curve tracing techniques, Standard curves and their tracing, Curvature, Chord of curvature, Curvature at origin, Center and circle of curvature.
[15 Lectures]

Unit 4. Partial Differentiations and Maxima and Minima of Functions of 2 and 3 Variable: Basic ideas of limits and continuity of functions of 2 and 3 variables, Partial derivatives and their geometrical interpretation, Higher order partial derivatives, Homogeneous functions, Euler's theorem (proof for 2 variables only), Total differentials, Extreme values, Stationary points, Criteria for maxima and minima, Subsidiary conditions, Lagrange's method of undetermined multipliers. [15 Lectures]

Unit 5. Integration and Definite Integrals: Integration concepts, Integration techniques and standard formulae, Integration of rational functions and hyperbolic functions, Integration as the limit of a sum, Definite integral and fundamental theorem of integral calculus (without proof), properties of definite integral.
[10 Lectures]

Unit 6. Beta and Gamma Functions and Reduction formulae: Improper integrals, Beta and Gamma functions and their properties, Reduction formulae. [8 Lectures]

Unit 7. Rectification and Quadrature, Volume and Surface Area of Solid of Revolution: Rectification notion, Length formulae, Idea of quadrature and area formula, Volume and surface area of solid of revolution. [10 Lectures]

Unit 8. Double Integrals: Double and iterated integrals in rectangular coordinates, Changes of variables in double integrals(to polar coordinates and curvilinear coordinates), Computing area and volume using double integrals, Application of double integrals in mechanics: mass and static moments of a lamina, centre of gravity, moments of inertia of a lamina. [10 Lectures]

Unit 9. Vector Calculus: Vector Fields, Gradient Fields, Line Integrals, Line Integrals in Space, Line Integrals of Vector Fields, The Fundamental Theorem for Line Integrals, Independence of Paths, Conservation of Energy, Green's Theorem, Extended Version of Green's Theorem, Curl and Divergence, Vector forms of Green's Theorem. [10 Lectures]

Unit 10. Vector Calculus (Contd.): Parametric Surfaces and their Areas, Surface Integrals, Surface Integrals of Vector Fields, Stoke's Theorem, The Divergence Theorem. [10 Lectures]

Unit 11. Differential Equations of the First Order and the First Degree: Introduction, standard form, Variables-separable equations, Homogeneous equations, Equations reducible to homogeneous equations, Non-homogeneous equation of the first order, Exact differential equation, Condition for exactness, Integrating factors first order, Exact differential equation, Condition for exactness, Integrating factors and techniques, Linear differential equations and equations reducible to linear forms. [15 Lectures]

Unit 12. Linear Differential Equations with Constant Coefficient: Linear equations with constant coefficients, Linear equations solvable using symbolic operators, Symbolic operation techniques, Particular integrals and complementary function, Homogeneous linear equations, Equations reducible to homogeneous form. [12 Lectures]

Text books

1. M.B. Singh and B.C. Bajracharya; Differential Calculus, Sukunda Pustak Bhandar, Kathmandu, 1995.
2. G.D. Pant and G.S. Shrestha; Integral Calculus and Differential Equations, Sunita Prakashan, Kathmandu 1994.
3. James Stewart, Calculus Early Transcendentals, Cengage Learning, 7th Edition Metric Version, 2015.

Reference books

4. Anton, Bivens and Davis, Calculus, Wiley, 7th Edition, 2012.
5. D.A. Murray; Introductory Course in differential Equations, Oriental Longman.
6. T.M. Apostal; Calculus Vol I & II, Wiley Eastern Ltd, New Delhi, 1986.
7. S.M. Maskey; Calculus, Ratna Pustak Bhandar, Kathmandu, 2008.

Tribhuvan University

Institute of Science and Technology

Course of Study for Four Year Mathematics

Course Title: Analytical Geometry and Vector Analysis **Full Marks:** 75
Course No. : MAT 102 **Pass Mark:** 26.25
Level : B.Sc. **Year:** I
Nature of Course: Theory **Lectures:** 150 Hrs.

Course Description: This course is designed for first year of Four years B.Sc. program. The main aim of this course is to provide knowledge of Analytical Geometry and Vector Analysis.

Course Objectives: The objective of this course is to acquaint students with the basic concepts of Analytical Geometry and Vector Analysis. It aims at enabling students to build good knowledgebase in the subject of Analytical Geometry and Vector Analysis

Unit 1. Transformation of Coordinates: Introduction to polar, cylindrical and spherical coordinates, Transformation, Rotation, Process involving combination of translation and rotation of axes, Invariants in orthogonal transformation. [10 Lectures]

Unit 2. Conic Sections and their properties: Introduction, Conic section as a locus of a point and as a section of a cone, Central conic sections, Ellipse and hyperbola, Derivation of their equations in standard forms, Auxiliary circles and eccentric angle, Equations of tangent and normal, Chord of contact, Pole and polar and their properties, Diameter, conjugate diameter and equi-conjugate diameter, Asymptotes of hyperbola, Relations between the equation of the hyperbola, its asymptotes and the conjugate hyperbola, Equation of a hyperbola, Equation of a hyperbola referred to the asymptotes as coordinate axes.
[20 Lectures]

Unit 3. Polar Equation of a Conic: Polar equation of a conic section with focus being a pole, Equation of the chord of conic, Equation to the tangent, normal and chord of contact, Equation of the polar to a conic and Equation of the asymptotes. [10 Lectures]

Unit 4. General Equation of the Second Degree: General equation of the second degree and the conic representation by them, Nature of the conic, Center of conic, Equation of the tangent and condition of tangency, Equation of pair of tangents, Director circle, Equation of the normal to a conic, Equation of pole and polar with respect to a conic, Diameter and conjugate diameters, Intersection of conics, Asymptotes to a conic.
[10 Lectures]

Unit 5. Coordinates in three space and Plane: Review of coordinates in space, angle between two lines, General equation of the first degree representing a plane, angle between two planes, Plane through three points, Plane through intersection of the two planes, Condition for representing a pair of planes by the homogeneous equation of the second degree [10 Lectures]

Unit 6. Straight lines: Representation of a line as the intersection of two planes, Line in symmetric form, Line through two points, Reduction of the general form to the symmetrical form, Perpendicular distance of a point from a line, Condition for a line to lie in a plane, General equation of a plane containing a line, Coplanar lines and condition for it, Skew lines, Magnitude and equation of the line of shortest distance between two skew lies, Intersection of three planes. [12 Lectures]

Unit 7. Sphere: Sphere and equation of a sphere, Its representation by the general equation of the second degree, Sphere through four given points, Plane section of a sphere, Intersection of two spheres, Sphere with a given diameter, Tangent plane and condition of tangency. [8 Lectures]

Unit 8. Cone and Cylinder: Definition and equation of a cone, Condition that the general equation of the second degree to represent a cone, Condition that a cone has three mutually perpendicular generators, Tangent lines and tangent plane, Condition of tangency, Reciprocal cone, Enveloping and right circular cone, Cylinder and enveloping cylinder, Right circular cylinder. [13 Lectures]

Unit 9. Central Conicoids: Conicoids and central conicoids, Standard equation of the central conicoid, Intersection of a line with a conicoid, Tangent and tangent planes, condition of tangency, Director sphere, Equation of the normal, Cubic curve through the feet of six normals, Genereal equation of the conicoid through the six feet of the normals, Polar plane and plane of contact, Enveloping cone of the central conicoid and enveloping cylinder to a conicoid section of a conicoid, Diametrical plane, Conjugate diameters and diametrical planes of a ellipsoid, Properties of conjugate semi-diameters.

[15 Lectures]

Unit 10. Product of three or more vectors: Multiplication of three vectors, scalar triple product, Applications and geometrical meanings of scalar triple product, Properties of scalar triple product, Condition of coplanarity of three vectors, Vector triple product, Scalar product of four vectors and vector product of four vectors, Reciprocal system of vectors. [10 Lectures]

Unit 11. Differentiation of Vectors: Vector function of a single variable, Vector function and its expression in terms of unit vectors, Limit and continuity of vector functions, Differentiation of a vector function w.r.t. a scalar, Partial derivatives of vectors, Higher derivatives of a vector function w.r.t. a scalar, Differentiation of the product of a scalar and a vector, Differentiation of a scalar product and vector product of two and three vectors. [10 Lectures]

Unit 12. Gradient, divergence and Curl, and Expression Formulae: Scalar point function, Vector point function, Scalar field, Vector field, Vector operators, Gradient scalar field, Gradient polar coordinates, Condition of a scalar point function to be constant and conversely, Total differential, Directional derivative, Divergence of a vector field, Solenoidal vector, Curl of a vector field, Expansion formulae, Second order differential operators, Expansion formulae involving the first order and the second order differential operator [12 Lectures]

Text books

1. Y.R. Sthapit and B.C. Bajracharya; A Text Book of Three Dimensional Geometry, Sukunda Pustak Bhandar, Kathmandu.
2. M.B. Singh and B.C. Bajracharya; A Text Book of Vector Analysis, Sukunda Pustak Bhandar, Kathmandu
3. M.R. Joshi; Analytical Geometry, Sukunda Pustak Bhandar, Kathmandu

Reference books

1. S. Narayan; Analytical Solid Geometry, S. Chand and Co.
2. Lalji Prasad, Vector Analysis, Paramoung Publication 1986.
3. S.L. Loney; Elements of coordinate Geometry, MacMillan Books co. NY 1984
4. J.T. Bell; An Elementary Treatise of Coordinate Geometry of Three Dimensions, MacMillan Book Co. NY 9846