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.: 102 **Pass Marks:** 35%

Nature of the Course: Theory **Year:** I

Level: B. Sc.

Course Contents:

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. 6 hrs

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. 14 hrs

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. 6hrs

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. 6 hrs

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 6 hrs

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. 8 hrs

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. 4 hrs

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. 8 hrs

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. 10 hrs

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. 6 hrs

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. 8 hrs

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 operators. 8 hrs

Books Suggested:

1. Y.R. Sthapit and B.C. Bajracharya; A Text Book of Three Dimensional Geometry, Sukunda Pustak Bhandar, Kathmandu.
2. S.L. Loney; Elements of coordinate Geometry, MacMillan Books co. NY 1984
3. J.T. Bell; An Elementary Treatise of Coordinate Geometry of Three Dimensions, MacMillan Book Co. NY 9846
4. M.B. Singh and B.C. Bajracharya; A Text Book of Vector Analysis, Sukunda Pustak Bhandar, Kathmandu
5. S. Narayan; Analytical Solid Geometry, S. Chand and Co.
6. Lalji Prasad, Vector Analysis, Paramoung Publication 1986.
7. M.R. Joshi; Analytical Geometry, Sukunda Pustak Bhandar, Kathmandu.