Pokhara University
Faculty of Science and Technology

Course Code: MTH 150
Course title: Algebra and Geometry (3-2-0)
Nature of the course: Theory
Level: Bachelor

Full Marks: 100
Pass Marks: 45
Total Lectures: 45 hours
Program: BE

1. Course Description

The course covers linear algebra, vector algebra, linear programing, two-dimensional and three-dimensional analytical geometry.

2. General Objectives

To provide the sound knowledge of Algebra and Geometry of two and three dimensions.

3. Methods of Instruction

Lecture, Discussion, and Class Work

4. Contents in Detail

Specific Objectives	Contents
• Solve system of linear equations and find rank of a matrix	**Unit I: Matrix and System of linear equations (4 hrs.)** 1.1 System of linear equations, classification, matrix and vector representations, solution by Cramer's and Gauss elimination methods. 1.2 Rank of a matrix, elementary transformation on matrices, equivalent matrices and their ranks, computation of rank of matrix by reducing into echelon (triangular) form and canonical (normal) form, rank of coefficient matrix and consistency of system of equations.
• Solve the problems related to vector space and determine eigenvalues and eigenvectors.	**Unit II: Vector Space (7 hrs.)** 2.1 Vectors and vector spaces, $\mathbb{R}^2 and\ \mathbb{R}^3$ as vector spaces and their subspaces, Basis. 2.2 Linear dependence and independence, rank of matrix in terms of linearly independent column (row)vectors. 2.3 Linear transformation and transformation by matrix multiplication as linear transformation, orthogonal matrix and transformation by orthogonal matrix. 2.4 Eigenvalues and eigenvectors, characteristic equation and computation of Eigenvalues and eigenvectors, properties of eigenvalues. 2.5 Cayley-Hamilton theorem (statement and verification only), application to compute inverse of a matrix (up to 3×3 matrix). 2.6 Similar matrices and diagonalization of matrix (up to 2×2 matrices only).

• Solve linear programing problems by Simple method.	**Unit III: Linear Programing Problems (5 hrs.)** 3.1 Introduction, Model Formulation, Standard Form, Solution by Simplex Method 3.2 Duality, Dual Simplex Method 3.3 Simplex method for mixed inequalities (Big-M method)
• Solve the problems related to product of three and four vectors and	**Unit IV: Vector Algebra (6 hrs.)** 4.1 Review of vectors in terms of coordinates, scalar and vector product of two vectors. 4.2 Vector and scalar product of three and four vectors with physical interpretations. 4.3 Reciprocal system of vectors, properties of reciprocal system of vectors and related problems.
• Test the convergence and divergence of the series	**Unit V: Infinite Series (5 hrs.)** 5.1 Infinite sequence and concept of convergence, infinite series, convergence of series, invariance of convergence (by addition or removal of certain finite numbers or terms, by multiplication by any finite constant, sum and product of convergent series), necessary condition for an infinite series to be convergent (divergent test), convergence of infinite geometric series. 5.2 Series with positive terms (or all terms negative) and different convergence tests (theorems statement with illustrations, proof not required). The hyper-harmonic series (p-series) and its convergence, Comparison test, ratio test, root test. 5.3 Alternating series (Series with negative and positive terms alternatively) Leibnitz test, absolute convergence, power series, interval of convergence and radius of convergence
• Solve the problems related coordinate transformation, ellipse, hyperbola, and conic section	**Unit VI: Two-dimensional Geometry (6 hrs.)** 6.1 Transformation of coordinates: by transformation of origin, by transformation of axes by changing direction of axes, combined transformation and use of transformation to reduce complex equation into standard equations. 6.2 Ellipse: Standard equation of ellipse with derivation, equation of tangent and normal condition for tangency. 6.3 Hyperbola: Standard equation of a hyperbola with derivation, rectangular hyperbola, conjugate hyperbola, equation of tangent and normal condition for tangency. 6.4 General equation of Conic section in Cartesian and Polar form
• Solve the problems related straight lines sphere, cone, and cylinder	**Unit VII: Three-dimensional Geometry (12 hrs.)** 7.1 Review coordinate in space and plane. 7.2 Straight line: Introduction, line in symmetrical form, line passing through two given points, reduction of general equation of a line into symmetrical form, angle between a plane and a line, conditions for a line to lie on a plane, length of a perpendicular from a given point to the line, coplanar lines, condition for

	coplanarity of two lines, shortest distance its length and equation. 7.3 Sphere: Equation of a sphere, condition for a general equation of second degree to represent a sphere, equation in diameter form, plane section of a sphere, circle as intersection of a plane and a sphere, intersection of two spheres, equation of a tangent plane, condition of tangency and related problem. 7.4 Cone: Equation of a cone with given vertex and generator intersecting given conic related problems, Equation of right circular cone and related problems 7.5 Cylinder: Equation of a cylinder whose generator intersecting a given conic and parallel to the line $\frac{x}{l}=\frac{y}{m}=\frac{z}{m}$ and related problems, Equation of a right circular cylinder and related problems

5. List of Tutorials

The following tutorial activities of 30 hours per group of maximum 24 students shall be conducted to cover all the required contents of this course. This will enable the students to complete the related mathematical problems under the supervision of the subject teacher.

a) Problems on solution of system of linear equations by Gauss method (1 hr)
b) Determining rank of a matrix and test the consistency then solve the linear equations (2 hrs)
c) Problems on vector space and subspace (1 hr)
d) Linear dependence and independence, Linear transformation (1 hr)
e) Eigenvalues, eigenvectors and diagonalization, verifying Caley-Hamilton Theorem and its application in finding the inverse (2 hrs)
f) Simplex method for standard problems (2 hr)
g) Duality in LPP (1 hr)
h) Simplex method for mixed inequalities (Big-M method) (1 hr)
i) Dot and vector product of 3 and 4 vectors with geometrical interpretation (2 hrs)
j) Reciprocal system of vectors (1 hr)
k) To test for convergence of a series by different tests (3 hrs)
l) Finding centre of convergence, radius of convergence and interval of convergence (2 hrs)
m) To solve the problems on transformation of coordinates (1 hr)
n) Problems on ellipse and hyperbola (3 hrs)
o) Problems on straight lines (3 hrs)
p) Problems on sphere (2 hrs)
q) Problems related to cone and cylinder (2 hrs)

6. Evaluation System and Students' Responsibilities

Evaluation System

The internal evaluation of a student may consist of assignments, attendance, term-exams, and project works etc. The internal evaluation scheme for this course is as follows:

Internal Evaluation	**Weight**	**Marks**	**External Evaluation**	**Marks**
Theory		50		

Attendance & Class Participation	10%		Semester-End examination	50
Assignments	20%			
Presentations/Quizzes	10%			
Internal Assessment	60%			
Total Internal		50		
Full Marks: 50 + 50 = 100				

Students' Responsibilities

Each student must secure at least 45% marks in internal assessment evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

7. Prescribed Books and References

Text Books

1. Kreyszig, E. *Advanced Engineering Mathematics*. New Delhi: John Wiley and Sons Inc.
2. Thomas, G. & Finney, R. *Calculus and Analytical Geometry*. New Delhi: Narosa Publishing House.

References

1. Swokoswski, E.W. *Calculus with Analytic Geometry*. Prindle, Weber and Schmidi.
2. Narayan, S. *Analytical Solid Geometry*. S. Chand and company.
3. Prasad, C. *Algebra and Theory of Equations*. Pothishala Pvt. Ltd.
4. Cheney, W. & Kincaid, D. *Linear Algebra: Theory and applications*. Jones and Bartlett Publisher.
5. Vittal, P. R. *Analytical Geometry 2D and 3D*, Delhi: Pearson India.