Mathematics (Advanced)- II: Elementary Algebra

Faculty: FMS
Course Code: MTH103
Course Title: Topics in Elementary Algebra and Vectors
Number of Credits: 4 (4+0+0)

Course objectives: To introduce the basic tools of the theory of polynomial equations, complex numbers and some elementary number theory. The students will also be introduced to the matrix theory and its application to systems of linear equations.

Minimum prerequisites for taking this course, if any: Class XII pass with Mathematics.

Course structure with units, if applicable:

UNIT I: Theory of Equations and Complex Numbers
General properties of polynomials and equations, Fundamental theorem of algebra, Relations between the roots and the coefficients, Upper bounds for the real roots; Theorems on imaginary, integral and rational roots; Newton's method for integral roots, Descartes' rule of signs; De-Moivre's theorem for integer and rational indices and their applications, The nth roots of unity, Cardan's solution of the cubic, Descartes' solution of the quartic equation.

UNIT II: Basic Number Theory
Division algorithm in $\mathbb{Z}$, Divisibility and the Euclidean algorithm, Fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences.

UNIT III: Matrices and System of Linear Equations
Fundamental operations with vectors in Euclidean space $\mathbb{R}^3$, Linear combinations of vectors, Dot product, and their properties, Cauchy-Schwarz inequality, Triangle inequality, Solving linear systems using Gaussian elimination, Gauss-Jordan row reduction, Reduced row echelon form, Equivalent systems, Rank and row space, Eigenvalues, Eigenvectors, Eigenspace, Diagonalization, Characteristic polynomial of a matrix, Cayley-Hamilton theorem.

Reading suggestions:

1. Andrilli, S., & Hecker, D. (2016). Elementary Linear Algebra (5th ed.). Elsevier India.
2. Friedberg, Stephen H., Insel, Arnold J., & Spence, Lawrence E. (2003). Linear Algebra (4th ed.). Prentice-Hall of India Pvt. Ltd. New Delhi.
3. Hoffman, Kenneth, & Kunze, Ray Alden (1978). Linear Algebra (2nd ed.). Prentice Hall of India Pvt. Limited. Delhi. Pearson Education India Reprint, 2015.
4. Andreescu, Titu & Andrica, D. (2014). Complex numbers from A to...Z. (2nd ed.) Birkhäuser.
5. Dickson, Leonard Eugene (2009). First Course in the Theory of Equations. John Wiley & Sons, Inc. The Project Gutenberg eBook: http://www.gutenberg.org/ebooks/29785
6. Gallian, Joseph. A. (2017). Contemporary Abstract Algebra (9th ed.). Cengage Learning India Private Limited, Delhi. Indian Reprint 2021.
7. Goodaire, Edgar G., & Parmenter, Michael M. (2006). Discrete Mathematics with

Graph Theory (3rd ed.). Pearson Education Pvt. Ltd. Indian Reprint 2018.

Evaluation:
Mid-semester Written Examination: 40% Marks
End-semester Written Examination: 40% Marks
Quiz / Assignment/Presentation (oral / poster)/other: 20% Marks