

MA103 – Calculus of Single Variable and Linear Algebra
(2023 Autumn Semester)

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Course website: <http://people.iitgn.ac.in/~projesh/Teaching/MA103.2023/MA103.2023.html>

Course goals: This is a compulsory course for undergraduate first year students. The course will focus on the following three modules: (i) Linear Algebra, (ii) Calculus of Single Variable, and (iii) Sequences and Series.

COURSE CONTENTS

- (1) **Linear Algebra:** Systems of linear equations, matrices and Gauss elimination, determinant of a matrix, Invertible matrices, transpose of a matrix, special matrices (diagonal, triangular, symmetric etc); Vector space, linear independence, basis and dimension, linear transformations, matrix of a linear transformation, change of basis and similarity, rank of a matrix, Rank-Nullity theorem, eigenvalues and eigenvectors, characteristic polynomials, multiplicity, diagonalization; Inner product spaces, Gram- Schmidt process, orthonormal bases, projections and least-squares approximation, Spectral theorem for real symmetric matrices, Singular value decomposition (overview).
- (2) **Calculus of a Single Variable:** Limits and Continuity – definition and examples, Intermediate Value Property (IVP), Derivative of a function, Differentiation rules, L'Hôpital's Rule, Chain rule, Implicit differentiation, Local maxima and Local minima, Intermediate Value theorem, Rolle's Theorem and Mean Value Theorem, Boundedness, monotonicity, Functions and their Geometric properties; Convexity, Concavity and curve sketching; Antiderivatives, Definite integrals (definition and examples), Riemann integration, Fundamental theorem of calculus, Area between curves, Techniques of integration - transcendental functions, integration by parts, Improper integrals..
- (3) **Sequences and Series:** Convergence of a sequence, Subsequences and Cauchy Sequences, Cauchy Criteria, Infinite series, Convergence of series, Tests for convergence, Sandwich Theorem, Monotone sequence, Comparison test, Ratio test, Root test, Alternating series, Power series, Radius of convergence, Taylor series and Maclaurin series, Taylor's Theorem.

Textbooks

- (1) H. Anton and C. Rorres, *Elementary Linear Algebra Applications Version*. 11th edition, Wiley India,, 2005.
- (2) G.B. Thomas, Jr., M.D. Weir, J. Hass, F.R. Giordano, *Thomas' Calculus*. 11th edition, Pearson Education. Indian reprint by Dorling Kindersley (India) Pvt. Ltd. 2008.
- (3) G. Strang, *Linear Algebra and its Applications*. 4th edition, Thomson Brooks/Cole, Indian reprint, 2007.

LECTURES AND TUTORIALS

- **Lectures:** Mon 10.00 – 11.20 am and Thu 08.30 – 9.50 am (Jasubhai Auditorium)
- **Tutorials:** Wed 11.30 am – 12.50 pm (TBA)

Tutorial and Assignments

Two types of problem sets will be posted in regular intervals: Tutorials and Assignments.

- **Tutorial problems:** There are 9 tutorial sections for this class. Each student will be assigned to a unique tutorial section. This allocation will soon be communicated. At least some fraction of tutorial —will be discussed in tutorial session.
- **Assignment problems:** Assignment problems will not be discussed in class. Students are expected to work out these problems and submit them by the appropriate deadline. Solutions to assignments will be provided after deadline.

Discussing in a group is allowed and encouraged; however, each student should hand in their independently written solutions, written in their own words. Mere copying of others' work is strictly prohibited.

POLICY FOR EVALUATION

- **Quiz I:** 10%
- **Quiz II:** 10%
- **Examination I:** 30%
- **Examination II:** 30%
- **Assignment:** 10%
- **Attendance:** 10%

ATTENDANCE POLICY

Class participation will help you in staying on track and developing a deeper understanding and interest in the subject. As a result, attendance at lectures and tutorials will be recorded. The following is the policy for the marks based on the percentage in attendance:

% in Attendance	Marks
Above or equal to 70	10
50 to less than 70	5
Below 50	0

HONOR CODE

Students are expected to follow the Institute Honor Code at all times. Any suspected/alleged violations of the Honor Code will be investigated and may lead to disciplinary action, as per Institute policy.

GRADING POLICY

Relative grading policy will be followed.