

MA103 – Calculus of Single Variable and Linear Algebra
(2024 Autumn Semester)

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Office hours: TBA

Course Associates: TBA. (There will be 11 tutorial sections and hence 11 course associates.)

Course website: TBA

Course goals: This is a compulsory course for the first year undergraduate 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:** Tues. 8:30 – 9:50 am and Fri. 8:30 – 9:50 am (Jasubhai Auditorium)
- **Tutorials:** Mon. 5 am – 6:20 pm (7/101, 7/210, 7/103, 7/104, 7/105, 7/110, 7/201, 7/204, 7/205, 7/206, 7/207).

Tutorial and Assignments

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

- **Tutorial problems:** As mentioned before, there are 11 tutorial sections for this class. Each student will be assigned to a unique tutorial section. This allocation will be communicated soon. *Every student should attend only that tutorial section which is assigned to him/her.* The tutorial problems will be posted well in advance. It is the responsibility of the students to work on the problems before coming to a 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 deadline. Solution to an assignment will be provided after the deadline.

Discussing in a group is allowed and encouraged while working on tutorial and assignment problems; 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 stay on track and develop a deeper understanding and interest in the subject. Your attendance at lectures and tutorials will be recorded. Following marks will be allotted based on the percentage calculated based on your 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 Honour Code at all times. Any suspected/alleged violations of the Honour Code will be investigated and may lead to a disciplinary action as per the institute policy.

GRADING POLICY

Relative grading policy will be followed.