Department of Mathematics and Statistics,
Indian Institute of Technology Kanpur
MTH 101A, 2017-2018, Even Semester

Instructor and Tutor: Sasmita Patnaik
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Tutorial: Thursday 8 - 8:50 am.
Office hour: Thursday 4 - 5 pm.

Attendance is compulsory on tutorial days to encourage student's participation in problem solving sessions.

Text-book:
Thomas' Calculus (12th edition) by George B. Thomas Jr., Maurice D. Weir & Joel R. Hass.

Reference-book:
Introduction to Real Analysis (4th edition) by Robert G. Bartle & Donald R. Sherbert.

Course web site: https://sites.google.com/view/mth101-2017/home

Some proofs in the lecture notes and some problems in the practice problems are marked (*). Such proofs and problems will not be asked in the exams and quizzes.

Examinations: There will be two quizzes. Each one will be 20 minutes duration and 15 marks. There will be one mid-semester examination of 2 hours duration and 70 marks. End Semester Examination will be 3 hours duration and 100 marks.

Course Plan

Lecture 1: Real number system: Completeness property of $\mathbb{R}$.

Lecture 2: Convergence of a sequence, Sandwich theorem, Monotone sequences.

Lecture 3: Cauchy criterion, Bolzano Weierstrass Theorem

Lecture 4: Limits and Continuity of functions.

Lecture 5: Intermediate value property, Differentiability.

Lecture 6: Local maxima, Local minima, Rolle's theorem and Mean value theorem.

Lectures 7, 8, 9: Cauchy mean value theorem, L'Hospital rule, Convexity, Second derivative test for max and min, Point of inflection, curve sketching.

Lecture 10 Curve sketching (contd.), Taylor's theorem.

Lecture 11: Convergence of series, Geometric and Harmonic series, Absolute convergence.

Lecture 12: Comparison test, Cauchy condensation test.

Lecture 13: Ratio test, Root test, Leibniz's theorem.

Lecture 14: Power series, Radius of convergence, Taylor series, Maclaurin series.

Lecture 15: Introduction to Riemann integration.

Lecture 16: Elementary properties of Riemann integral.

Lecture 17: Fundamental Theorems of calculus.

Lecture 18: Improper integral of first & second kind.

Lecture 19: Applications of definite integral: Area between two curves.

Lecture 20: Polar coordinates, Graphs using polar coordinates, Area between two curves

Lecture 21: Volumes by Shell and Washer methods, Length of a curve.

Mid Semester Examination: February 19 - February 24, 2018

Lecture 22: Area of surface of revolution, Pappus's Theorem.

Lecture 23: Review of vector algebra, Equations of lines and planes.

Lecture 24: Continuity and Differentiability of vector functions, Arc length for space curves, Unit tangent vector.

Lecture 25: Unit normal and Curvature to plane and space curves.

Lecture 26: Functions of several variables, Continuity, Partial derivatives, differentiability.

Lecture 27: Increment theorem, Chain rule.

Lecture 28: Gradient, Directional derivatives, Tangent plane and Normal line.

Lecture 29: Mixed derivative theorem, Mean value theorem (MVT), Extended MVT.

Lecture 30: Maxima, Minima and Saddle points.

Lecture 31: The method of Lagrange multipliers.

Lecture 32: Double integral, Fubini's theorem, Volumes and Areas.

Lecture 33: Change of variable in a double integral, special case: Polar coordinates, Triple integral, Applications.

Lecture 34: Change of variables in a triple integral, Special cases : Cylindrical and Spherical coordinates, Surface area.

Lecture 35: Surface area (contd.), Surface integrals, Line integrals.

Lecture 36: Green's Theorem.

Lecture 37: Vector fields, Divergence and Curl of a vector field.

Lecture 38: Stokes' Theorem.

Lecture 39: Divergence theorem.

End Semester Examination : April 22 - May 2, 2018
