

Reference: <https://iitk.ac.in/math/index.php/2014-05-21-10-30-47/courses> (MTH 101)

Syllabus: Pre-requisite: None

Single Variable Calculus: Real number system: Completeness axiom, density of rationals (irrationals), convergence of a sequence, Sandwich theorem, Monotone sequences, Cauchy Criterion, Subsequence, Every bounded sequence has a convergent subsequence, convergence of a sequence satisfying Cauchy criterion, Limits and Continuity of functions, Boundedness of a continuous function on $[a, b]$, Existence of max of a continuous function on $[a, b]$, Intermediate value property, Differentiability, Necessary condition for local maxima, Rolles theorem and Mean Value theorem, Cauchy mean value theorem, L'Hospital rule, Fixed point iteration method (Picard's method), Newton's method, Increasing and decreasing function, Convexity, Second derivative test for max and min, Point of Inflection, Curve Sketching, Taylor's theorem and remainder, Convergence of series, Geometric and Harmonic Series, Absolute convergence, Comparison test, Cauchy Condensation test, Ratio test, Root test, Examples, Leibniz' theorem, Power series, Radius of convergence, Taylor Series, Maclaurin Series, Introduction to Riemann Integration, Integrability, The Integral existence theorem for continuous functions and monotone functions, Elementary properties of integral, Fundamental theorems of Calculus, Trapezoidal approximation, Simpson's Rule, Improper integral of first and second kind, Comparison test, Absolute convergence, Application of definite integral, Area between two curves, Polar coordinates, Graphs of polar coordinates, Area between two curves when their equations are given in polar coordinates, Volumes by slicing, Volumes by Shells and Washers, Length of a curve, Area of surface of revolution, Pappus's theorem, Review of vector algebra, Equations of lines and planes, Continuity and Differentiability of vector functions, Arc length for space curves, Unit tangent vector, Unit normal and curvature to plane and space curves, Binormal, Functions of several variables, Continuity, Partial derivatives, Differentiability, Differentiability implies continuity, Increment theorem, Chain rule, Gradient, Directional derivatives, Tangent plane and Normal line, Mixed derivative theorem, Mean value theorem, Minima and Saddle point, Necessary and sufficient conditions for Maxima, minima and Saddle point, The method of Lagrange multipliers, Double Integral, Fubini's theorem, Volumes and Areas, Change of variable in double integral. Special cases: Polar coordinates, Triple

integral, Applications, Change of variable in triple integral. Special cases:
Cylindrical and Spherical coordinates, Surface area, Surface integral, Line
Reference materials:

1. Thomas and Finney: "Calculus and Analytical Geometry", 9th Edition,
Addison and Wesley Publishing Company.

Credits: 11