

U.G. 2nd Semester

Paper: MTH201C (Core) Analysis - I

Credits: 5 = 4+1+0 (64 Lectures)

Unit-I (10 lectures)

Algebraic and order properties of \mathbb{R} , δ -neighborhood of a point in \mathbb{R} , idea of countable sets, uncountable sets. Bounded and unbounded sets, suprema and infima.

Unit-II (07 lectures)

The completeness property of \mathbb{R} , the Archimedean property, density of rational and irrational numbers in \mathbb{R} , intervals.

Unit-III (11 lectures)

Interior point, limit point, boundary points of a set, isolated points, open sets, closed sets, closure, derived set, cantor set, compact sets, Heine-Borel theorem, Bolzano-Weierstrass theorem for sets.

Unit-IV (18 lectures)

Sequences, bounded sequence, convergent sequence, limit of a sequence. limit theorems, monotone sequences, monotone convergence theorem. subsequences, divergence criteria, monotone subsequence theorem (statement only), Bolzano Weierstrass Theorem for sequences. Cauchy sequence, Cauchy's Convergence criterion.

Unit-V (18 lectures)

Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

Books Recommended

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. G. G. Bilodeau , P. R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.

Books for Reference

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, McGraw Hill Education; 1st Edition, 2007.
2. B. S. Thomson, A. M. Bruckner and J. B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
3. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994.
4. F. Ayres, E. Mendelson, Schaum's Outline of Calculus, McGraw Higher Ed, 6th Edition, 2012.

Paper: MTH202C (Core)

Differential Equations-I

Credits: 5=4+1+0 (64 Lectures)

Unit– I: (10 lectures)

Review of first order first degree differential equations; linear and Bernoulli's differential equations. Exact differential equations and integrating factors of first order differential equations; Lipschitz condition; existence and uniqueness theorem (statement only).

Unit– II: (10 lectures)

Method of solving higher degree equations solvable for x , y and p . Clairaut's form and singular solutions, orthogonal trajectories. Singular solution of first order ordinary differential equations. Applications of first order differential equation.

Unit– III: (16 lectures)

General linear equation of second and higher order, principle of superposition for a homogeneous equation, Wronskian: its properties and applications, solutions of linear homogeneous and non-homogeneous equations of higher order with constant coefficients, method of variation of parameters, method of undetermined coefficients.

Unit– IV: (14 lectures)

Linear differential equations of second order with variable coefficients, standard methods, removal of first derivative, transformation of the equation by changing the independent variable, variation of parameter, applications of second order differential equations.

Unit– V: (14 lectures)

System of first order ordinary differential equations. Total differential equation of the form $Pdx+Qdy+Rdz=0$ and simultaneous equations of the form $dx/P=dy/Q=dz/R$. Exact differential equations including the special form $\frac{d^n y}{dx^n} = f(x)$.

Books Recommended

1. S. L. Ross, Differential Equations, John Wiley and Sons, India, 2004.
2. G. Simmons, Differentials Equations with Applications and Historical Notes 2nd Edition (International Series in Pure & Applied Mathematics), McGraw-Hill Higher Education, 1991

Books for Reference

1. B. Barnes and G. R. Fulford, Mathematical Modeling with Case Studies, A Differential Equation Approach Using Maple, Taylor and Francis, London and New York, 2002.
2. C. H. Edwards and D. E. Penny, Differential Equations and Boundary Value Problems: Computing and Modeling, Pearson Education, India, 2005.
3. R. Bronson, Gabriel Costa, Differential Equations 3rd Edition, Schaum's Outline, 2009.

**Paper: MTH203G (General Elective)
Calculus and Differential Equations**

Credits: 4 = 3+1+0 (48 Lectures)

Unit-1 (20 lectures)

Successive differentiation, standard results on nth order derivatives and Leibnit'z theorem, Rolle's theorem, Lagrange's Mean Value theorem, Cauchy's Mean Value theorem, Taylor's theorem, Maclaurin's theorem. Maclaurin's infinite power series for a given function; expansion of $\exp(x)$, $\sin x$, $\cos x$, $\log(1+x)$ and allied functions. Indeterminate forms.

Functions of several variables, limit and continuity, partial derivatives, differentiability, Eulers theorem on homogeneous functions, chain rule, extreme values of functions of two variables.

Reduction formulae for integration of the following functions: $x^n e^{ax}$, $x^m \sin nx$, $x^m \cos nx$, $\tan nx$, $\operatorname{cosec} nx$, $\cos mx$, $\sin mx$.

Unit-2 (14 lectures)

Sequence of real numbers, bounded, convergent and non- convergent sequences, uniqueness of the limit and boundedness of a convergent sequence., Cauchy's general principle of convergence, Cauchy sequence, subsequences, convergence and divergence of monotonic sequences, algebraic operations of limit, Sandwich theorem. Infinite series and the basic properties of infinite series. Absolute & conditional tests for convergence, comparison test, ratio test, Leibnitz test, Cauchy's root test.

Unit-3 (14 lectures)

Introduction to first order first degree differential equations, exact differential equations, integrating factors of first order differential equations, orthogonal trajectories. First order higher degree differential equations. General solution of homogeneous equation of second order, linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation.

Books Recommended:

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005
2. S. Arora, S. C. Malik, Mathematical analysis, New Age Science Ltd, 2009
3. S.L. Ross, Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.

Books for Reference:

1. M.D. Raisinghania, Ordinary and partial differential Equation:. S.Chand and Co., India, 2017
2. B. C. Das and B. N. Mukherjee, Differential Calculus, U. N. Dhur & sons, 1932.
3. B. C. Das and B. N. Mukherjee, Integral Calculus, U N Dhur & Sons, 1932.