Approval: 22nd Senate Meeting

Course Name	: Real Analysis
Course Number	: MA-511
Credit	: 3-1-0-4
Prerequisites	: None
Students intended for	: M.Sc. /M.S./Ph.D. /B.Tech 3rd and 4th year
Elective or core	: Core for M.Sc. in applied Mathematics and Elective for other discipline.
Semester	: Odd/Even

Preamble: The objective of this course is to introduce real analysis. Real analysis is a backbone of mathematics (pure and applied both) for example we need to have a profound knowledge of real analysis to study partial differential equation, functional analysis, probability theory etc.

1. Introduction to real numbers, Construction, Dedekind cuts, Completeness property, Archimedean property, Countable and uncountable set. **[4hours]**
2. Open balls and open sets in Euclidean space, Definition of interior points, Closed sets, Adherent points, Accumulation points, Closure, Bolzano-Weirstrass Theorem, Cantor intersection theorem, Heine-Borel Theorem, Compactness. **[6hours]**
3. Metric spaces, Open sets, Closed sets, Dense sets, Metric subspaces, Compact subsets of a metric space, Boundary of a set, Totallyboundedness, Completeness. **[7hours]**
4. Convergent sequences in a metric space, Cauchy sequences, Complete metric space, Limit of a function, Continuous functions, Continuity of composite functions, Continuity and inverse image of open and closed sets, Functions continuous on compact sets, Connectedness. **[8hours]**
5. Review of Riemann Integration, Riemann-Stieltjes integral: definition and examples, Properties of the integral. **[4hours]**
6. Uniform continuity, Fixed point theorem for contractions, Sequences of functions, Point wise convergence of sequences of functions, Uniform convergence of sequences of functions, Uniform convergence and continuity, Cauchy condition for uniform convergence, Uniform convergence of infinite series of functions, Cauchy condition for uniform convergence of series, Weirstrass M-test, Dirichlet's test for uniform convergence, Uniform convergence and differentiation, Uniform convergence and integration **[10hours]**
7. Metric space C[a,b], Characterize compact subsets, i.e., Arzela-Ascoli theorem. **[3hrs]**

Text Books

1. **W. Rudin**, Principles of Mathematical Analysis, 3rd ed., McGraw-Hill, 2013.
2. **T. Apostol**, Mathematical Analysis, 2nd ed., Narosa Publishers, 2002.

Reference Books

1. **Elias M. Stein and Rami Shakarchi**, Real Analysis, Princeton Lectures, 2010.
2. **Terrance Tao**, Analysis I and II, Trim, Hindustan book agency, 2006.