Syllabus template

Semester: 2	
Programme: Mathematics	
Course: Analysis-1	
Paper code: C1MT230221T	**Credits: 4**
Hours/week: 4 hours	
Category: Core	
Theory/Practical/Composite: Theory	
No of Modules : Nil	

Course Overview: This course provides a rigorous foundation for the study of real numbers and the fundamental concepts of analysis. It introduces students to the **algebraic and order structure of the real number system**, the **completeness property**, and explores how these underpin the behavior of **sequences, series, and limits of functions**.

Course Outcome: Analysis-1

1. Explain and apply the algebraic and order properties of real numbers, including the completeness, Archimedean, and density properties.
2. Analyze and determine the boundedness, supremum, and infimum of subsets of $\mathbb{R}$, illustrating the completeness property through examples.
3. Examine the behavior of sequences — convergence, divergence, monotonicity, and boundedness — using formal limit definitions and theorems such as the Squeeze and Monotone Convergence Theorems.
4. Evaluate and prove fundamental results involving subsequences, lim sup / lim inf, and the Bolzano–Weierstrass and Cauchy convergence criteria for sequences..
5. Apply and compare various tests for convergence of infinite series, including comparison, ratio, root, Raabe's, and alternating series tests, and understand the Riemann rearrangement theorem.
6. Define and analyze the limits of real-valued functions, applying limit theorems and sequential criteria to determine convergence, divergence, and one-sided/infinite limits.

Prerequisites: ***Basic knowledge about any prior course****: The first course in real analysis.*

SYLLABUS

UNIT/Module	CONTENT	HOURS or NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
I.	Bounded and Unbounded subsets, Suprema and Infima, The Completeness Property of R (2). The Archimedean Property, Density of Rational (and Irrational) numbers in R with special reference to well-ordering property (2).	4 hours	CO1, CO2	K2, K3, K4

II.	Sequence of real numbers Bounded sequence, Convergent sequence, Limit of a sequence (4). Limit Theorems, Proof of Squeeze theorem and application (3). Monotone Sequences, Monotone Convergence Theorem, Nested interval theorem (4). Subsequences, Divergence criteria Monotone Subsequence Theorem, Bolzano Weierstrass Theorem for Sequences (5). Subsequential limit. Limsup and liminf of a sequence. Looking into limsup and limimf from viewpoint of MCT (6). Cauchy sequence, Cauchy's Convergence Criterion (2)	24 hours	CO3, CO4	K4, K5
III.	Cauchy's criterion of convergence (2); Test for convergence: comparison test, limit comparison test, ratio test, Cauchy's nth root test, Raabe's test, Cauchy's condensation test (5); Alternating series, absolute and conditional convergence, Leibnitz test, Abel's and Dirichlet's test (4); Rearrangement of series, Riemann's Rearrangement theorem (Statement only) (3).	14	CO5	K3, K5
IV.	Definition, sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity (10)	10	CO6	K3, K4
Text Books				
1. Introduction to Real Analysis: Bartle and Sherbert				
2. Real Analysis: S.K. Mapa				
Suggested readings				
1. Calculus and Mathematical Analysis: S. Goldberg				

2. Principles of Mathematical Analysis:W. Rudin
3. Mathematical Analysis : T. Apostol
4. Analysis 1: Terence Tao
Web Resources
1. https://nptel.ac.in/courses/111106053
2. https://onlinecourses.nptel.ac.in/noc20_ma51/preview
Evaluation: Theory CIA: 20+5+5=30 Semester Exam: 70
Paper Structure for Theory Semester Exam: 7 questions each carrying 10 marks out of 12/13 questions.

Course outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive levels
CO1	Explain and apply the algebraic and order properties of real numbers, including the completeness, Archimedean, and density properties.	K2, K3
CO2	Analyze and determine the boundedness, supremum, and infimum of subsets of $\mathbb{R}$, illustrating the completeness property through examples.	K4
CO3	Examine the behavior of sequences — convergence, divergence, monotonicity, and boundedness — using formal limit definitions and theorems such as the Squeeze and Monotone Convergence Theorems.	K4
CO4	Evaluate and prove fundamental results involving subsequences, lim sup / lim inf, and the Bolzano–Weierstrass and Cauchy convergence criteria for sequences..	K5
CO5	Apply and compare various tests for convergence of infinite series, including comparison, ratio, root, Raabe's, and alternating series tests, and understand the Riemann rearrangement theorem.	K3, K5
CO6	Define and analyze the limits of real-valued functions, applying limit theorems and sequential criteria to determine convergence, divergence, and one-sided/infinite limits.	K3, K4