Syllabus template

Semester: 3	
Programme: Mathematics	
Course: Analysis-2	
Paper code: C2MT230311T	**Credits: 4**
Hours/week: 4 hours	
Category: Core	
Theory/Practical/Composite: Theory	
No of Modules : Nil	

Course Overview: This course covers essential topics in real analysis, specifically focusing on **continuity** and **differentiability** of functions. It introduces fundamental concepts, theorems, and properties, laying the groundwork for understanding the behavior of functions in both theoretical and applied contexts like maxima, minima, acceleration accent, tangent lines slopes. Students will explore continuity, its criteria, and the properties of continuous functions, followed by an in-depth study of differentiability, derivative theorems, and applications.

Course Outcome: Analysis-1I

1. Define and explain the concept of continuity of a function and apply the sequential criterion for continuity and discontinuity. Analyze the algebra of continuous functions and prove the properties of continuous functions on closed and bounded intervals.
2. Analyze and apply the intermediate value property (IVP) to continuous functions. Investigate fixed points of continuous functions, and prove related results for monotone functions and continuous injective functions.
3. Understand and differentiate between uniform and nonuniform continuity. Apply the criterion for uniform continuity, particularly for functions defined on closed and bounded intervals, and use the Lipschitz condition to check for uniform continuity.
4. Recall and define the concept of differentiability at a point and over an interval. Apply Carathéodory's theorem and the chain rule for differentiating composite functions. Calculate and interpret the sign of a derivative.
5. Analyze and apply Rolle's theorem, Mean Value Theorem, Darboux's theorem, and Cauchy's Mean Value Theorem. Use these theorems to find fixed points and evaluate the behavior of functions
6. Apply Taylor's theorem (including Lagrange's and Cauchy's form of the remainder) to solve problems involving convexity and relative extrema. Create Taylor and Maclaurin series expansions for exponential and trigonometric functions, and use them for approximation and analysis.

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

SYLLABUS

UNIT/Module	**CONTENT**	**HOURS or NUMBER OF**	**CO Mapping**	**COGNITIVE LEVEL**

		CLASSES		
I.	Continuous functions, sequential criterion of continuity and discontinuity (4); Algebra of continuous functions (2) Statement and proof of properties of continuous functions defined on closed and bounded intervals: boundedness, attainment of bounds, Bolzano's theorem (6); Intermediate value property & allied results, fixed points of continuous functions. Set of discontinuities of monotone functions, continuous injective functions are strictly monotone, converse of IVP (5). Uniform continuity, nonuniform continuity criterion, functions continuous on a closed and bounded interval is uniformly continuous, Lipschitz condition and uniform continuity (6) Continuous extension theorem, monotone and inverse functions, inverse function theorem (5)	28 hours	CO1, CO2, CO3,CO4	K1,K2, K3, K4
II.	Concept of differentiability of a function at a point and in an interval, Caratheodory's theorem, chain rule, sign of derivative(3);Algebra of differentiable functions; Relative extrema, interior extremum, point extremum(3) ; Successive derivative: Leibnitz theorem and its applications(2) ;Rolle's theorem, Meanvalue theorems, Darboux theorem, fixed points of differentiable functions; Cauchy's mean value theorem(5),Taylor's	24 hours	CO1,CO2,CO5, CO6	K2, K4, K5, K6

	theorem with Lagrange's and Cauchy's form of reminder; Application of Taylor's theorem to convex functions ,relative extrema(5);Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions(4). Indeterminate forms: L.Hospital's rule and its applications(2)			

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	Define and explain the concept of continuity of a function and apply the sequential criterion for continuity and discontinuity. Analyze the algebra of continuous functions and prove the properties of continuous functions on closed and bounded intervals.	K2, K3
CO2	Analyze and apply the intermediate value property (IVP) to continuous functions. Investigate fixed points of continuous functions, and prove related results for monotone functions and continuous injective functions.	K4, K3
CO3	Understand and differentiate between uniform and nonuniform continuity. Apply the criterion for uniform continuity, particularly for functions defined on closed and bounded intervals, and use the Lipschitz condition to	K2, K3

	check for uniform continuity	
CO4	Recall and define the concept of differentiability at a point and over an interval. Apply Carathéodory's theorem and the chain rule for differentiating composite functions. Calculate and interpret the sign of a derivative.	K1, K3
CO5	Analyze and apply Rolle's theorem, Mean Value Theorem, Darboux's theorem, and Cauchy's Mean Value Theorem. Use these theorems to find fixed points and evaluate the behavior of functions	K4, K6
CO6	Apply Taylor's theorem (including Lagrange's and Cauchy's form of the remainder) to solve problems involving convexity and relative extrema. Create Taylor and Maclaurin series expansions for exponential and trigonometric functions, and use them for approximation and analysis.	K3, K5