DEPARTMENT OF MATHEMATICS

Subject : 060090308 CC5 Real Analysis

Teaching Schedule

Course Objectives: To develop an in-depth mathematical understanding of the theory of calculus and to utilize rigorous mathematical proofs of basic results in real analysis.

Course Outcomes: Upon completion of the course, students shall be able to

CO1: define and recognize the basic properties of the field of real numbers.

CO2: demonstrate an understanding of limits and how they are used in continuity, differentiability, sequences, and series.

CO3: formulate characterizations of continuity in terms of convergent sequences and in terms of limits of functions.

CO4: define the limit of a function at a value, a limit of a sequence, and the Cauchy criterion.

CO5: state various convergence tests for series (e.g. comparison test or the ratio test) and use them to detect convergence or divergence of series.

CO6: apply the theorem in a correct mathematical way.

Unit	Sub Unit	No. of Lect.(s)	Topics	Reference Chapter/ Additional Reading	Teaching Methodology to be used	Active Learning Activities	Evaluation Parameter
Unit 1: Real valued functions							
[17]	1.1	1	Real number system, Algebraic and ordered properties of R, Rational Irrational numbers in R	Ch#2,3,4 Elements of Real Analysis S. Narayan	Chalk & Talk	**For Slow Learner:** Students must write answer of question(s) given by teacher after completion of unit **For Active Learner:** Student will solve extra examples other than examples which are given in assignment after completion of Unit.	Assignment-1
	1.2	1	Open sets of R, Closed sets of R				
	1.3	2	Countable and uncountable sets of R				
	1.4	1	Bounded and unbounded sets of R				
	1.5	3	Suprema and Infima, The Completeness property of R				
	1.6	2	The Archimedean property				
	1.7	3	δ-neighborhood of a point in R				

	1.8	4	Compact sets, connected Sets, Heine-Borel theorem.				
Unit 2: Limit, Continuity and Differentiability							
[23]	2.1	1	Limit points, Isolated points	Ch#2,4 Real Analysis P. K. Gupta	Chalk & Talk	**For Slow Learner:** Students must write answer of question(s) given by teacher after completion of unit **For Active Learner:** Student will solve extra examples other than examples which are given in assignment after completion of Unit.	Unit Test -1 and Assignment-2
	2.2	2	Bolzano-Weierstrass theorem				
	2.3	2	Continuous functions				
	2.4	3	Algebra of continuous function, Properties of continuous function				
	2.5	3	Intermediate value theorem				
	2.6	3	Uniform continuity, discontinuities of function				
	2.7	3	derivative of function of several variable				
	2.8	3	Rolle's theorem with geometrical interpretation				
	2.9	3	Lagrange's theorem with geometrical interpretation				
Unit 3: Convergence of sequences							
[12]	3.1	2	Sequences, Bounded sequence, Convergent sequence	Ch#5 Elements of Real Analysis S. Narayan	Chalk & Talk	**For Slow Learner:** Students must write answer of question(s) given by teacher after completion of unit **For Active Learner:** Student will solve extra examples other than examples which are given in assignment after completion of Unit.	Unit test-2 Assignment-3
	3.2	2	Limit of a sequence, Limit theorems				
	3.3	2	Monotone sequences, Monotone convergence theorem				
	3.4	2	Subsequences, Divergence criteria				
	3.5	2	Bolzano Weierstrass theorem for Sequences				

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	3.6	2	Cauchy sequence, Cauchy's convergence criterion				
Unit 4: Infinite series							
[23]	4.1	2	Infinite series	Ch#6 Elements of Real Analysis S. Narayan	Chalk & Talk	**For Slow Learner:** Students must write answer of question(s) given by teacher after completion of unit **For Active Learner:** Student will solve extra examples other than examples which are given in assignment after completion of Unit.	Internal Examination and Assignment-4
	4.2	3	Convergence and divergence of infinite series				
	4.3	2	Cauchy criterion				
	4.4	3	Comparison test				
	4.5	2	Limit comparison test				
	4.6	2	Ratio Test				
	4.7	2	Cauchy's nth root test				
	4.8	2	Integral test				
	4.9	3	Alternating series				
	4.10	2	Leibniz test, Absolute and conditional convergence.				

Text books:

1. S. Narayan and M. D. Raisinghania, "Elements of Real Analysis", Sultan Chand & Sons   Educational Publishers, New Delhi, 2015.

Reference books:

1. P. K. Gupta and S. Gupta-"Real Analysis", 1st Edition, Sultan Chand & Sons Educational Publishers, New Delhi.
2. N. P. Bali, "Real Analysis", - 1st Edition, Firewall Media Publications Pvt. Ltd., New Delhi, 2009.
3. R.G. Bartle and D. R. Sherbert –" Introduction to Real Analysis" - 3rd Edition, John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
4. S.C. Malik and Savita Arora, "Real Analysis" – New Age International (P) Ltd., Publishers, New Delhi, 2009.

Course Objectives and Course Outcomes Mapping:

☐ To develop an in-depth mathematical understanding of the theory of calculus: CO1, CO2, CO3

☐ To utilize rigorous mathematical proofs of basic results in real analysis: CO4, CO5, CO6

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Course Units and Course Outcomes Mapping:

Unit No.	Unit	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	Real valued functions	√					√
2	Limit, Continuity and Differentiability		√	√			√
3	Convergence of sequences			√	√		√
4	Infinite series					√	√

Programme Outcomes (PO)

PO1: Knowledge

Provides knowledge about the fundamentals of pure, applied and computing mathematics and its applications to students that creates the opportunities in industries and research centers.

PO2: Core Competence

Creates competency in science and mathematics to formulate, analyses and solve problem and/or also to pursue advanced study or research.

PO3: Breadth

Trains students having good knowledge in unearth core of academia and industry by the roots of mathematics.

PO4: Evaluation

Imparts in students to raise trial and error-based curiosity and problem-solving functionality with research based advanced tutorial for higher level decision makings tools.

Programme Outcomes and Course Outcomes mapping:

Programme Outcomes	Course Outcome					
	CO1	CO2	CO3	CO4	CO5	CO6
PO1	√	√		√	√	
PO2		√	√		√	√
PO3			√		√	√
PO4					√	√