



# ARSD College, University of Delhi

## Model Course Handout/Lesson Plan

Course Name:		<b>B.Sc. (H) Mathematics</b>				
Semester	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
I	DSE-2	Elementary Real Analysis	3	1	0	4
Teacher/Instructor(s)		<b>ADIBA NAZ</b>				
Session		<b>2022-23</b>				

### Course Objectives:

The course will develop a deep and rigorous understanding of real line with algebraic, order and completeness properties to prove the results about convergence and divergence of sequences and series of real numbers. These concepts have wide range of applications in real life.

### Course Learning Outcomes:

This course will enable the students to:

- 1) Understand the fundamental properties of the real numbers, including completeness and Archimedean, and density property of rational numbers in.
- 2) Learn to define sequences in terms of functions from to a subset of and find the limit.
- 3) Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate the limit superior and limit inferior of a bounded sequence.
- 4) Apply limit comparison, ratio, root, and alternating series tests for convergence and absolute convergence of infinite series of real numbers.

### Lesson Plan:

Unit No.	Learning Objective	Lecture No.	Topics to be Covered
1	Real Number	1	The Algebraic Properties of $\mathbb{R}$
		2	The Order Properties of $\mathbb{R}$
		3	Inequalities in $\mathbb{R}$
		4	Arithmetic-Geometric Mean and Bernoulli Inequality
		5	Absolute Value of a Real Number
		6	Triangle Inequality
		7	The Real Line
		8	Suprema and Infima
		9	The Completeness Property of $\mathbb{R}$
		10	Archimedean Property
		11	Corollaries of Archimedean Property
		12	Density of Rational Numbers in $\mathbb{R}$
		13	Sequences and its Examples
		14	Limit of a Sequence

		15	Convergent Sequences
		16	Squeeze Theorem and its Applications
		17	Limit Theorems
		18	Illustrations of Limit Theorems
2	Sequences	19	Monotone Sequences
		20	Monotone Convergence Theorem
		21	Applications of Monotone Convergence Theorem
		22	Subsequences
		23	Bolzano-Weierstrass Theorem
		24	Limit Superior and Limit Inferior for Bounded Sequences with Illustrations
		25	Cauchy Sequences of Real Numbers
		26	Cauchy's Convergence Criterion
		27	Cauchy's Convergence Criterion
3	Series	28	Convergence and Divergence of Infinite Series
		29	Sequence of Partial Sums of Infinite Series
		30	Cauchy Criterion for Convergence of Series
		31	Test for Convergence of Positive Term Series
		32	Integral Test and Convergence p-Series Test
		33	Basic Comparison Test
		34	Limit Comparison Test
		35	Ratio and Root Test
		36	Examples of Ratio and Root Test
		37	Alternating Series
		38	Illustrations of Alternating Series
		39	Leibnitz Test
		40	Absolute Convergence
		41	Conditional Convergence
		42	Revision and Test

### Evaluation Scheme:

S. No.	Component	Duration	Marks
1	Internal Assessment <ul style="list-style-type: none"> <li>• Quiz</li> <li>• Class Test</li> <li>• Attendance</li> <li>• Assignment</li> </ul>		25
2	End Semester Examination	3 hr	75

### Details of the Course:

Unit	Content	Contact Hours
1	<b>Real Number System</b> Algebraic and order properties of $\mathbb{R}$ , Absolute value of a real number, Bounded above and bounded below sets, Supremum and infimum of a non-empty subset of $\mathbb{R}$ , The completeness property of $\mathbb{R}$ , Archimedean property, Density of rational numbers in $\mathbb{R}$	18

2	<b>Sequences</b>	
	Sequences and their limits, Convergent sequence, Limit theorems, Monotone sequences, Monotone convergence theorem, Subsequences, Bolzano-Weierstrass theorem for sequences, Limit superior and limit inferior for bounded sequence, Cauchy sequence, Cauchy's convergence criterion.	9
3	<b>Infinite Series</b>	
	Convergence and divergence of infinite series of real numbers, Necessary condition for convergence, Cauchy criterion for convergence, Tests for convergence of positive term series, Integral test, Basic comparison test, Limit comparison test, D'Alembert's ratio test, Cauchy's $n$ th root test, Alternating series, Leibniz test, Absolute and conditional convergence.	15
<b>Total</b>		<b>42</b>

### Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1	Bartle, Robert G., & Sherbert, Donald R. (2011). <i>Introduction to Real Analysis</i> (4th ed.). John Wiley & Sons. Wiley India Edition	2015
2	Bilodeau, Gerald G., Thie, Paul R., & Keough, G. E. (2010). <i>An Introduction to Analysis</i> (2nd ed.). Jones and Bartlett India Pvt. Ltd. Student Edition.	2015
3	Denlinger, Charles G. (2011). <i>Elements of Real Analysis</i> . Jones and Bartlett India Pvt. Ltd. Student Edition.	2015

### Mode of Evaluation:

Internal Assessment/End Semester Exam