Shyam Lal College, University of Delhi
Model Course Handout/Lesson Plan

Course Name: B.Sc. (Physical Science) with Computer Science						
Semester	**Course Code**	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credit**
5th		Elements of Real Analysis	3	1	0	4
Teacher	**Dr. Seema Guglani**					
Session	2023-24					

Course Objectives: The primary objective of this course is to:

- The real line with algebraic, order and completeness properties.
- Convergence and divergence of sequences and series of real numbers with applications.

Course Learning Outcomes: This course will enable the students to:

- Understand the basic properties of the set of real numbers, including completeness and Archimedean with some consequences.
- Recognize bounded, convergent, monotonic and Cauchy sequences
- Learn to apply various tests such as limit comparison, ratio, root, and alternating series tests for convergence and absolute convergence of infinite series of real numbers.

Week	Topic to be covered	Pedagogical Approaches	References
Weeks 1 and 2	Field and order properties of $\mathbb{R}$, basic properties and inequalities of the absolute value of a real number.	Technology based learning	Chapter 1 (Sections 1.1, and 1.2).
Weeks 3 and 4	Bounded above and bounded below sets, Suprema and infima, The completeness axiom and the Archimedean property of $\mathbb{R}$.	Technology based learning	Chapter 1 (Section 1.6 [1.6.1 to 1.6.14, Theorems 1.6.2 and 1.6.10 without proofs]). Chapter 1 (Section 1.5 [1.5.1, 1.5.2, and 1.5.9]).
Weeks 5 and 6	Convergence of a real sequence, Algebra of limits.	Technology based learning	Chapter 2 (Section 2.1). Chapter 2 (Section 2.2

			[2.2.1 to 2.2.14, Theorems 2.2.8, 2.2.12, and 2.2.13 (d to f) without proofs])
Week 7	The squeeze principle and applications.	Group Learning and Teaching	Chapter 2 (Section 2.3 [2.3.1 to 2.3.14, Theorems 2.3.6, 2.3.10, and 2.3.14 without proofs])
Weeks 8 and 9	Monotone sequences, Monotone convergence theorem and applications.	Group Learning and Teaching	Chapter 2 (Section 2.5 [2.5.1 to 2.5.10, Theorems 2.5.5 and 2.5.7 without proofs)
Week 10	Cauchy sequences, Cauchy criterion for convergence and applications.	Group Learning and Teaching	Chapter 2 (Section 2.7 [2.7.1 to 2.7.6, Theorem 2.7.4 without proof])
Week 11	Convergence and divergence of infinite series of real numbers, Necessary condition for convergence, Cauchy criterion for convergence of series	Technology based learning	Chapter 2 (Section 8.1).
Weeks 12 to 14	Tests for convergence of positive term series, Applications of the integral test, Comparison tests, D'Alembert's ratio test, Cauchy's *n*th root test, Raabe's test.	Group Learning and Teaching	Chapter 2 (Section 8.2 [8.2.1 to 8.2.12, 8.2.14, 8.2.15, 8.2.17, 8.2.21, and 8.2.22, with all theorems without proofs]).
Week 15	Alternating series, Leibniz alternating series test, Absolute and conditional convergence	Group Learning and Teaching	Chapter 2 (Section 8.3 [8.3.1 to 8.3.10, Theorems 8.3.2, and 8.3.4 without proofs]).

Evaluation Scheme:

No.	Component		Duration	Marks
1	Internal Assessment	Tests		30
		Attendance		
		Assignments		

2	Continuous Assessment	Quiz with MCQ		40
		Case Study		
		Projects		
		Assignments		
		Attendance		
		Seminar Presentations		
3	End Semester Examination		3 hrs.	90

Essential Reading

1. Denlinger, Charles G. (2011). Elements of Real Analysis. Jones & Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.

Suggestive Readings

• Bartle, Robert G., & Sherbert, Donald R. (2011). Introduction to Real Analysis (4thed.). John Wiley & Sons. Wiley India Edition 2015.
• Bilodeau, Gerald G., Thie, Paul R., & Keough, G. E. (2010). An Introduction to Analysis (2nd ed.). Jones & Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.

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Model Course Handout/Lesson Plan

Course Name: B.Sc. (H) Mathematics						
Semester	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
3rd	2352012302	Riemann Integration	3	1	0	4
Teacher	Dr. Seema Guglani					
Session	2023-24					

Course Objectives: The primary objective of this course is to:

- Understand the integration of bounded functions on a closed and bounded interval and its extension to the cases where either the interval of integration is infinite, or the integrand has infinite limits at a finite number of points on the interval of integration.
- Learn some of the properties of Riemann integrable functions, its generalization and the applications of the fundamental theorems of integration.
- Get an exposure to the utility of integration for practical purposes.

Course Learning Outcomes: This course will enable the students to:

- Learn about some of the classes and properties of Riemann integrable functions, and the applications of the Riemann sums to the volume and surface of a solid of revolution.
- Get insight of integration by substitution and integration by parts.
- Know about convergence of improper integrals including, beta and gamma functions.

Week	**Topic to be covered**	**Pedagogical Approaches**	**References**
Weeks 1 and 2	Definition of upper and lower Darboux sums, Darboux integral, Inequalities for upper and lower Darboux sums.	Technology based learning	[1]: Chapter 6 (Sections 32.1 to 32.4).
Weeks 3 and 5	Necessary and sufficient conditions for the Darboux integrability; Riemann's definition of integrability by Riemann sum and the equivalence of Riemann's and Darboux's definitions of integrability.	Group Learning and Teaching	[1]: Chapter 6 (Sections 32.5 to 32.10).
Week 6	Definition and examples of the Riemann-Stieltjes integral	Group Learning and Teaching	[1]: Chapter 6 (Sections 35.1, and 35.2).

Weeks 7 and 9	Riemann integrability of monotone functions and continuous functions, Properties of Riemann integrable functions.	Group Learning and Teaching	[1]: Chapter 6 (Sections 33.1, and 33.6).
Week 10	Definitions of piecewise continuous and piecewise monotone functions and their Riemann integrability; Intermediate value theorem for integrals	Technology based learning	[1]: Chapter 6 (Sections 33.7 to 33.9, and Exercise 33.14).
Week 11	Fundamental Theorems of Calculus (I and II).	Technology based learning	[1]: Chapter 6 (Sections 34.1 to 34.3).
Weeks 12 and 13	Methods of integration: integration by substitution and integration by parts; Volume by slicing and cylindrical shells, Length of a curve in the plane and the area of surfaces of revolution.	Technology based learning	[2]: Chapter 4 (Section 4.9), Chapter 7 (Section 7.2), and Chapter 5 (Sections 5.2 to 5.5)
Weeks 14 and 15	Improper integrals of Type-I, Type-II and mixed type, Convergence of improper integrals, The beta and gamma functions and their properties.	Group Learning and Teaching	[3]: Chapter 7 (Section 7.8). [4]: Chapter 9 [Sections 9.5 (up to examples 9.47, page 395), and 9.6 (pages 405 to 408).

Evaluation Scheme:

No.	Component		Duration	Marks
1	Internal Assessment	Tests		30
		Attendance		
		Assignments		
2	Continuous Assessment	Quiz with MCQ		40
		Case Study		
		Projects		
		Assignments		

		Attendance		
		Seminar Presentations		
3	End Semester Examination		3 hrs.	90

Essential Readings

1. Ross, Kenneth A. (2013). Elementary Analysis: The Theory of Calculus (2nd ed.). Undergraduate Texts in Mathematics, Springer.
2. Anton, Howard, Bivens Irl and Davis Stephens (2012). Calculus (10th ed.). John Wiley & Sons, Inc.
3. Denlinger, Charles G. (2011). Elements of Real Analysis, Jones & Bartlett India Pvt. Ltd.
4. Ghorpade, Sudhir R. and Limaye, B. V. (2006). A Course in Calculus and Real Analysis. Undergraduate Texts in Mathematics, Springer (SIE). Indian Reprint.

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Course Name: B.Sc. (H) Mathematics						
Semester	**Course Code**	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credit**
3rd	6967006001	Vedic Mathematics-2	1	0	1	2
Teacher	**Dr. Seema Guglani**					
Session	2023-24					

Course Objectives: The primary objective of this course is to:

- Introduce the contributions of key mathematicians like Varahamihira, Brahmagupta, and Ramanujan.
- Teach practical Vedic techniques for solving equations, HCF, LCM, and linear equations.
- Explore the concepts and applications of matrices, determinants, and their historical significance.

Course Learning Outcomes: This course will enable the students to:

- Appreciate the mathematical contributions of ancient Indian mathematicians.
- Apply Vedic techniques to solve mathematical problems efficiently.
- Understand and work with matrices, determinants, and their inverses.
- Construct and analyse geometric shapes using Vedic methods.
- Utilize technology in mathematical problem-solving and presentations.

Week	Topic to be covered	Pedagogical Approaches
Weeks 1 to 3	• Varahamihira • Brahmagupta • Srinivasa Ramanujan • Neelkanth Somayya • Bharti Krishna Tirtha	Group Learning and Teaching
Weeks 4 to 7	• HCF and LCM • Introduction of simple equation • Solutions of simple equations • Solutions of linear equations in two variables • Practical application of linear equations in two variables	Technology based learning
Weeks 8 to 11	• Introduction and history of	Technology based learning

	Matrices and Determinants ● Matrices and Determinants of third order ● Inverse of Matrices	
Week 12 to 15	● Different forms of straight lines ● The Triangle ● The Cyclic Quadrilateral, Squares, and the Circle ● Geometrical constructions & Transformation of shapes ● Kalpa Sutras -Srautha Sutras and Sulbha Sutras	Group Learning and Teaching

Evaluation Scheme:

No.	Component		Duration	Marks
1	Internal Assessment	Tests		10
		Attendance		
		Assignments		
2	Continuous Assessment	Quiz with MCQ		40
		Case Study		
		Projects		
		Assignments		
		Attendance		
		Seminar Presentations		
3	End Semester Examination		1 hr	30

Essential Reading

- Thakur, Rajesh Kumar (2019). Advanced Vedic Mathematics. Rupa Publications India Pvt Ltd.
- Tiratha, B.K. (1965). Vedic Mathematics, Motilal Banarasi Dass, New Delhi.