

Part A: Introduction			
Program: Diploma Course		Class: B. A. / B.Sc. Part II	Year: 2022 Session: 2023-2024
1	Course Code	Paper – MATH-4T	
2	Course Title	Real Analysis	
3	Course Type	Theory	
4	Pre-requisite ( if any)	No	
5	Course Learning Outcome (CLO)	<p><b>This Course will enable the students to:</b></p> <ul style="list-style-type: none"> <li>• Understand basic properties of real number system such as least upper bound property and order property.</li> <li>• Realize importance of bounded, convergent, Cauchy and monotonic sequences of real numbers, find their limit superior and limit inferior.</li> <li>• Apply various tests to determine convergence and absolute convergence of a series of real numbers.</li> <li>• Learn about Riemann integrability of bounded functions and algebra of R-integrable functions.</li> <li>• Determine various applications of the fundamental theorem of integral calculus.</li> <li>• Relate concepts of uniform continuity, differentiation, integration and uniform convergence.</li> </ul>	
6	Credit Value	4	
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks :

Part B: Content of the Course		
Total Periods: 60		
Unit	Topics	No. of Periods
I	<b>Real Numbers:</b> The set of real numbers $\mathbb{R}$ as an ordered field, Least upper bound properties of $\mathbb{R}$ , Metric property and completeness of $\mathbb{R}$ , Archimedean property of $\mathbb{R}$ , Dense subsets of $\mathbb{R}$ , Nested intervals property; Neighbourhood of a point in $\mathbb{R}$ , Open sets, limit point of a set, closed and perfect sets in $\mathbb{R}$ , connected and compact subsets of $\mathbb{R}$ , Heine-Borel theorem.	12
II	<b>Convergence of Sequences in <math>\mathbb{R}</math>:</b> Bounded and monotonic sequences, Convergent sequence and its limit, Limit theorems, Monotone convergence	12

	theorem, Subsequences, Bolzano-Weierstrass theorem, Limit superior and limit inferior, Cauchy sequence, Cauchy's convergence criterion.	
III	<b>Infinite Series:</b> Convergence of a series of positive real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Tests for convergence: Comparison test, Limit comparison test, D'Alembert's ratio test, Cauchy's $n^{\text{th}}$ root test, Abel's test, Integral test; Alternating series, Absolute and conditional convergence, Leibniz theorem, Rearrangements of series, Riemann's rearrangement theorem.	12
IV	<b>Riemann Integration:</b> Riemann integrability of bounded functions, Examples of R-integrable and non-integrable functions, Algebra of Riemann integrable functions, Integrability of continuous and monotonic functions, Darboux theorems, Fundamental theorem of integral calculus, First mean value theorem and second mean value theorems (Bonnet and Weierstrass forms). Necessary and sufficient condition for Riemann integrable function (Statement only).	12
V	<b>Uniform Convergence, Continuity and Improper Integrals:</b> Pointwise and uniform convergence of sequence and series of functions, Uniform continuity, Weierstrass's M-test, Uniform convergence and continuity, Uniform convergence and differentiability, Improper integrals and tests for improper integrals, Beta and Gamma functions.	12

Part C - Learning Resource

**Text Books, Reference Books:**

1. T. M. Apostol. *Mathematical Analysis: A Modern Approach to Advanced Calculus*. Pearson Education. 2008
2. Charalambos D. Aliprantis & ) Owen Burkinshaw. *Principles of Real Analysis* (3<sup>rd</sup> edition). Academic Press. 1998
3. Robert G. Bartle & Donald R. Sherbert. *Introduction to Real Analysis* (4<sup>th</sup> edition). Wiley India. 2015
4. Gerald G. Bilodeau, Paul R. Thie & G. E. Keough. *An Introduction to Analysis* (2<sup>nd</sup> edition), Jones and Bartlett India Pvt. Ltd. 2015
5. E. Hewitt & K. Stromberg (2013). *Real and Abstract Analysis*. Springer-Verlag.
6. K. A. Ross. *Elementary Analysis: The Theory of Calculus* (2<sup>nd</sup> edition). Springer. 2013

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7 Walter Rudin. *Principles of Mathematical Analysis* (3<sup>rd</sup> edition), Tata McGraw Hill.

**E-Resources:**

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. [https://www.youtube.com/watch?v=Bef8QjJCy0&list=PLbMVogVj5nJQ1UXrOm7KqTg9UKk6eXRp\\_](https://www.youtube.com/watch?v=Bef8QjJCy0&list=PLbMVogVj5nJQ1UXrOm7KqTg9UKk6eXRp_)
3. [https://www.youtube.com/watch?v=C2qIoHkhEuM&list=PLOzRYVm0a65cpVtdj\\_5SBEh6VQvC\\_BvR](https://www.youtube.com/watch?v=C2qIoHkhEuM&list=PLOzRYVm0a65cpVtdj_5SBEh6VQvC_BvR)

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:

50 Marks

Declaration

This is to certify that the syllabus is framed by the Central Board of Studies (Mathematics) as per the guidelines (TOR) of the Department of Higher Education, Raipur Chhattisgarh.


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