Part A: Introduction				
Program: Diploma Course		Class: B.Sc. Sem. IV	Year: 2023	Session:2023-2024
1	Course Code	MSC-4		
2	Course Title	Real Analysis		
3	Course Type	Theory		
4	Course Learning Outcome (CLO)	**This Course will enable the students to:** i) Understand basic properties of real number system such as least upper bound propertyand Order property. ii) Realize importance of bounded, convergent, Cauchy and monotonic sequences of real numbers, find their limit superior and limit inferior. iii) Learn about Riemann integrability of bounded functions and algebra of R-integrablefunctions. iv) Determine various applications of the fundamental theorem of integral calculus. v) Relate concepts of uniform continuity, differentiation, integration and uniform convergence. vi) Learn about metric space, compact and connected space.		
5	Credit Value	Theory & Tutorial:4		
6	Total Marks	Maximum Marks : 100 (Ext. 80 + Int. 20)	Minimum Passing Marks : 40	

Part B: Content of the Course		
Module	**Topics**	**No. of Hours**
I	**Real Numbers :** 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; Neighborhood of a point in $\mathbb{R}$, Open sets, limit point of a set, closed and perfect sets in $\mathbb{R}$, connected and compact subsets	15

	of $\mathbb{R}$, Heine-Borel theorem.	
II	**Convergence of sequences in $\mathbb{R}$:** Bounded and monotonic sequences, Convergent sequence and its limit, Limit theorems, Monotone convergence theorem, Subsequences, Bolzano-Weierstrass theorem, Limit superior and limit inferior, Cauchy sequence, Cauchy's convergence criterion.	15
III	**Infinite Series:** Convergence and divergence of infinite series of positive real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Test for convergence of positive term series; Basic comparison test, Limit comparison test, D-Alembert's Ratio test, Cauchy root test, Raabe's test, Logarithmic test, Cauchy Integral test Alternating series, Leibnitz's test, Series of arbitrary terms, Absolute and conditional convergence, Rearrangement of series and Riemann's theorem.	15
IV	**Riemann Integration and Improper Integrals:** 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). Improper Integral.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

1. T. M. Apostol (2008). *Mathematical Analysis: A Modern Approach to AdvancedCalculus*. Pearson Education.
2. Charalambos D. Aliprantis &) Owen Burkinshaw1998). *Principles of Real Analysis* (3rd edition). Academic Press.
3. Robert G. Bartle & Donald R. Sherbert (2015). *Introduction to Real Analysis* (4thedition).Wiley India.
4. Gerald G. Bilodeau, Paul R. Thie & G. E. Keough (2015). *An Introduction to Analysis* (2nd edition), Jones and Bartlett India Pvt. Ltd.
5. E. Hewitt & K. Stromberg (2013). *Real and Abstract Analysis.* Springer-Verlag.
6. K. A. Ross (2013). *Elementary Analysis*: *The Theory of Calculus* (2nd edition).Springer.
7. Walter Rudin. *Principles of Mathematical Analysis* (3rd edition), Tata

	McGraw Hill. 8 Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Comprehensive Evaluation (CCE):** **20 Marks** **Semester End Exam (SEE):** **80 Marks**		
Internal Assessment: Continuous Comprehensive Evaluation(CCE)	Internal Test -02 of 10 Marks each Assignment/Seminar-01 0f 10 Marks	Sum of best of two test and assignment marks
Semester End Exam (SEE)	Paper-**Two Section**-A&B Section-A: Objective and short answer type question-1x10+3x10= 40 Marks Section-B: Descriptive answer type question Module wise- 10x4 =40 Marks	
Amendment or Modification shall may be made by course coordinator as per situation or directed by the department/Examination cell/NEP-20 Scheme coordinator		

Name and signature of convener & member of BOS:

(Dr. U.K. Shrivastava)