Tribhuvan University
Institute of Science and Technology
Course of Study for Four Year Mathematics

Course Title: Mathematical Analysis I   **Full Marks:** 75
Course No. : Math 202   **Pass Marks:** 35%
Level: B.Sc. .   **Year:** II
Nature of the course: Theory
Period Per Week: 9 (6 Theory + 3 Tutorial)

Course Contents:

Unit 1 **Basic Concepts**   19 Lecture hours

Elementary logic

Connectives, Quantifiers, Basic laws of logic, Techniques of proof

Sets and functions

Sets and set operations, Relations and functions, One-to-one and onto functions, One-to-one correspondence, Images and inverse images, Composition, Inverse functions.

Unit 2 **Real Number System**   24 Lecture hours

Peano's axioms, Field axioms, Order axioms, Bounded and unbounded sets, Supremum and infimum, Completeness axioms, Archimedean property, Well ordering principle, Rational density, Countable and uncountable sets, Cardinality..

Unit 3 **Point-Set Topology of the Real Line**   12 Lecture hours

Neighbourhood, Interior points and limit points of a set, Open and closed sets and their properties, Bolzano-Weierstrass theorem, Closure of a set, Derived sets, Perfect sets.

Unit 4 **Sequences of Real Numbers**   16 Lecture hours

Sequences and subsequences, Convergent sequences, Bolzano-Weierstrass theorem for sequences, Cauchy sequences, Convergence criteria, Operations on convergent sequences, Monotonic sequence and convergence, Nested intervals theorem.

Unit 5 **Series of Real Numbers**   17 Lecture hours

Series and sequences, Convergence and divergence, Cauchy's criteria for convergence, Different tests for convergence, Alternating series, Absolute and conditional convergence.

Unit 6 **Limits and Continuity**   20 Lecture hours

Limits, Sequential criterion for limits, One-sided limits, Properties of limits, Continuity of functions, Sequential criterion for continuity, Discontinuities, Continuity and inverse images, Functions continuous on closed intervals, Sign preserving property, Intermediate value theorem, Bolzano's theorem, Uniform continuity, Lipschitz condition, Monotone and inverse functions, Continuous Inverse theorem.

Unit 7 **Differentiation**   16 Lecture hours

Derivative of a real-valued function of a single variable, Differentiability at a point and in an interval, Sequential criterion for derivatives, Differentiability and continuity, Monotonic functions, Rules of differentiation, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem and their geometric interpretations, Higher order derivatives, Taylor's theorem, Maclaurin's theorem and their infinite series form, Applications of Taylor's theorem in extreme values problems, Indeterminate forms, L'Hospital rule.

Unit 8 **Riemann Integration**   14 Lecture hours

Partitions and refinement of partitions, upper and lower integrals, Riemann integrable functions and Riemann integrals, Condition of integrability, Properties of Riemann integrals, Alternative approach: Step function approach to Riemann integration.

Unit 9 **Fundamental Theorems of Calculus**   12 Lecture hours

Primitives, Fundamental theorem of calculus, First mean value theorem, Generalized first mean value theorem, Integration by parts, Change of variable in an integral, Second mean value theorem (particular case).

References

1   Bajracharya, Prakash Muni: *Real Analysis – An Introduction to Proof,* Buddha Academic Publishers & Distributors Pvt.Ltd., Kathmandu, Nepal
2   Shrestha, R.M.: *Fundamentals of Mathematical Analysis*, Sukunda Pustak Bhawan, Kathmandu, Nepal.
3   Maskey, S.M.: *Principles of Real Analysis*, Bhundipuran Prakashan, Kathmandu, Nepal.
4   Bartle, Robert G. & Sherbert, Donald R.: *Introduction to Real Analysis*, John Wiley and Sons Inc., Singapore.
5   Krishan, Hari, *Real Analysis*, Pragati Prakashan, Meerut, India.
6   Malik, S.C.& Arora, Savita: *Mathematical Analysis*, Wiley Eastern Limited, New Delhi.