Course Code	Course Title	L-P-T	Credits
MMAT1C006T	Measure and Integration	3-0-1	4

Objectives: The aim of this course is to study general theory of measure and Integration. It is Pre-requisite course for Fourier analysis and Wavelets and has lots of applications in functional analysis, Operators theory integral equations, Probability theory and several branches of physics

CO 01	**Fundamental Concepts:** • Understand and articulate the concepts of algebra, ring, sigma algebra, sigma ring, sequence of sets, limit superior and limit inferior of sequences, examples and counter examples. • The concept of measure, integration, and their properties.
CO 02	**Measure Theory**: • Construct and describe measures on measurable spaces, including Borel and Lebesgue measures. • Understand the properties of measurable sets and functions, including countable additivity and monotonicity.
CO 03	**Lebesgue Integration**: • Develop and apply the Lebesgue integral for measurable functions and comprehend its advantages over the Riemann integral. • Prove and utilize key theorems such as the Dominated Convergence Theorem and Fubini's Theorem to evaluate integrals of functions.
CO 04	**Convergence Theorems:** • Analyze different modes of convergence (pointwise, uniform, almost everywhere) and their implications on the integration of functions. • Apply the Monotone Convergence Theorem and Fatou's Lemma in solving integration problems
CO 05	**Applications of Measure and Integration**: • Apply concepts of measure theory and integration to probability theory and statistical applications. Solve real-world problems in fields such as economics, physics, and engineering using integration techniques.

Course content

Unit-1

σ –Algebra of sets, limits of sequences of sets, Generations of algebra, σ-Borel algebras, Measures on a σ-algebras, Measureable spaces and measure spaces, outer measures, construction of measure by means of outer measure, Construction of outer measures by means of sequential covering class.

Unit-2

Lebesgue measure on R, some properties of Labesgue measure, Traditional invariance of Lebesgue measures, Existence of non Lebesgue measurable sets, Measurable functions, operations with measurable functions Equality almost everywhere Sequence of measurable functions.

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Shalabh

Unit-3

Lebesgue Integrations, Integrations of step function, approximation theorem, Lebesgue integral of non-negative functions, Lebesgue integral of measurable functions.

Unit-4

Convergence, almost uniform convergence, Egoroffs theorem, convergence in measure, convergence in mean, Cauchy sequence in measure.

Unit-5

Fatous Lemna, Lebesgue monotone convergence, Lebesgue dominated convergence theorem and applications.

Reference Books:

1. J.yeh, Lectures on Real Analysis, World Scientific, 2000.
2. M.E Munroe, Measure and Integration, and edition, Addision Wesley, 1971.
3. G DeBarra, Measure theory and Integration, Wiley Eastern Ltd, 1987.
4. H L Royden, Real Analysis, 3rd edition, Macmillian, New York, 1988.

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