

MTH: Stochastic Calculus

Programme: M.Sc. And B. Tech. (ALL)

Year: 2021-22

Semester: II/VI/VIII

Course: Open Elective

Credits: 4

Hours: 40+12

Course Context and Overview (100 words):

Stochastic Calculus has applications in various areas of science and engineering. In addition, it is the mathematics required for finance. Many quant companies seek people with background in Ito calculus and stochastic differential equations.

Mathematically, this is another type calculus (different from ordinary calculus) which has profound applications. The course aims to introduce Stochastic Integral which is different from Lebesgue-Stieltjes integral.

Prerequisites Courses (If any): Probability & Statistics

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1- understand the conditional expectation of a random variable given a sigma field
CO2 - understand the Brownian motion and it's properties
CO3 - understand the Stochastic Integral
CO4 - use Ito's formula for solving the Stochastic Differential Equations

Course Topics:

Topics	Lecture Hours
UNIT 1 Review of Probability Concepts	6
Probability Space, Random Variable, Expectations as Lebesgue Integrals, Convergence theorems, Radon-Nikodym Derivative	

UNIT 2 – Information & Conditioning	8
Information and sigma-algebras, Independence, General Conditional Expectations	
UNIT 3 – Brownian Motion	12
Random Walk & It's Properties, Brownian Motion as limiting case of random walk, Distribution of Brownian Motion, Filtration for Brownian Motion, Martingale Property for Brownian Motion, Quadratic Variation, Markov Property, First Passage Time Distribution, Reflection Principle.	
UNIT 4 – Stochastic Calculus	14
Construction of the Ito Integral, Properties of Ito Integral, Ito's formula, Stochastic Differential Equations	

Text Book:

- Stochastic Calculus for finance II (Continuous Time Models), Steven E. Shreve, Springer, 2004.
- Basic Stochastic Processes (A Course Through Exercises), Zdzislaw Brzezniak and Tomasz Zastawniak, Springer, 2005.

Reference Books:

- Brownian Motion: An Introduction to Stochastic Processes, René L. Schilling
- Lothar Partzsch, de Gruyter, Berlin, 2012.

Evaluation Methods:

<i>Items</i>	<i>Weightage</i>
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Mid-term	30%
Final Examination	50%
Quizzes	20%
Total	100

Prepared By: Dr. Sunil Kumar Gauttam
Last Updated: January 11, 2022