## Approval: 6th Senate Meeting

**Course Name:** Stochastic Calculus for Financial Engineering
**Course Number**: MA-656

**Credit**: 2-1-0-3

**Students intended for**: MS/Ph.D.

**Semester**: Even/Odd

**Elective or Compulsory:** Elective

**Prerequisites:** Good knowledge of multivariable calculus, probability, statistics and stochastic process. Some knowledge of MATLAB/R/Spread sheets Packages.

**Course objective**: The course is intended to give students an introduction to the basic theory of options pricing. Some background about financial derivatives would be given and then stochastic modelling approach applied to pricing the derivatives would be discussed. The course would cover the Ito's calculus and some fundamental results related to financial modelling. Some applications of these for trading financial instruments and to hedge the positions with options and other derivatives would be discussed.

**Course Contents**:

Definitions and introduction to Financial instruments and derivatives, no arbitrage principle, risk-neutral probability measure. **6 L**

Give 1-2 lectures on Stochastic process, distribution functions, (again because students may need to recall it for building comfort level), Random walk, Brownian and Geometric Brownian Motion, Lévy's construction. Reflection principle, hitting times, scaling properties. Theory of Martingales, filtrations, adapted processes, Optional Sampling Theorem. **7 L**

Quadratic variation and Brownian motion, Itô integral, properties of stochastic integral, Representation Theorem, Lévy's characterisation of Brownian motion, Girsanov's Theorem, Feymann Kac Theorem, Ito's Formula . **8 L**

Self-financing strategies, martingale measures, risk-neutral pricing. Applications of Stochastic Calculus in Option Pricing. Black-Scholes Model and Pricing Formula, European options, Risk management strategies for options. **7 L**

### Text books:


1. D Duffie, Dynamic Asset Pricing Theory. Princeton 1996.
2. G Grimmett & D Stirzaker, Probability and Random processes. Oxford 1982.
3. Thomas Mikosch, Elementary Stochastic Calculus with Finance in view, World Scientific, 2006.
4. S. E. Shreve, Stochastic Calculus for Finance, Vol. I & Vol. II, Springer, 2004.


### Reference Books:


1. Ralf Korn, ElkeKorn, Option Pricing and Portfolio Optimization, American Mathematical

Society, 2000.
2. M. Capinski and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer, 2005.
3. N. H. Bingham and R. Kiesel, Risk Neutral Valuation, 2nd Edition, Springer, 2004.