STOCHASTIC PROCESSES IN ECONOMICS AND FINANCE

This course will provide an advanced level introduction to the theory of stochastic processes, as an essential tool of economics and Financial modeling. This course will cover the following topics:

- **STOCHASTIC PROCESSES: SOME NOTIONS**
  Introduction
  Probability Review
  Random Variables
  Conditional Expectation
  Specification o Stochastic Processes
  Stationary Processes
- **MARKOV CHAINS AND MARKOV PROCESSES**
  Definitions and properties
  Transition probabilities
  Applications of Markov Chain
  Some special Markov Chains
  Applications
  Markov Processes and Applications
- **POISSON PROCESSES**
  The Poisson Process
  The Law of Rare Events
  Generalizations of Poisson Processes
  Non homogeneous Poisson Process
  Compound Poisson Processes
  Applications
- **BROWNIAN MOTION**
  Preliminaries
  Simple Properties of Standard Brownian Motion
  Variations on Brownian Motion
  Brownian Motion with drift
  Geometric Brownian Motion
  Pricing Stock Options
  An example in Options Pricing
  The Arbitrage Theorem
  The Black-Scholes Option Pricing Formula

Additional Topics (if Time permits)

- **MARTINGALES IN DISCRETE TIME**
  Conditional Expectation
  Martingales
  The Use of Martingales in Asset Pricing
  Games of Chance
  Stopping times
  Martingale Representations
  Doob's –Meyer Decomposition
  Application to Finance: Trading Gains
- **STOCHASTIC CALCULUS**
  Introduction
  Itô Stochastic Integral
  Properties of the Itô Integral
  Stochastic Differential Equations and Itô Formula
  Jump-Diffusion Theory.

TEXT / REFERENCE BOOKS:

- Brzezniak, Z. and Zastawniak, T. Basic Stochastic Processes. Springer, 1999.
- Hull, J.C., Options, Futures, and Other Derivatives. Prentice Hall, 199
- Medhi, J.P. Stochastic Processes. John Wiley & Sons Inc., 1994.
- Mikosch, T., Elementary Stochastic Calculus with Finance in View. World Scientific., 1998.
- Pliska, S.R., Introduction to Mathematical Finance. Discrete time Models. Blackwell Publishers Ltd. 1998.
- Resnick, S., Adventures in Stochastic Processes. Birkhäuser, 1994.
- Ross, S.M. Stochastic Processes. John Wiley & Sons Inc., 1996.
- Taylor, H.M., and Karlin, S., An Introduction to Stochastic Modeling. Academic Press, 1998.