

Financial Engineering-II

- 1.1 Course Number: MA 342
- 1.2 Contact Hours: 3-0-0 Credits: 09
- 1.3 Semester-offered: 3rd Year-Even
- 1.4 Prerequisite: Basic knowledge of elementary calculus, probability and some linear algebra, Financial Engineering-I, Mathematical Finance.
- 1.5 Syllabus Committee Member: Dr. C. Kundu, and Dr. M. K. Rajpoot, Dr. A. Kumar (Convener), Dr. G. Rakshit.
2. **Objective:** This course is designed to develop continuous financial market, arbitrage pricing, completeness, short rate and forward rate models.
3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Continuous time financial market models	Black-Scholes-Merton model, Black-Scholes-Merton equation and formula, dividend paying assets, forwards and futures, risk-neutral valuation of European, American and Exotic derivative securities.	06
2	Arbitrage Pricing, Completeness & Hedging	Hedging of contingent claims, Greeks, implied volatility, volatility smile; Options on futures; Incomplete markets, stochastic volatility models, pricing and hedging in incomplete markets;	06
3	Change of numeraire, Bond and Interest rates	Fixed income markets, bonds and interest rates, pricing of fixed income securities. change of numeraire.	06
4	Short rate models	Short rate models, term structure equation, martingale models for short rate (Vasicek, Cox-Ingersoll-Ross, Dothan, Ho-Lee and Hull-White models), multifactor models.	10
5	Forward rate models & LIBOR and swap market models	Heath-Jarrow-Morton framework, pricing and hedging under short rate and forward rate models, swaps, caps and floors; LIBOR and swap market models.	11
		Total	39

4. Readings

4.1 Textbook:

1. T. Bjork, Arbitrage Theory in Continuous Time, 3rd Ed., Oxford University Press, 2003.
2. S. Shreve, Stochastic Calculus for Finance, Vol. II, Springer, 2004.

4.2 Reference books:

1. J. C. Hull, Options, Futures and Other Derivatives, 10th Ed., Pearson, 2018.
2. D. Brigo and F. Mercurio, Interest Rate Models: Theory and Practice, Springer, 2006.
3. N. H. Bingham and R. Kiesel, Risk-Neutral Valuation, 2nd Ed., Springer, 2004.
4. J. Cvitanic and F. Zapatero, Introduction to the Economics and Mathematics of Financial Markets, Prentice-Hall of India, 2007.
5. M. Musiela and M. Rutkowski, Martingale Method in Financial Modelling, 2nd Ed., Springer, 2005.

5 Outcome of the Course:

At the end of the course the students will be able to understand the fundamental knowledge of arbitrage pricing, completeness, short rate and forward rate models.