Indian Institute of Technology, Kanpur

Department of Economic Sciences

New Course Proposal

1. Course No: ECO7XX ⁊ 2 2

2. Course Title: An Introduction to Derivatives Pricing.

3. Per Week Lectures: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional Hours: 0
Credits: 9

4. Duration of Course: Full Semester Course

5. Proposing Department: Economic Sciences

6. Other Departments which may be interested: Department of Management Sciences

7. Other faculty members interested in teaching the proposed course:

8. Proposing instructor: Joydeep Dutta

9. Level of the course: PG

10. Course Description: This course introduces the students to the exiting field of pricing financial derivatives under no arbitrage hypothesis. The key idea for pricing these financial instruments is the introduction of the risk-neutral probabilities. To make the course largely self-contained we will describe the pricing problem both in discrete time and continuous. The course will culminate in deriving the famous Black-Scholes price for a European call option using the risk-neutral pricing approach. The mathematical tools needed for this course like, conditional expectation, martingales, Brownian motion, geometric Brownian motion, Ito's Integral and Ito calculus will be discussed in detail.

A) Objectives: To equip the students with enough material on quantitative finance so that they can either start doing basic research in mathematical finance or may also join as quants in finance companies and investment firms.

B) Contents

S. No	Broad Title	Topics	No. Lectures
1	Basics of Financial Derivative	Options, Futures, Forwards, Arbitrage, Hedging, Complete Market Hypothesis	3

2	Derivative Pricing in Discrete time	Pricing European Call option, Basics of Asset Pricing and pricing American Call Options	12
3	Mathematical Tools	Geometric Brownian Motion, Ito's Integral and Ito Calculus	12
4	Derivatives Pricing in Continuous Time	Black-Scholes Formula, Interest Rate Models, Stochastic Volatility	12
5	Monte-Carlo Methods in Finance	Using Monte-Carlo Method to compute the price of a European call Option	2

C) Prerequisites: HSO 201/HSO 201A, MSO 201/MSO 201A or any basic probability course.

D) Short summary for including in the Courses of Study Booklet: This course is for the study of pricing financial derivatives under the no arbitrage hypothesis. The topics include, basics of financial derivatives, no arbitrage, binomial pricing model, risk-neutral probabilities, basics of asset pricing, pricing American options in discrete time, Conditional Expectations, Martingales, Brownian Motion, Geometric Brownian Motion, Ito's Integral, Ito's Calculus, Black-Scholes PDE, the Greeks, Girsanov's Theorem, Risk-Neutral Valuation, Interest rate models, stochastic volatility, Monte-Carlo Methods in Finance.

11) Recommended textbooks:
1. Steven. S. Shreve, Stochastic Calculus for Finance, Vol -I and Vol-2, Springer 2004.

2. Y. K. Kwok, Mathematical Models of Financial Derivatives, Second Edition, Springer 2008.

Dated: 12 th February 2024   Proposer: Joydeep Dutta

Dated: DPGC Convener:

                                             The course is approved/not approved

                                             Chairman, SPGC

                                             Dated: