1. **Course Title:** Computational Finance

2. **Credit Structure (L-T-P-Cr):** 3 0 1 3

3. **Course Code:** CS401

4. **Prerequisites:** SC-215, Python coding

5. **Course Objectives**

6. **Course Content:**

   A derivative is a financial instrument that derives its price from an underlying asset like a stock. An example is a forward contract where two parties agree to buy/sell an asset at a fixed price at some future date. Another example is that of a call option where one party (option buyer) agrees to buy an asset from another party (option seller) at a future date. But in this case the contract is asymmetric, that is, the option buyer has the right but no obligation to exercise the option whereas the option seller is obligated to exercise the option at end date. How do you value such a financial contract? The value of the option is the option price of the call option. There is a nice mathematical theory of option pricing which is based on principles of efficient markets and mathematical theory of probability. The Black-Scholes-Merton model of pricing a European call option is a landmark work in financial and economic theory which received the Noble price for economics in 1997. Current financial markets are replete with complicated financial instruments; exotic options and option exchanges are common place. Everyday billions of dollars of options are traded on various exchanges of the world. Options are traded everyday on various underlying assets like stock, currency or commodities. This course introduces the student to the theory of option pricing and financial derivatives.

**Content**

1. Introduce stock markets, importance of returns, information efficiency/arbitrage.

2. Forward contracts and call and put options and option price determinants.


4. Random walk to Geometric Brownian Motion

5. Black-Scholes PDE via hedging argument and Ito's lemma
   - Black-Scholes formula via the risk-neutral valuation argument

6. Monte Carlo methods for option pricing

7. Finite difference methods: Explicit, Implicit and Crank-Nicholson

8. Barrier options. Finite difference for barrier options

9. Basic Greeks with Python. Greeks with Monte Carlo

10. Volatility smile. Straddle, Risk-reversal and Butterfly


7. **Suggested Text/s:**
   - Options, Futures and Other Derivatives J.C. Hull and S. Basu
   - Stochastic calculus for finance I and II Shreve