College of Engineering Pune
(An Autonomous Institute of Government of Maharashtra)
Department of Mathematics
(MA (MI)-   ) Numerical Methods in Finance
Minor Certification in Mathematics with specialization in 'Quantitative Finance' (Semester V)

Teaching Scheme   Examination Scheme
Lectures : 3 hrs / week   Internal Test 1: 20 marks
                                         Internal Test 2: 20 marks
                                         End Sem. Exam: 60 marks

Course Description: Financial product valuations are based on number crunching of various kinds. Some are simple arithmetic calculations, while certain complex products make use of more advanced algorithms, simulations and equations. This course starts with methods used in both these areas.

UNIT I : Introduction to Finance, Interest Rates, Type of Rates, measuring interest rates, Zero Rates, IRR, Bond Pricing, Determining Treasury Zero Rates, Convexity, Theories of Term structure of interest rates, Cashflows, Net Present Value, Discount Factors, Bonds, Dirty Price, Clean Price, Bond Duration, Modified Duration, Accrued Interest.   **[08 Hrs]**

UNIT II : Interpolation Methods (Linear, Cubic Spline, Polynomial), Historical Volatility, Implied Volatility, Historical Volatility, Yield Curve, Probability Distribution.   **[06 Hrs]**

UNIT III : Binomial Tree-formulae, Pricing, Generalization, Introduction to Geometric Brownian Motion, Monte Carlo Simulation, Correlation, Ito's Lemma, Wiener Process, Discrete time model.

[08 Hrs]

UNIT IV : Black Scholes Pricing, Foreign Exchange Pricing, Lognormal distribution, Risk Neutral Valuation, Black Scholes-Merton Pricing formula, Option Greeks (Delta, Gamma, Vega), Concept of Greeks, First Degree Greeks, Second Degree Greeks.   **[10 Hrs]**

UNIT V : Risk Management Measures, Sharpe Ratio, Value at Risk, VAR measure, Historical simulation, Model building approach, The Linear Model, The Quadratic Model, Comparison of approaches, Stress testing and Back testing, Principal component analysis.   **[08 Hrs]**

Text Book :

"Options, Futures and Other Derivatives" – John C. Hull, Sankarshan Basu Pearson Publication Latest Edition)

Reference Book :

"Quantitative Finance Volume 1" – Paul Wilmott (Latest Edition, Wiley Finance)

Course Outcomes :

1. understand interest rates, cashflows, NPV calculations and FX pricing.

2. learn bond pricing, calculation methods for bond parameters (Yield, Price, Accrued Interest).

3. experiment with different probability distributions and perform Monte Carlo simulations.

4. compare and classify well-known Options Pricing methods and Options Greeks.

5. formulate risk management strategies by applying numerical methods concepts.