Shri Vile Parle Kelavani Mandal's
Dwarkadas J. Sanghvi College of Engineering
(Autonomous College Affiliated to the University of Mumbai)

Scheme and Detailed syllabus (DJS23)

of

Honors Degree Program

in

Computational Finance

(Semester IV)

Scheme of Semester IV (DJS23) HONORS for Department of Computer Science and Engineering (Data Science)

Sr. No.	Course Code	Course	Teaching Scheme				Semester End Examination (SEE) - A					Continuous Assessment (CA) - B						Aggregate (A+B)	Credits Earned	
			Theory (Hrs)	Practical (Hrs)	Tutorial (Hrs)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Term Test 3 (TT3)	Term Test Total (TT1 + TT2+ TT3)	Term Work	CA Total (B)		
1	DJS23DH1251	Computational Methods and Pricing Models	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	4
2	DJS23DH1251L	Computational Methods and Pricing Models Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	--	25	25	25	1	
		Total	**3**	**2**	**--**	**4**	**2**	**60**	**--**	**--**	**--**	**60**	**15**	**15**	**10**	**40**	**25**	**65**	**125**	**4**	**4**

Honors in Computational Finance   **Semester: IV**

Course: Computational Methods and Pricing Models (DJS23DH1251)

Computational Methods and Pricing Models Laboratory (DJS23DH1251L)

Pre-requisite: Basic Mathematics, Financial Markets and Risk Analysis

Course Objectives: To make students learn:

1. To introduce students to pricing financial instruments and the application of numerical methods for option pricing.
2. Develop the ability to apply various option strategies and cash flow models to make informed financial decisions.
3. Analyze risk management strategies and alternative investment options for optimizing investment portfolios.

Outcomes: Students will be able to:

1. Explain the principles of financial instrument pricing and numerical methods for option pricing.
2. Make use of various option strategies and cash flow models for financial decision-making.
3. Apply risk management strategies and alternative investment options for portfolio optimization.

Computational Method and Pricing Models (DJS23DH1251)		
Unit	**Description**	**Duration**
1	**Basic Pricing Concepts** Overview of financial instruments: Debt instruments, Equity instruments, Derivatives, Hybrid instruments, Role of financial instruments in financial markets, Participants in the financial market, Concept of time value of money, No-Arbitrage Principle, Forward Pricing: Pricing of forward contracts using no-arbitrage conditions.	06
2	**Swaps, Options and their Pricing** Introduction to Options and the Option Market, Key Terminologies in Options Trading: European options and American options, strike pricing, Option Intrinsic Value Status: ITM, ATM, OTM. Types of Options: Vanilla Options (Call and Put), Exotic Options (Barrier, Asian, Lookback, etc.), Introduction to Option Pricing, Introduction to analytical method in option pricing, The need for numerical methods in option pricing. Black-Scholes Model: Introduction, Assumptions and Limitations of the Black-Scholes model, Swaps: Fixed-to-floating interest rate swaps and their pricing. Introduction to Numerical Integration: Trapezoidal and Simpson's Rule.	10
3	**Options Strategies and Their Payoff Profiles** Introduction to Option Strategies: Basics and Objectives, Single-Leg Strategies: Long Call, Long Put, Covered Call, and Protective Put. Vertical Spreads: Bull Call Spreads and Bear Put Spreads. Volatility Strategies: Straddles, Strangles, and Their Payoff Profiles. Introduction to Neutral Market Strategies: Butterfly Spreads and Iron Condors. Interpreting Payoff Diagrams and Brief Overview of Portfolio Applications.	07
4	**Deterministic Cash Flow Models** Introduction to Bonds and Basic Bond Pricing. Deterministic Cash Flows, Pricing and Valuation of Perpetual Annuities, Fixed Cash Flow Models.	06

5	**Financial Risk Management** Introduction to Risk Management in Finance and Market Completeness. Risk-Neutral Pricing, Application of Risk-Neutral Pricing, Concept of portfolio and Martingale Pricing, Hedging Strategies to Reduce Market Risk, Value at Risk (VaR) in Financial Risk Management.		06
6	**Alternative Investments and Structured Products** Introduction to Alternative Investments ((real estate, commodities, private equity, hedge funds) Real Estate Valuation Techniques (Net Present Value (NPV), Discounted Cash Flow (DCF)) Commodities Pricing (Cost of Carry model). Introduction to private equity and venture capital investments, its valuation techniques, Overview of common hedge fund strategies (long/short equity, market-neutral, and arbitrage). Introduction to statistical arbitrage concepts.		07
		Total	**42**

Suggested List of Experiments:

Computational Methods and Pricing Models Laboratory (DJS23DH1251L)	
Sr. No.	**Title of the Experiment**
1	Implement Loan Payment Calculator and Amortization Schedule.
2	Implement Mortgage Payment Calculator with Monthly Extra Principal Payments.
3	Implementation of Black-Scholes Option Pricing Model.
4	Perform Pricing a fixed-for-floating interest rate swap using the concept of the no-arbitrage condition.
5	Advanced Option Strategies with Payoff Profiles and Greeks.
6	Calculate and plot payoff profiles Complex Option Strategies.
7	Implementation of Bond Pricing and Yield Curves with Sensitivity Analysis.
8	Calculate the present value of perpetual annuities and fixed cash flow models.
9	Demonstrate Risk-Neutral Pricing and Hedging Strategies.
10	Demonstrate Value at Risk (VaR) Calculation for a sample Portfolio.
11	Implementation for Real Estate Valuation Using NPV and DCF Models.
12	Analyzing commodities pricing using the Cost of Carry Model.

Minimum 8 experiments from the above-suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

*The Term Work will be calculated based on Laboratory Performance (15m) and Assignments (10m).

Books Recommended:

Text Books:
1. Prassanna Chandra, Financial Management, Tata McGraw Hill education pvt. Ltd., 7th edition, 2020.
2. John C. Hull, Options, Futures, and Other Derivatives" Pearson Education, Inc, 9th edition, 2017.
3. Tuckman, Bruce, and Angel Serrat. Fixed income securities: tools for today's markets. John Wiley & Sons, 2nd edition, 2022.
4. Don M. Chance and Robert Brooks. An Introduction to Derivatives and Risk Management. Joe Sabatino. 8th edition, 2010.
5. Hossein B. Kazemi Keith H. Black Donald R. Chamber, Alternative Investment, Wiley & Sons, 3rd edition, 2016.

Reference Books:

1. Achdou, Yves, and Olivier Pironneau. *Computational methods for option pricing*. Society for Industrial and Applied Mathematics, 2005.
2. Wu, Lixin. *Interest rate modeling: Theory and practice*. CRC Press, 2019.
3. Tavella, Domingo. *Quantitative methods in derivatives pricing: an introduction to computational finance*. John Wiley & Sons, 2003.
4. Jiang, Lishang. *Mathematical modeling and methods of option pricing*. World Scientific Publishing Company, 2005.

Weblinks:

1. Coursera Course on Introduction to Financial Engineering and Risk Management:
   https://www.coursera.org/learn/financial-engineering-intro

2. Coursera Course Pricing Options with Mathematical Models
   https://www.coursera.org/learn/pricing-options-with-mathematical-models

3. NPTEL Course on Financial Derivatives & Risk Management
   https://onlinecourses.nptel.ac.in/noc24_mg19/preview

Prepared by   Checked by   Head of the Department   Principal