Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus

Honors Degree Program in Computational Finance

Computer Science and Engineering (Data Science)

With effect from Year 2026-27

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

R. C. PATEL
INSTITUTE OF TECHNOLOGY
An Autonomous Institute

R. C. Patel Institute of Technology, Shirpur

Institute Vision

To become a leading Institute in Technical education fostering innovation, research, ethical values, and sustainable development for the betterment of society.

Institute Mission

To impart high quality Technical Education through:

M1: Innovative and Interactive learning process and high quality, globally recognized instructional programs.

M2: Fostering a collaborative scientific temper among students with ethical responsibility towards the society.

M3: Preparing students from diverse backgrounds to have aptitude for employment, entrepreneurship and research with a spirit of professionalism.

M4: To contribute to nation's sustainable development.

Department of Computer Science & Engineering (Data Science)

Department Vision

To provide cutting-edge Computer Engineering education in Data Science while instilling socio-moral values.

Department Mission

M1: To deliver state-of-the-art, ICT-enabled teaching and learning to achieve excellence in Data Science education.

M2: To develop professionally competent Data Science Engineers, meeting evolving industrial and societal needs.

M3: To prepare employable professionals with ethical values and a commitment to professional and social responsibility.

Program Educational Objectives (PEOs) of the Department

PEO1: Graduates will achieve proficiency in Data Science and pursue lifelong learning to advance as professionals, entrepreneurs, and leaders.

PEO2: Graduates will operate effectively in diverse, dynamic professional and cultural environments, respecting societal perspectives.

PEO3: Graduates will demonstrate ethical values and social responsibility in their professional and personal lives.

Program Specific Outcomes (PSOs) of the Department

PSO1: Apply programming concepts, algorithms, and data structures to develop data-driven software and web solutions.

PSO2: Develop intelligent solutions using machine learning, data analysis, and cloud technologies for practical problem-solving.

Honors Degree Program in Computational Finance(w.e.f. 2026-27)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
							Continuous Assessment (CA)							
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)	ESE			
				L	T	P	[A]			[B]	[C]	[A+B+C]		
Sem-V														
	H1	RCP23DCH1301	Computational Methods and Pricing Models	3			25	15	15	15	60	100	3	4
1	H1	RCP23DLH1301	Computational Methods and Pricing Models Laboratory			2	25					25	1	
2	H1	RCP23DCH1302	Econometric Modelling	3			25	15	15	15	60	100	3	3
			Total	6		2	75			30	120	225	7	

Prepared by:
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Dean Academics/Dy. Director

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Director

R.C. Patel Institute of Technology
AN AUTONOMOUS INSTITUTE
Shirpur 425 405 (Dhule)

Honors Degree Program in Computational Finance
Semester - V

Program: Computer Science & Engineering (Data Science)	T. Y. B.Tech.	Semester: V
Computational Methods and Pricing Models (RCP23DCH1301)		
Computational Methods and Pricing Models Laboratory (RCP23DLH1301)		

Prerequisite: Basic Mathematics, Financial Markets and Risk Analysis

Course Objective(s):

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.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the principles of financial instrument pricing and numerical methods for option pricing.	L2	Understand
CO2	Make use of various option strategies and cash flow models for financial decision-making.	L3	Apply
CO3	Apply risk management strategies and alternative investment options for portfolio optimization.	L3	Apply

Computational Methods and Pricing Models (RCP23DCH1301) Course Contents

Unit-I 06 Hrs.

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.

Unit-II 10 Hrs.

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.

Unit-III 07 Hrs.

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.

Unit-IV 06 Hrs.

Deterministic Cash Flow Models:

Introduction to Bonds and Basic Bond Pricing. Deterministic Cash Flows, Pricing and Valuation of Perpetual Annuities, Fixed Cash Flow Models.

Unit-V 06 Hrs.

Financial Risk Management: Introduction to Risk Management in Finance and Market Complete-

ness. 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.

Unit-VI 07 Hrs.

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.

Computational Methods and Pricing Models Laboratory (RCP23DLH1301)

List of Laboratory Experiments

Suggested Experiments(At Least 08)

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.
Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Text Books:

1. Prassanna Chandra, Financial Management, Tata McGraw Hill education pvt. Ltd., 7^{th} Edition, 2023.
2. John C. Hull, Options, Futures, and Other Derivatives" Pearson Education, Inc, 9^{th} edition, 2017.
3. Tuckman, Bruce, and Angel Serrat. Fixed income securities: tools for today's markets. John Wiley & Sons, 2^{nd} edition, 2022.
4. Don M. Chance and Robert Brooks. An Introduction to Derivatives and Risk Management. Joe Sabatino. 8^{th} edition, 2010.
5. Hossein B. Kazemi Keith H. Black Donald R. Chamber, Alternative Investment, Wiley & Sons, 3^{rd} 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

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech.	Semester: V
Econometric Modelling (RCP23DCH1302)		

Prerequisite: Statistics for Data Science, Financial Market and Risk Analysis, Computational Methods and Pricing Models

Course Objective(s):

1. To develop advance statistics skills for financial data analysis.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply simple and multiple regression models for data analysis, while addressing violations of classical regression assumptions.	L3	Apply
CO2	Analyze advanced econometric techniques for time series analysis to extract insights from economic data.	L4	Analyze
CO3	Evaluate practical econometric skills to solve real-world economic problems and apply theoretical knowledge to data analysis.	L5	Evaluate

Econometric Modelling (RCP23DCH1302)
Course Contents

Unit-I 04 Hrs.

Nature of Econometrics and Economic Data:

Introduction to Econometrics, steps in Empirical Econometric Analysis, Structure of Economic Data: Cross-section data, Time-series data, Pooled Cross Sections and Panel or Longitudinal data. Causality and the Notion of Ceteris Paribus in Econometric Analysis.

Unit-II 09 Hrs.

Simple Linear Regression Models:

Two variable case, Regression Vs Correlation, Linearity Vs Non-collinearity, Stochastic specification: The significance of error term, Estimation: The principal of ordinary least squares; Assumptions under CLRM, BLUE properties of estimators; The Gauss Markov Theorem, Goodness of fit- R-squared; Tests of Hypotheses; Scaling and Units of measurement; Confidence Intervals; Forecasting. K variable linear regression model: estimation of parameters; Qualitative Independent variables-dummy variable trap.

Unit-III 08 Hrs.

Multiple Regression Analysis and Diagnostics Tests.

Multiple Regression Model, Analysis, Derivation of the parameters, Assumptions. Geometric Interpretation, Frisch-Waugh –Lovell Theorem, Derivation of Residual Variance.

Unit-IV 08 Hrs.

Violations of Classical Assumptions: Consequences, Detection and Remedy

Heteroscedasticity: problem and Consequences; Tests, Detection and Alternative methods of estimation. Autocorrelation: Sources, Consequences, Tests of autocorrelation, Remedial measures.

Unit-V 06 Hrs.

Multicollinearity

Nature of the Problem; Sources, Perfect multicollinearity vs Imperfect multicollinearity, Its consequences; Detection and Remedies of multicollinearity.

Unit-VI 07 Hrs.

Time Series Econometrics

AR, MA, and ARMA processes. Modelling Trends and Seasonality, Linear Probability model, Intro-

duction to Vector Autoregressive (VAR) models.

Text Books:

1. Jeffrey M. Wooldridge, "Introductory Econometrics," South-Western Cengage, 7th edition, 2022.
2. Lokesh Boro and Niranjan Das, "Introductory Econometrics," Bidya Bhawan, 1th Edition, 2021.
3. James H. Stock & Mark W. Watson, "Introduction to Econometrics," Pearson, 4th edition, 2019.

Reference Books:

1. Brooks, Chris, "Introductory Econometrics for Finance," Cambridge, 2019.
2. Damodar Gujrati, "Basic Econometrics," McGraw Hill, 2020.
3. Francis X. Diebold, "Elements of Forecasting," Cengage South-Western, 2019.
4. Kevin P. Murphy, "Probabilistic Machine Learning: An Introduction," MIT Press, 2022.