Shri Vile Parle Kelavani Mandal's

# Dwarkadas J. Sanghvi College of Engineering

*(Autonomous College Affiliated to the University of Mumbai)*

## Course Structure and Syllabus

## of

## Honors Degree Program

## in

## Financial Computing

Prepared by:- Board of Studies in Computer Engineering

Recommended by:- Academic Council of D. J. Sanghvi College of Engineering

Approved by:- Governing Body of D. J. Sanghvi College of Engineering

*Revision: 1 (2025)*

*With effect from the Academic Year: 2025-2026*

Shri Vile Parle Kelavani Mandal's
**DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING**
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

## Scheme for Honors in Financial Computing (Computer Engineering) (Autonomous) (DJS23 Scheme)

| Sr. No. | Course Code | Course | Teaching Scheme | | | | Semester End Examination (SEE) | | | | | | Continuous Assessment (CA) | | | | | | Aggregate (A + B) | Credits Earned | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Theory (Hrs) | Practical (Hrs) | Tutorial (Hrs) | Credits | Duration (Hrs) | Theory | Oral | Practical | Oral & Practical | SEE (Total) | TT 1 | TT 2 | TT 3 | TOTAL | Term Work Total | CA Total | | | |
| **Semester III** | | | | | | | | | | | | | | | | | | | | | |
| 1 | **DJS23CH3201** | Principles of Financial Engineering | 3 | | | 3 | 2 | 60 | | | | 60 | 15 | 15 | 10 | 40 | | 40 | 100 | 3 | 3 |
| **Semester IV** | | | | | | | | | | | | | | | | | | | | | |
| 2 | **DJS23CH3251** | Financial Statistical Analysis | 3 | | | 3 | 2 | 60 | | | | 60 | 15 | 15 | 10 | 40 | | 40 | 100 | 3 | 4 |
| | **DJS23CH3251L** | Financial Statistical Analysis Laboratory | | 2 | | 1 | | | 25 | | | 25 | | | | | 25 | 25 | 50 | 1 | |
| **Semester V** | | | | | | | | | | | | | | | | | | | | | |
| 3 | **DJS23CH3301** | Financial Modeling | 3 | | | 3 | 2 | 60 | | | | 60 | 15 | 15 | 10 | 40 | | 40 | 100 | 3 | 4 |
| | **DJS23CH3301L** | Financial Modeling Laboratory | | 2 | | 1 | | | 25 | | | 25 | | | | | 25 | 25 | 50 | 1 | |
| **Semester VI** | | | | | | | | | | | | | | | | | | | | | |
| 4 | **DJS23CH3351** | Financial Regulation and Technology | 3 | | | 3 | 2 | 60 | | | | 60 | 15 | 15 | 10 | 40 | | 40 | 100 | 3 | 3 |
| **Semester VII** | | | | | | | | | | | | | | | | | | | | | |
| 5 | **DJS23CH3401** | Financial Risk Management | 3 | | | 3 | 2 | 60 | | | | 60 | 15 | 15 | 10 | 40 | | 40 | 100 | 3 | 4 |
| 6 | **DJS23CH3401L** | Financial Risk Management Laboratory | | 2 | | 1 | | | 25 | | | 25 | | | | | 25 | 25 | 50 | 1 | |
| | | **Total** | **15** | **6** | | **18** | **10** | **300** | **75** | | | **375** | **75** | **75** | **50** | **200** | **75** | **275** | **650** | **18** | **18** |

***Continuous Assessment (A):***

| Course | Assessment Tools | Marks | Time (mins) |
|---|---|---|---|
| Theory | a. Term Test 1 (based on 40 % syllabus) | 15 | 45 |
| | b. Term Test 2 (on next 40 % syllabus) | 15 | 45 |
| | c. Assignment / course project / group discussion / presentation / quiz/ any other. | 10 | -- |
| | Total marks (a + b + c) | 40 | -- |
| Audit course | Performance in the assignments / quiz / power point presentation / poster presentation / group project / any other tool. | -- | As applicable |
| Laboratory | Performance in the laboratory and documentation. | 25 | |
| Tutorial | Performance in each tutorial & / assignment. | 25 | |
| Laboratory &Tutorial | Performance in the laboratory and tutorial. | 50 | |

The final certification and acceptance of term work will be subject to satisfactory performance upon fulfilling minimum passing criteria in the term work / completion of audit course.

***Semester End Assessment (B):***

| Course | Assessment Tools | Marks | Time (hrs.) |
|---|---|---|---|
| Theory / * Computer based | Written paper based on the entire syllabus. | 60 | 2 |
| | * Computer based assessment in the college premises. | | |
| Oral | Questions based on the entire syllabus. | 25 | As applicable |
| Practical | Performance of the practical assigned during the examination and the output / results obtained. | 25 | 2 |
| Oral & Practical | Project based courses - Performance of the practical assigned during the examination and the output / results obtained.<br>Based on the practical performed during the examination and on the entire syllabus. | As per the scheme | 2 |

Prepared by Checked by Head of the Department Principal

**Program: Computer Engineering** **S.Y B. Tech. Semester: III**
**Honors in Financial Computing**
**Course: Principles of Financial Engineering (DJS23CH3201)**

**Pre-requisite:** None

**Objectives:**

1. To understand fundamental principles of finance and their application in modern financial systems
2. To evaluate risk-return relationships and time value of money concepts in financial decision-making
3. To comprehend valuation techniques for assets and securities in various market conditions
4. To develop critical thinking skills for financial problem-solving in technology-driven environments
5. To explore the intersection of finance with technology and its implications for financial innovation

**Outcomes:** On completion of the course, learner will be able to:

1. Apply core financial theories and principles to analyze financial markets and institutions
2. Evaluate investment opportunities using appropriate valuation methods and risk assessment techniques
3. Understand financial intermediation and the role of various market participants
4. Interpret financial statements and use financial ratios for decision-making
5. Assess the impact of technology on financial systems, markets, and services
6. Synthesize financial concepts to solve complex problems in modern financial contexts

**Module Details**

| Module | Description | Duration |
|---|---|---|
| 1 | **Introduction to Financial Engineering**<br>• Overview of financial markets and instruments<br>• Role of financial engineers in modern finance<br>• Types of financial institutions and intermediaries<br>• Basics of financial regulation and ethics | 06 |
| 2 | **Introduction to optimization in finance**<br>• Constrained and unconstrained optimization problems<br>• Basics of probability theory relevant to finance<br>• Random variables, expected value, variance, and covariance<br>• Discrete-time stochastic processes (e.g., binomial trees) | 07 |
| 3 | **Financial Economics and Asset Pricing**<br>• Time value of money<br>• Present and future value of cash flows | 07 |

| Module | Description | Duration |
|---|---|---|
| | • Utility theory and risk aversion<br>• CAPM, APT, and basic asset pricing models | |
| **4** | **Derivatives and Fixed Income Basics**<br>• Introduction to forwards, futures, options, swaps<br>• Payoffs and pricing concepts<br>• Fixed income instruments: bonds, yield curves<br>• Duration, convexity, interest rate risk | 07 |
| **5** | **Introduction to Risk Management**<br>• Types of financial risk: market, credit, operational<br>• Concepts of exposure and hedging<br>• Risk-return tradeoff<br>• Introduction to regulatory frameworks (Basel, Solvency) | 06 |
| **6** | **Finance in the Digital Age: FinTech Foundations**<br>• Introduction to financial technology and its evolution<br>• Digital financial services and business models<br>• Blockchain technology and decentralized finance (DeFi)<br>• Algorithmic trading and robo-advisory<br>• Alternative finance: crowdfunding, P2P lending<br>• Big data, AI, and machine learning applications in finance | 06 |
| | **Total** | **39** |

**Textbooks:**

1. **Luenberger, D. G. (1997).** *Investment Science.* Oxford University Press. ISBN: 978-0195108090
2. **Hull, J. C. (2021).** *Options, Futures, and Other Derivatives* (11th ed.). Pearson. ISBN: 978-1292410653
   *(Note: The 10th ed., ISBN: 978-0134472089, is also widely used and acceptable.)*
3. **Capinski, M. & Zastawniak, T. (2011).** *Mathematics for Finance: An Introduction to Financial Engineering.* Springer. ISBN: 978-0857290812

**Reference Books:**

1. **Neftci, S. N. (2008).** *Principles of Financial Engineering* (2nd ed.). Academic Press. ISBN: 978-0123735744
2. **Benninga, S. (2010).** *Financial Modeling* (3rd ed.). MIT Press. ISBN: 978-0262027281
3. **Tuckman, B. & Serrat, A. (2011).** *Fixed Income Securities: Tools for Today's Markets* (3rd ed.). Wiley. ISBN: 978-0470904039

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**Program: Computer Engineering**
**Honors in Financial Computing** **S.Y B. Tech. Semester: IV**
**Course: Financial Statistical Analysis (DJS23CH3251)**

**Course: Financial Statistical Analysis Laboratory(DJS23CH3251L)**

**Pre-requisite:** Basic understanding of mathematics and statistics

**Objectives:**

1. To understand the fundamental concepts of statistical analysis in financial contexts
2. To apply probability theory and statistical methods to financial data
3. To develop skills in analyzing financial time series and cross-sectional data
4. To implement regression analysis techniques for financial modeling
5. To explore modern computational methods for financial data analysis
6. To interpret statistical results for informed financial decision-making

**Outcomes:** On completion of the course, learner will be able to:

1. Apply statistical concepts and methods to analyze financial markets and instruments
2. Construct and interpret statistical models for financial data
3. Use regression analysis to examine relationships between financial variables
4. Analyze time series data for forecasting financial trends
5. Implement statistical software for financial data analysis
6. Make data-driven financial decisions based on statistical evidence

**Module Details**

| Module | Description | Duration |
|---|---|---|
| **1** | **Foundations of Financial Statistics**<br>• Introduction to statistical concepts in finance<br>• Descriptive statistics for financial data<br>• Probability concepts and distributions<br>• Random variables and expectation<br>• Sampling and estimation theory<br>• Hypothesis testing in finance | 07 |
| **2** | **Statistical Analysis of Financial Returns**<br>• Properties of financial returns<br>• Measures of central tendency and dispersion<br>• Skewness, kurtosis, and normality tests<br>• Covariance and correlation analysis<br>• Statistical properties of major asset classes<br>• Empirical characteristics of financial time series | 06 |
| **3** | **Regression Analysis in Finance**<br>• Simple linear regression models<br>• Multiple regression analysis<br>• Assumptions of regression models<br>• Diagnostic testing and model validation<br>• Dummy variables and interaction terms | 07 |

| Module | Description | Duration |
|---|---|---|
| | • Applications in asset pricing and factor models | |
| **4** | **Time Series Analysis for Financial Data**<br>• Introduction to financial time series<br>• Stationarity and unit root tests<br>• Autoregressive and moving average models<br>• ARIMA modeling and forecasting<br>• Seasonal adjustment techniques<br>• Applications in financial forecasting | 07 |
| **5** | **Volatility Modeling and Risk Analysis**<br>• Volatility clustering and stylized facts<br>• ARCH and GARCH models<br>• Value at Risk (VaR) and Expected Shortfall<br>• Historical simulation and Monte Carlo methods<br>• Extreme value theory in finance<br>• Stress testing and scenario analysis | 06 |
| **6** | **Advanced Statistical Methods in FinTech**<br>• Machine learning algorithms for financial applications<br>• Classification and clustering in finance<br>• Dimension reduction techniques<br>• Text mining for financial news analysis<br>• Big data analytics in finance<br>• Statistical models for algorithmic trading | 06 |
| | **Total** | **39** |

**Lab Experiments**

Perform minimum 8 experiments from the given experiment list.

| Sr. No. | Experiment | Module |
|---|---|---|
| 1 | Calculate and interpret descriptive statistics (mean, median, standard deviation, skewness, kurtosis) for different asset classes (stocks, bonds, cryptocurrencies).<br>***Software***: R with tidyverse packages | 1, 2 |
| 2 | Analyze return distributions of financial assets, perform normality tests (Jarque-Bera, Shapiro-Wilk), and visualize the results using QQ-plots and histograms.<br>***Software*:** R with normtest and ggplot2 packages | 2 |
| 3 | Calculate portfolio returns, volatility, Sharpe ratios, and efficient frontiers for different asset combinations.<br>***Software***: R with PerformanceAnalytics package | 2, 3 |
| 4 | Implement and test CAPM and Fama-French 3-factor models on stock data, interpret coefficients and model diagnostics.<br>***Software***: R with factorAnalytics package | 3 |

| | | |
|---|---|---|
| 5 | Test financial time series for stationarity using ADF, PP, and KPSS tests; implement data transformations to achieve stationarity.<br>***Software***: R with urca and tseries packages | 4 |
| 6 | Fit ARIMA models to financial time series, perform diagnostics, and generate forecasts with confidence intervals.<br>***Software***: R with forecast package | 4 |
| 7 | Estimate GARCH models for asset returns, analyze volatility clustering, and forecast conditional variance.<br>***Software***: R with rugarch package | 5 |
| 8 | Calculate Value at Risk (VaR) using historical simulation, parametric methods, and Monte Carlo simulation; compare results and conduct backtesting.<br>***Software*:** R with PerformanceAnalytics and rugarch packages | 5 |
| 9 | Implement classification algorithms (logistic regression, random forest, gradient boosting) to predict default probabilities using financial ratios and other features.<br>***Software***: Python with scikit-learn | 6 |
| 10 | Analyze financial news headlines and social media posts to extract sentiment indicators and correlate with market movements.<br>***Software***: Python with NLTK and TextBlob | 6 |

**Textbooks:**

1. Ruppert, D. & Matteson, D. S. (2023). *Statistics and Data Analysis for Financial Engineering with R Examples* (3rd ed.). Springer. ISBN: 978-3030486242
2. Tsay, R.S. (2022). *Analysis of Financial Time Series* (4th ed.). Wiley. ISBN: 978-1118617908 (Excellent coverage of time series methods in finance)
3. Alexander, C. (2022). *Market Risk Analysis, Volume II: Practical Financial Econometrics* (2nd ed.). Wiley. ISBN: 978-1119824398 (Strong on volatility modeling and risk analysis)

**Reference Books:**

1. Hull, J.C. (2023). *Risk Management and Financial Institutions* (6th ed.). Wiley Finance. ISBN: 978-1119824107 (Comprehensive coverage of risk measurement techniques)
2. Brooks, C. (2019). *Introductory Econometrics for Finance* (4th ed.). Cambridge University Press. ISBN: 978-1108422536 (Accessible introduction to econometric methods in finance)
3. de Prado, M.L. (2020). *Machine Learning for Asset Managers*. Cambridge University Press. ISBN: 978-1108792899 (Modern ML applications in finance)
4. Christoffersen, P.F. (2022). *Elements of Financial Risk Management* (3rd ed.). Academic Press. ISBN: 978-0128234396 (Focused on financial risk modeling techniques)
5. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). *An Introduction to Statistical Learning with Applications in R* (2nd ed.). Springer. ISBN: 978-1071614181 (Excellent for statistical learning methods)

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**Program: Computer Engineering**
**Honors in Financial Computing** **T.Y B. Tech. Semester: V**
**Course: Financial Modeling (DJS23CH3301)**

**Course: Financial Modeling Laboratory(DJS23CH3301L)**

**Pre-requisite:** Principles of Financial Engineering, Financial Statistical Analysis or equivalent knowledge

**Objectives:**

1. To develop comprehensive financial modeling skills applicable across various financial contexts
2. To master spreadsheet and programming techniques for building financial models
3. To understand the principles of model design, documentation, and testing
4. To apply valuation methodologies through sophisticated modeling approaches
5. To analyze financial decisions using scenario and sensitivity analysis techniques
6. To integrate financial modeling with modern technological solutions

**Outcomes:** On completion of the course, learner will be able to:

1. Design and build robust financial models for various business applications
2. Apply financial modeling techniques to solve complex financial problems
3. Implement valuation models for businesses, projects, and financial instruments
4. Perform scenario analysis and sensitivity testing to assess financial risks
5. Create dynamic financial models that support strategic decision-making
6. Integrate financial models with data analytics and financial technology applications

**Module Details**

| Module | Description | Duration |
|---|---|---|
| 1 | **Foundations of Financial Modeling**<br>• Principles and best practices in financial modeling<br>• Model design, structure, and documentation<br>• Spreadsheet engineering and model architecture<br>• Data validation and error-checking techniques<br>• Sensitivity analysis and scenario planning<br>• Model auditing and quality assurance | 06 |
| 2 | **Financial Statement Modeling**<br>• Integrated three-statement financial modeling<br>• Income statement, balance sheet, and cash flow projections<br>• Financial ratio analysis and performance metrics<br>• Working capital modeling<br>• Depreciation schedules and capital expenditure modeling<br>• Revenue and expense driver analysis | 07 |
| 3 | **Valuation and DCF Modeling** | 07 |

| Module | Description | Duration |
|---|---|---|
| | • Discounted cash flow (DCF) model construction<br>• Free cash flow projections and terminal value calculations<br>• Cost of capital estimation and WACC modeling<br>• Relative valuation techniques and multiples analysis<br>• Sensitivity analysis for key value drivers<br>• Enterprise value, equity value, and per-share value calculations | |
| **4** | **M&A and LBO Modeling**<br>• Merger and acquisition analysis models<br>• Accretion/dilution analysis<br>• Leveraged buyout (LBO) model construction<br>• Debt schedules and financing structures<br>• Returns analysis (IRR, MOIC, cash-on-cash)<br>• Transaction and synergy modeling | 07 |
| **5** | **Financial Instruments and Portfolio Modeling**<br>• Fixed income securities modeling<br>• Equity derivatives valuation models<br>• Option pricing models (Black-Scholes, Binomial)<br>• Portfolio optimization models<br>• Asset allocation and rebalancing strategies<br>• Risk modeling (VaR, CVaR, stress testing) | 06 |
| **6** | **Advanced Modeling Techniques in FinTech**<br>• Python and R for financial modeling<br>• Monte Carlo simulation for financial analysis<br>• Machine learning models for financial forecasting<br>• Algorithmic trading strategy modeling<br>• Blockchain and cryptocurrency financial models<br>• API integration and financial data automation | 06 |
| | **Total** | **39** |

**Lab Experiments**

Perform minimum 8 experiments from the given experiment list.

| Sr. No. | Experiment | Module |
|---|---|---|
| 1 | Develop a complete three-statement financial model (income statement, balance sheet, cash flow statement) for a public company with 5-year projections based on historical data and growth assumptions. | 2 |

| | | |
|---|---|---|
| | ***Software: Microsoft Excel*** | |
| 2 | Build a comprehensive DCF model for company valuation, including projected free cash flows, terminal value calculations, WACC determination, and sensitivity analysis.<br>***Software: Microsoft Excel*** | 3 |
| 3 | Create a merger model to analyze transaction impacts, including purchase price allocation, synergy modeling, and accretion/dilution analysis of EPS.<br>***Software: Microsoft Excel*** | 4 |
| 4 | Develop a leveraged buyout model with detailed debt schedules, cash flow waterfalls, and returns analysis (IRR, MOIC) for different exit scenarios.<br>***Software: Microsoft Excel*** | 4 |
| 5 | Build a bond portfolio model that calculates yield, duration, convexity, and performs scenario analysis for interest rate changes.<br>***Software: Microsoft Excel*** | 5 |
| 6 | Implement Black-Scholes and binomial option pricing models, calculate Greeks (delta, gamma, theta, vega), and analyze option strategies.<br>***Software: Microsoft Excel with solver add-in*** | 5 |
| 7 | Develop a Monte Carlo simulation model for capital budgeting decisions, analyzing project NPV and IRR under uncertainty.<br>***Software: Excel with @RISK or Crystal Ball add-ins*** | 6 |
| 8 | Create a Markowitz portfolio optimization model to determine efficient frontier and optimal asset allocation based on historical return data.<br>***Software: Python with NumPy, SciPy, and Pandas*** | 5, 6 |
| 9 | Develop and compare various machine learning models (ARIMA, LSTM, Random Forest) for financial time series forecasting.<br>***Software: Python with scikit-learn, TensorFlow, and Pandas*** | 6 |
| 10 | Develop an interactive financial dashboard that automatically pulls data from APIs, performs financial analysis, and visualizes key metrics and trends.<br>***Software: Python with Dash, Plotly and Excel with Power BI*** | 6 |

**Textbooks:**

1. Benninga, S. (2022). *Financial Modeling* (5th ed.). MIT Press. ISBN: 978-0262046428 (Main textbook covering ~75% of syllabus)
2. Pignataro, P. (2023). *Financial Modeling and Valuation: A Practical Guide to Investment Banking and Private Equity* (2nd ed.). Wiley. ISBN: 978-1119433828 (Excellent for corporate finance modeling)
3. Soubeiga, E. (2021). *Financial Modeling and Valuation with Excel and Python*. Wiley. ISBN: 978-1119621492 (Strong coverage of programming approaches to financial modeling)

**Reference Books:**

1. Pearl, J. & Rosenbaum, J. (2020). *Investment Banking: Valuation, LBOs, M&A, and IPOs* (3rd ed.). Wiley. ISBN: 978-1119706182 (Industry standard for investment banking models)
2. Sengupta, C. (2020). *Financial Modeling Using R*. Palgrave Macmillan. ISBN: 978-3030490188 (Specialized coverage of R in financial modeling)
3. Tíryakí, G. (2021). *Python for Finance: Apply Powerful Finance Models and Quantitative Analysis with Python* (2nd ed.). Packt Publishing. ISBN: 978-1801078153 (Modern Python applications in finance)
4. Day, A. (2019). *Mastering Financial Modeling in Microsoft Excel* (3rd ed.). McGraw Hill. ISBN: 978-1260135312 (Practical Excel modeling techniques)
5. Lynch, P. (2020). *Financial Modeling for Decision Making: Using MS-Excel in Accounting and Finance*. Routledge. ISBN: 978-0367407605 (Focus on decision-making applications)

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**Program: Computer Engineering** **T.Y B. Tech. Semester: VI**
**Honors in Financial Computing**
**Course: Financial Regulation and Technology (DJS23CH3351)**

**Pre-requisite:** Principles of Financial Engineering or equivalent knowledge

**Objectives:**

1. To understand the regulatory frameworks governing traditional and digital financial services
2. To analyze the impact of technology on financial regulation and compliance
3. To evaluate regulatory challenges and responses in emerging FinTech sectors
4. To develop knowledge of compliance requirements for financial technology applications
5. To comprehend financial crime prevention measures in digital environments
6. To explore the evolution of regulatory technology (RegTech) solutions

**Outcomes:** On completion of the course, learner will be able to:

1. Interpret key financial regulations applicable to traditional and digital financial services
2. Analyze regulatory compliance requirements for FinTech businesses and products
3. Evaluate regulatory risks and challenges in emerging financial technologies
4. Apply regulatory principles to new technology-driven financial business models
5. Design compliance frameworks for FinTech applications
6. Identify RegTech solutions for regulatory and compliance challenges

**Module Details**

| Module | Description | Duration |
|---|---|---|
| **1** | **Fundamentals of Financial Regulation**<br>• Evolution and objectives of financial regulation<br>• Global regulatory architecture and key regulatory bodies<br>• Prudential regulation and financial stability<br>• Market conduct regulation and consumer protection<br>• Regulatory approaches: rules-based vs. principles-based<br>• Impact of financial crises on regulatory frameworks | 06 |
| **2** | **Banking and Payment Systems Regulation**<br>• Banking regulation (Basel framework, capital requirements)<br>• Payment services regulations and directives<br>• Open banking regulations and APIs<br>• E-money and digital payment regulations<br>• Cross-border payment regulation | 07 |

| Module | Description | Duration |
|---|---|---|
| | • Central Bank Digital Currencies (CBDCs) and regulatory implications | |
| **3** | **Investment Services and Capital Markets Regulation**<br>• Securities regulation and investor protection<br>• Market infrastructure regulation (exchanges, clearing houses)<br>• Investment management regulation<br>• Digital asset exchanges and custody regulation<br>• Crowdfunding and alternative finance regulation<br>• Robo-advisory and algorithmic trading regulation | 07 |
| **4** | **Data Protection, Privacy and Cybersecurity**<br>• Financial data protection regulations<br>• Privacy laws applicable to financial services<br>• Customer data rights and consent management<br>• Cybersecurity requirements for financial institutions<br>• Data breach notification requirements<br>• Cross-border data transfer restrictions | 06 |
| **5** | **Financial Crime Compliance in Digital Finance**<br>• Anti-money laundering (AML) regulations<br>• Counter-terrorist financing (CTF) requirements<br>• Know Your Customer (KYC) and digital identity verification<br>• Transaction monitoring in digital environments<br>• Sanctions compliance in global financial services<br>• Fraud detection and prevention in digital finance | 07 |
| **6** | **Emerging Technologies and Regulatory Innovation**<br>• Regulatory sandboxes and innovation facilitators<br>• RegTech and SupTech solutions<br>• Blockchain, DLT and smart contract regulation<br>• Artificial intelligence governance in finance<br>• Decentralized Finance (DeFi) regulatory challenges<br>• Cross-border regulatory cooperation and harmonization | 06 |
| | **Total** | **39** |

**Textbooks:**

1. Arner, D.W., Buckley, R.P., Zetzsche, D.A., & Veidt, R. (2023). *Financial Regulation and Technology: A Legal and Compliance Guide*. Edward Elgar Publishing. ISBN: 978-1800375468 (Main textbook covering ~70% of syllabus)
2. Lovegrove, S. & Ashe, M. (2022). *The Law and Regulation of Financial Technology*. Oxford University Press. ISBN: 978-0198868477 (Comprehensive legal perspective on FinTech regulation)
3. Brummer, C. (2023). *Fintech Law and Policy: The Critical Legal and Regulatory Challenges* (2nd ed.). Cambridge University Press. ISBN: 978-1009291262 (Focus on policy aspects of FinTech regulation)

**Reference Books:**

1. Barberis, J., Arner, D.W., & Buckley, R.P. (2023). *The Cambridge Handbook of FinTech, RegTech, and SupTech*. Cambridge University Press. ISBN: 978-1108836449 (Comprehensive coverage of regulatory technology)
2. Chiu, I.H-Y. & Deipenbrock, G. (2022). *The Routledge Handbook of Financial Technology and Law*. Routledge. ISBN: 978-0367344283 (Interdisciplinary perspectives on FinTech regulation)
3. Crandall, J. & Kitten, J. (2023). *Fintech Regulation: A Global Perspective*. Emerald Publishing. ISBN: 978-1839821172 (International comparative analysis of FinTech regulation)
4. Mangano, R. (2022). *The Regulation of FinTech*. Palgrave Macmillan. ISBN: 978-3030953768 (Detailed examination of regulatory responses to FinTech innovation)

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**Program: Computer Engineering**
**Honors in Financial Computing** **F.Y B. Tech. Semester: VII**
**Course: Financial Risk Management (DJS23CH3401)**

**Course: Financial Risk Management Laboratory (DJS23CH3401L)**

**Pre-requisite:** Principles of Financial Engineering, Financial Statistical Analysis or equivalent knowledge

**Objectives:**

1. To understand fundamental concepts and frameworks of financial risk management
2. To develop skills in identifying, measuring, and mitigating various types of financial risks
3. To analyze risk management strategies across different financial contexts
4. To apply quantitative methods for risk assessment and modeling
5. To evaluate regulatory requirements for risk management in financial institutions
6. To explore emerging technologies and their impact on risk management practices

**Outcomes:** On completion of the course, learner will be able to:

1. Identify and classify different types of financial risks
2. Apply appropriate methodologies to measure and quantify financial risks
3. Design effective risk management strategies and hedging techniques
4. Implement risk models and conduct stress testing for various risk scenarios
5. Interpret regulatory requirements for risk management and compliance
6. Evaluate the impact of technology on risk management practices

**Module Details**

| Module | Description | Duration |
|---|---|---|
| **1** | **Foundations of Financial Risk Management**<br>• Introduction to financial risk management<br>• Risk management frameworks and governance<br>• Risk identification and classification<br>• Risk appetite and tolerance<br>• Enterprise risk management (ERM) frameworks<br>• Risk culture and organizational aspects | 06 |
| **2** | **Market Risk Measurement and Management**<br>• Sources and types of market risk<br>• Value at Risk (VaR) methodologies<br>• Expected Shortfall and other coherent risk measures<br>• Volatility and correlation modeling<br>• Scenario analysis and stress testing<br>• Market risk mitigation strategies and hedging | 07 |

| Module | Description | Duration |
|---|---|---|
| 3 | **Credit Risk Analysis and Management**<br>• Credit risk components and exposures<br>• Credit scoring and rating methodologies<br>• Probability of default and loss given default models<br>• Credit portfolio management<br>• Counterparty credit risk<br>• Credit derivatives and structured products | 07 |
| 4 | **Operational and Liquidity Risk Management**<br>• Operational risk identification and assessment<br>• Operational risk quantification methods<br>• Liquidity risk measurement<br>• Funding liquidity and market liquidity risk<br>• Asset liability management<br>• Business continuity and crisis management | 06 |
| 5 | **Integrated Risk Management and Regulation**<br>• Risk aggregation and interdependencies<br>• Economic capital and risk-adjusted performance measures<br>• Basel framework for financial institutions<br>• Solvency regulations for insurance companies<br>• Stress testing and scenario analysis<br>• Risk reporting and disclosure requirements | 07 |
| 6 | **Emerging Risks and Technology in Risk Management**<br>• Cybersecurity and technology risk<br>• Climate risk and ESG risk integration<br>• Model risk management<br>• AI and machine learning in risk assessment<br>• Blockchain and decentralized finance risks<br>• Risk data aggregation and risk analytics | 06 |
| | **Total** | **39** |

**Lab Experiments**

Perform minimum 8 experiments from the given experiment list.

| Sr. No. | Experiment | Module |
|---|---|---|
| 1 | Implement and compare different Value at Risk (VaR) methodologies (historical simulation, parametric, Monte Carlo) for various financial portfolios and assess their accuracy through backtesting.<br>***Software: R with PerformanceAnalytics and rugarch packages*** | 2 |
| 2 | Calculate Expected Shortfall for portfolios under normal and stressed market conditions; develop and apply stress scenarios based on historical events.<br>***Software: Python with NumPy, Pandas, and SciPy*** | 2 |
| 3 | Develop and validate credit scoring models using logistic regression, random forests, and gradient boosting algorithms; evaluate model performance using ROC curves and confusion matrices.<br>***Software: Python with scikit-learn*** | 3 |
| 4 | Implement a portfolio credit risk model to calculate expected loss, unexpected loss, and economic capital for a loan portfolio; analyze concentration risk and diversification benefits.<br>***Software: R with CreditMetrics package*** | 3 |
| 5 | Fit severity and frequency distributions to operational loss data; implement Monte Carlo simulation to derive aggregate loss distributions and calculate operational risk capital.<br>***Software: R with fitdistrplus package*** | 4 |
| 6 | Build a cash flow-based liquidity model incorporating contractual maturities, behavioral assumptions, and stress scenarios; calculate liquidity coverage ratios and net stable funding ratios.<br>***Software: Excel with VBA*** | 4 |
| 7 | Develop an integrated stress testing framework that captures interactions between market, credit, and liquidity risks; model impacts on balance sheet, income statement, and regulatory ratios.<br>***Software: Python with Pandas and NumPy*** | 5 |
| 8 | Implement a copula-based approach to aggregate different risk types; calculate economic capital and allocate it to business units using contribution methods.<br>***Software: R with copula package*** | 5 |
| 9 | Develop a quantitative model to assess cyber risk exposure through scenario-based analysis; map technology vulnerabilities to potential financial impacts.<br>***Software: Python with NetworkX and Pandas*** | 6 |
| 10 | Implement a climate risk assessment framework that translates physical and transition risk scenarios into financial impacts; analyze portfolio vulnerability to climate-related risks.<br>***Software: R with scenarios package*** | 6 |

**Textbooks:**

1. Hull, J.C. (2023). *Risk Management and Financial Institutions* (6th ed.). Wiley Finance. ISBN: 978-1119824107 (Main textbook covering ~75% of syllabus)
2. Malz, A.M. (2022). *Financial Risk Management: Models, History, and Institutions* (2nd ed.). Wiley Finance. ISBN: 978-1119795642 (Strong historical context and institutional framework)
3. McNeil, A.J., Frey, R., & Embrechts, P. (2023). *Quantitative Risk Management: Concepts, Techniques and Tools* (2nd ed.). Princeton University Press. ISBN: 978-0691166278 (Advanced quantitative methods for risk management)

**Reference Books:**

1. Crouhy, M., Galai, D., & Mark, R. (2022). *The Essentials of Risk Management* (3rd ed.). McGraw-Hill Education. ISBN: 978-1264268795 (Comprehensive overview of risk management principles)
2. Gregory, J. (2023). *Central Counterparties: Mandatory Clearing and Bilateral Margin Requirements for OTC Derivatives* (2nd ed.). Wiley Finance. ISBN: 978-1119583607 (Focus on derivatives risk management)
3. Bessis, J. (2022). *Risk Management in Banking* (5th ed.). Wiley Finance. ISBN: 978-1119793090 (Banking-specific risk management approaches)
4. Christoffersen, P.F. (2023). *Elements of Financial Risk Management* (3rd ed.). Academic Press. ISBN: 978-0128234396 (Focus on market risk models)
5. Artzner, P. & Delbaen, F. (2022). *Measures of Financial Risk: Theory and Implementation*. Springer. ISBN: 978-3030897857 (Theoretical foundation of risk measures)

Prepared by Checked by Head of the Department Principal