**MS in Computational Finance**

**Open Electives:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Linear algebra and differential equations using Matlab</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Advanced Probability and Statistics using R</td>
<td>3</td>
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<tr>
<td>3.</td>
<td>Stochastic Processes &amp; Mathematical foundation for Finance</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Advanced Numerical Analysis/Methods using Matlab/R</td>
<td>3</td>
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</tbody>
</table>

**Core courses for MS in Computational Finance**

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<tr>
<td>1.</td>
<td>Introductory Finance</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Statistics and Financial Data Analysis using R</td>
<td>3</td>
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**Elective courses for MS in Computational Finance**

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<td>1.</td>
<td>Market Microstructure and Trading</td>
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<tr>
<td>2.</td>
<td>Asset Pricing and Inefficiency of Market</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Quantitative Risk Management</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Financial Derivatives</td>
<td>3</td>
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<tr>
<td>5.</td>
<td>Exotic Derivatives</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>Stochastic volatility</td>
<td>3</td>
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<td>7.</td>
<td>Machine Learning using R</td>
<td>3</td>
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<tr>
<td>8.</td>
<td>Game Theory and General Equilibrium Theory</td>
<td>3</td>
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<tr>
<td>9.</td>
<td>Algorithmic Trading using Python</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>Optimization in Finance</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>Operation Research</td>
<td>3</td>
</tr>
</tbody>
</table>
Open Electives

**Linear algebra and differential equations: using Matlab**

Linear second order ODEs, General ODEs and their classification. Homogeneous linear ODEs, The Principle of Superposition, Linear second order constant coefficient homogeneous ODEs. Non-homogeneous linear ODE, Linear operators, Solving non-homogeneous linear ODEs, Method of undetermined coefficients, Initial and boundary value problems, Degenerate inhomogeneities, Resonance, Equidimensional equations, solving linear constant coefficient second order IVPs Linear algebraic equations, Systems of linear algebraic equations, Gaussian elimination, Solution of general rectangular systems, Matrix Equations, Linear independence, Rank of a matrix, Fundamental theorem for linear systems, Gauss-Jordan method, Matrix Inversion, Eigenvalues and eigenvectors, Diagonalization Systems of differential equations, Linear second order systems, Linear second order scalar ODEs, Higher order linear ODEs, Solution to linear constant coefficient ODE systems, Solution to general linear ODE systems

**Text/ Reference Books:**
- Strang, Gilbert *Differential Equations and Linear Algebra*, Brooks/Cole
- Marty Golubitsky, Michael Dellnitz, *Linear Algebra and Differential Equations Using MATLAB*

**Advanced Probability and Statistics using R**

Text/ Reference Books:

Stochastic Processes & Mathematical foundation for Finance


Text/ Reference Books:

Advanced Numerical Analysis/Methods using Matlab/R


Text/ Reference Books:

Core courses for MS in Computational Finance

Introductory Finance

Pricing Model (one and multi-period model), No arbitrage, Q-Martingale, Fundamental Theorem of Asset Pricing, Geometric Brownian Motion as limit of Binomial Asset Pricing Model. Introduction to Derivatives, Futures and Option, European and American Options, Risk-Neutral Pricing, Martingale Representation Theorem, Black-Scholes formula for European Options, Non-path-dependent American Derivatives, Stopping Times, General American Derivatives, American Call Options, Evaluating derivatives via Binomial Option Pricing Models.

Text/Reference Books:
- Steven E. Shreve, "Stochastic Calculus for Finance II: Continuous Time Models", Springer.

Statistics and Financial Data Analysis: Using R


Text/Reference Books:

Elective courses for MS in Computational Finance

Market Microstructure and Trading


Text/Reference Books:

Asset Pricing and Inefficiency of Markets

**Text/ Reference Books:**

**Financial Risk Management**


**Text/ Reference Books:**

**Financial Derivatives**


**Text/ Reference Books:**

**Exotic Derivatives**

Text/ Reference Books:

Stochastic Volatility

Introduction to different notions of volatility: spot, realised and implied volatility; VIX and volatility indices; stylised facts of asset returns; econometric models; deterministic volatility model; local volatility (LV) models and the Dupire equation; stochastic volatility (SV) models: incompleteness and multiplicity of martingale measures, market completion - delta and vega hedging, examples of martingale measures and of SV models, the hedger's perspective and robustness of the BS formula.

Text/ Reference Books:

Machine Learning in Finance

Introduction to Machine Learning, Assessing Model accuracy, Simple Linear Regression, Multiple Linear Regression, Classification, Logistic Regression, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, and k-Nearest Neighbours, Cross-Validation and the Bootstrap, Dimension Reduction, Tree-Based Methods, Support Vector Machines, Unsupervised Learning,

Text/ Reference Books:
- Gareth, James, Witten, Daniela, Hastie, Trevor, Tibshirani, Robert, Introduction to Statistical Learning with Applications in R, Springer(2009)
- Shai, Shalev-Shwartz, , Ben-David, Shai Understanding Machine Learning, Cambridge University Press (2014)

Game Theory

Introduction to Game Theory, Simultaneous Games, The Prisoner's' Dilemma, Iterated Elimination, Nash Equilibrium, Mixed Strategies, Evolutionary Stability, Sequential Games, Backwards Induction, Subgame Perfect Equilibrium, Alternating Offer Bargaining, Sequential Rationality, Repeated Games, Games with Incomplete Information, Bayesian Games, Auctions, The Buyer-Seller Problem, Agreeing to Disagree, Strategic Voting, Bad Reputation, Modeling Irrationality

Text/ Reference Books:
Algorithmic trading: Using Python


Text/ Reference Books:

Optimization in Finance


Text/ Reference Books:

Operations Research


Text/ Reference Books: