

Post Graduate Diploma Program in Data Science and Financial Engineering

Syllabus and Curriculum

This 11 month course provides a rigorous **hands-on training** in analyzing large amounts of data and formulating sophisticated analytical models. The uniquely designed program starts from the basics, and culminates in cutting edge material and concepts. Experts from industry and research labs further enrich the participants understanding by exposing them to state of the art topics. This will surely enhance the participants skills in data science and financial engineering, which are a must for future research and employment. The main objectives of this course are:

- Develop a strong foundation for Inter-disciplinary work
- Combine course work from areas of Management and Analytics
- Exposure to latest trends in Academics and Industry through Projects and Internships
- Offer good Placements

In first three terms (each with a duration of 3-months approximately) 12 topics will be taught with rigorous practical applications on computers. As it is a part time diploma program , for each subject the concerned teacher will decide evaluation strategy (mostly projects, seminars, assignments). Learning is the main objective and this course is not based on exam evaluation system. After successful completion, MSE will provide course completion diploma certificate. The remaining topics listed in the syllabus will be covered in seminars/workshops. MSE will arrange campus placement week with participation of many MNCs etc.

Contents

Term I (February to May)

1. Basic Programming Languages

- Programming and Data Structures, Basics of Object Oriented Programming, Functions, Arrays, Stacks, Queues, Sorting and Searching , Graph Algorithms, Databases

2. Applied Cryptography

- Block Ciphers, Digital Signatures, Hashing, bit coin, crypto currency,

3. Introduction to Financial Economics

- Supply and Demand, Portfolios. Financial Markets, Risk, Derivatives, Options, Law of One Price, CAPM

4. Operations Research I

- Linear Algebra, Rank and Null Space, Probability, Random Variables, Distributions, Limit Theorems, Hypothesis Testing. Estimators, Linear Programming, Primal and Dual problems, Integer Programming

Term II (June to August)

5. Econometrics for Finance and Decision Science

- Regression, Dummy dependent variable models, Simultaneous equation models, panel data models with computer applications

6. Topics in Financial Engineering

- Discrete time Binomial Model to price derivatives, Arbitrage, Replicating Portfolio, Black Scholes Equation and its solution, Numerical and Simulation techniques

7. Operations Research II

- Non linear and Dynamic Programming, Quadratic Programming, KKT conditions, Network Flows, Queueing theory

8. Artificial Intelligence and Machine Learning

- Search, Supervised Learning, Linear Gaussian Discriminant Analysis, SVM, Unsupervised Learning, EM algorithm, Clustering, PCA

9. Big Data Hadoop Workshop

Term III (September to November)

10. Big Data Analysis

- Complexity Analysis, Intractable Problems, Approximation and Randomized Algorithms, Map Reduce. Google Page Rank Algorithm, A Priori Algorithm

11. Time Series Analysis

- Introduction to Stationary and Non-Stationary Time Series Analysis, Univariate, Multivariate Analysis, Ling memory and Non-linear time series models,

12. Deep Learning

- Neural Networks, Training a Deep learning Network, Convolutional Networks, Regularization, Applications

13. Advanced Models for Decision Making

- Models from Decision Theory, Revenue Management and Pricing, Queuing Theory, Optimization applied to real world case studies in Healthcare, Logistics, E-commerce etc to support decision making

14. Risk Analytics, Financial Markets and Regulatory Mechanisms: workshop

Term IV (December and January)

15. Robotics Workshop

16. Quantum Computing Workshop

Project and Placements