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University of Mumbai
मुंबई विद्यापीठ

Restructured & Revised Syllabus under Credit based Semester and Grading System

For

Master of Management Studies (MQF)

2 Years full-time Masters Degree Course in Quantitative Finance

(Effective from the academic year 2014 – 2015)

Title

Name of the Programme: - Master in Quantitative Finance (MQF)

Nature of the Programme: - Master in Quantitative Finance (MQF) is a 2 year Full time Degree course of University of Mumbai.

Eligibility Criteria

A learner for being eligible for admission into the Post Graduate Programme i.e Master in Quantitative Finance (MQF) shall have passed the Bachelor's degree examination of this university or any other university recognized as equivalent thereto with a minimum of 50% marks. Besides, the learner should have cleared the prescribed entrance test MH – CET conducted by the Directorate of Technical Education (DTE) Government of Maharashtra or any other entrance test approved by the regulatory authorities/University of Mumbai.

- Many institutions/colleges are conducting this course in Mumbai with varying in take of students.
- University of Mumbai also runs BMS as a 3 year full time undergraduate course in management.

Preamble:

The restructured and revised curriculum for MQF is developed considering the current industry needs in terms of skill sets demanded under new business environment. It also endeavours to align the programme structure and course curriculum with student aspirations and corporate expectations.

Need for MQF

The Current Scenario

- Changing global facets of businesses and economies
- Dynamism in industry practices and evolution of technology in finance.
- Emergence of new businesses and business practices
- Thrust on Application oriented and experiential learning
- Expectations of Key stakeholders viz. students, industry and academicians

This has led to

1) **Emergence of Novel Competencies and Skills**

Jobs that exist today did not exist 3 or 4 years ago. The direct linkage of the industry practices to the structure and detailed contents in terms of Skills, Knowledge, Attitude and Approach mandated the need for up gradation and restructuring of the course structure and curriculum.

2) **Transformation of the Learners mindset**

The psychological profile, learning style and outlook towards higher education has undergone a change due to explosion of information and abundance of knowledge. New and innovative methods of evaluation and application are the need of the hour.

3) **Demand for Application oriented and Experiential Learning**

Management Education has to transcend beyond the realms of classrooms and focus on interactive, experiential learning. There is a pressing need to inculcate application oriented thinking and practical approach based on sound knowledge of management theories, principles and concepts.

Rationale for the Course

Mumbai is fast emerging as an International Financial Centre. This is creating opportunity for a large number of finance professionals having internationally benchmarked skills and capabilities. At the same time, the financial market is changing rapidly. The swift pace of financial innovation in the last decade and the recent financial turmoil has changed the landscape of the financial sector. These changes call for novel ways of risk management and financial analysis. The proposed MQF course will help create a pool of trained and globally competitive professionals in the field of finance.

Objectives for new Curriculum

Top finance jobs demand a sharp decision maker; someone able to grasp the finer details, as well as their significance to the bigger picture. The Masters in Quantitative Finance course is structured to deliver a strong foundation in the principles and practice of finance, and the analytical tools and skills to form a sound basis for financial decision making. The objective of this course is to help individuals, and the organizations which employ them, enhance their effectiveness within the field of Quantitative finance.

Quantitative Finance as a field of study has strong roots in other scientific fields such as statistics and mathematics. Modern financial theories, such as the Black Scholes model, draw heavily on the areas of physics, statistics and mathematics such as Brownian motion and stochastic calculus; their very creation would have been impossible if science hadn't laid the initial groundwork. Also, theoretical constructs such as the capital asset pricing model (CAPM) and the efficient market hypothesis (EMH) attempt to logically explain the behavior of the stock market in an emotionless, completely scientific manner. Finance is a practical discipline. The MQF course is designed to combine rigorous academic work with real-world relevance and practical application to ensure that content is intellectually demanding while being related to the practical world of Quantitative finance.

The Objectives of the course are: -

- Enable students to concentrate on goals tailored to career in Quantitative finance and Risk Management.
- Incorporate some flexibility for institutes to teach new and contemporary curriculum for greater employability of their students in the financial domain.

The goal is aimed at to imbibe and enhance the following skill sets

i) Exposure to Global talents
ii) Peer based learning and team work
iii) Experiential Learning (Learning by Action and Application)

Summer Internship Report

Students are required to undertake a live Project/Assignment after the second semester with an organization in the month of May & June and submit the summer internship project report after the due completion of the Project/Assignment. This marks the conquest of a milestone.

Project

As part of the curriculum, the students will work on a project assignment of 100 marks relevant to an area of quantitative finance. They will submit a project report to the institute at the end of the fourth semester.

Faculty Students Ratio

While the faculty students ratio of 1:15 is maintained, the staffing pattern for appointment of faculty for all the Management programmes be modified. i.e 50% Full time faculty, 50% industry experts as visiting faculty be made applicable from the academic year 2014 – 15.

Institutes should attract more people with industry experience to participate in this programme. To attract industry experts into teaching, they be designated similar to full time faculty based on their industry experience as is noticed in the parallel practice at NCC Units.

A person having 15 years or more Industry Experience holding a senior supervisory position be designated as Hon. Professor & a person with 10 years or more industry experience holding a senior supervisory position be designated as Hon. Associate. Professor & a person having minimum 05 years of industry experience at a supervisory position be designated as Hon. Assistant Professor.

Teaching Pedagogy

Teachers are expected to impart knowledge through new and innovative pedagogical approaches. Some of these techniques are: -

Group Discussions, Lectures, Role plays, Field Work, Workshops, Counseling Sessions, Watching Educational and Informative Videos, Assignments, Quizzes, Tests, Live Projects, Case Studies, Presentations, Simulations, Industrial Visits, Participation in academic and extra – curricular activities, inculcation of industry specific skills and training & development sessions.

MQF – Semester – I

Sr. No.	Subject	Teaching Hours		Assessment Pattern				
		No. of Sessions of 90 minutes	No. of Sessions of 90 minutes per week	Continuous Assessment	Semester End Examination	Total Marks	Duration of Theory Paper	No of Credits
1	Corporate Finance	30	2	40 IA	60 IA	100	3	2.5
2	Inferential Statistics	30	2	40 IA	60 IA	100	3	2.5
3	Financial Markets & Products	30	2	40 IA	60 IA	100	3	2.5
4	Multi Dimensional Calculus	30	2	40 IA	60 IA	100	3	2.5
5	Linear Algebra	30	2	40 IA	60 IA	100	3	2.5
6	Economics	30	2	40 IA	60 IA	100	3	2.5
7	Financial Modelling in Excel	30	2	40 IA	60 IA	100	3	2.5
8	VBA Programming for Finance	30	2	40 IA	60 IA	100	3	2.5
			Total No of Credits					**20**

UA: - University Assessment; IA: - Internal Assessment

MQF – Semester – II

Sr. No.	Subject	Teaching Hours		Assessment Pattern				
		No. of Sessions of 90 minutes	No. of Sessions of 90 minutes per week	Continuous Assessment	Semester End Examination	Total Marks	Duration of Theory Paper	No of Credits
1	Financial Institutions	30	2	40 IA	60 IA	100	3	2.5
2	Econometrics for Finance	30	2	40 IA	60 IA	100	3	2.5
3	Probability Theory	30	2	40 IA	60 IA	100	3	2.5
4	C/C++ Programming for Finance	30	2	40 IA	60 IA	100	3	2.5

5	Stochastic Calculus – I	30	2	40 IA	60 IA	100	3	2.5
6	Quantitative Trading Strategies	30	2	40 IA	60 IA	100	3	2.5
7	Performance Attribution Analysis	30	2	40 IA	60 IA	100	3	2.5
8	International Finance	30	2	40 IA	60 IA	100	3	2.5
1	**Numerical Compatations**	30	2	**60 UA**		100	3	2.5
			Total No of Credits					**20**

Sr. No.	Subject	Teaching Hours		Assessment Pattern				
		No. of Sessions of 90 minutes	No. of Sessions of 90 minutes per week	Continuous Assessment	Semester End Examination	Total Marks	Duration of Theory Paper	No of Credits

UA: - University Assessment; IA: - Internal Assessment

MQF – Semester –III

2	Derivative Products & Strategies	30	2	40 IA	60 IA	100	3	2.5
3	**Fixed Income Securities & Mathematics**	**Teaching Hours**			**Assessment Pattern**			2.5
Sr. No.	Subject	No. of Sessions of 90 minutes	No. of Sessions of 90 minutes per week	Continuous Assessment	Semester End Examination	Total Marks	Duration of Theory Paper	No of Credits
4	Derivatives Valuations and Implementations in C++/VBA	30	2	40 IA	60 IA	100	3	2.5
1	**High Frequency**	30	2	40 IA	**60 UA**	100	3	2.5
5	Stochastic Calculus – II	30	2	40 IA	60 IA	100	3	2.5
6	Derivatives Valuations and Implementations in C++/VBA	30	2	40 IA	60 IA	100	3	2.5
7	Financial Risk Management	30	2	40 IA	60 IA	100	3	2.5
8	Technical Analysis & Portfolio Management	30	2	40 IA	60 IA	100	3	2.5
9	Summer Internship	100						2.5
			Total No of Credits					**22.5**

UA: - University Assessment; IA: - Internal Assessment

MQF – Semester –IV

	Finance							
2	Algorithmic Trading Strategies	30	2	40 IA	60 IA	100	3	2.5
3	Market Risk Management	30	2	40 IA	60 IA	100	3	2.5
4	Credit Risk Management	30	2	40 IA	60 IA	100	3	2.5
5	Operational Risk Management	30	2	40 IA	60 IA	100	3	2.5
6	Liquidity Risk Management	30	2	40 IA	60 IA	100	3	2.5
7		100						2.5
			Total No of Credits					**17.5**

UA: - University Assessment; IA: - Internal Assessment

Semester	**Total No of Credits**
Semester I	20
Semester II	20
Semester III	22.5
Semester IV	17.5
Total	**80**

Semester 1

Corporate Finance

This provides students from non-finance background a very focused introduction to finance from an investment management point of view. It will include topics like Capital structure of companies, Financial Statements Analysis, Financial Ratios, NPV, IRR, Sensitivity Analysis, Cost of Capital, CAPM, Growth Models, WACC, Equity Valuation models FCFF, DCF, DDM, EGM, etc., Mergers and Acquisition Analysis and Corporate Restructuring Analysis.

Inferential Statistics

This introduces students to the basic ideas and methods of descriptive statistics like sampling methods, frequency distributions, measures of central tendency, measures of dispersion, moments of distribution, etc. This then introduces the basic ideas and methods of statistical inference like estimation theory, sampling distributions, confidence intervals and hypothesis testing concerning estimators of mean and variance, ANOVA.

Financial Markets and Products

This includes concepts of Primary Market and Secondary Market, Financial Securities Market Operations, various types of Financial Instruments like Equity, Debt, Derivatives - Forwards, Futures, Options, Swaps, Swap options, MBS, etc. on specific asset classes like Equity and Equity Index derivatives, Fixed-Income and Interest Rate, Currency, Commodity, various types of financial returns, Corporate Actions and their effects on return calculations, various financial market activities like Speculation, Hedging and Arbitrage.

Multi-dimensional Calculus

Functions in Calculus, Variation of a Function, Riemann Integral and Stieltjes Integral, Lebesgue's Method of Integration, Differentials and Integrals, Taylor's Formula

Linear Algebra

This introduces concepts and methods of linear algebra including vectors and matrices, matrix Eigenvalue and Eigenvectors, methods for solving systems of Linear Equations - Gaussian Elimination with Backsubstitution, Lower-Upper (LU) Decomposition, Singular Value Decomposition (SVD), Cholesky Decomposition (CD), Eigen Value Decomposition (EVD) / Principal Component Analysis (PCA), Matrix Inversion using CD / EVD. The emphasis is on efficient implementation of the algorithms in C/C++.

Economics

1 Microeconomics

Consumer Theory: Choice, Preferences, Utility; Demand, Revealed Preferences, Comparative Statics; Consumer Surplus, Aggregation; Variations to the Basic Choice Model (Time, Uncertainty). *Producer Theory*: Technology, Profit Maximization, Cost Minimization; Supply, Aggregation Markets; Monopoly; Oligopoly and Game Theory; Walrasian Equilibrium. *Market Failures*: Externalities; Public Goods; Small Number of Agents, Nash Bargaining. *Asymmetric Information*: Adverse Selection, Moral Hazard, Principal-Agent Model; Auction Design; Voting and Other Applications.

2 Macroeconomics

An overview of the modern market economy as a system for dealing with the problem of scarcity. The analysis of relationships among such variables as national income, employment, inflation and the quantity of money.
Managing aggregate demand; fiscal policy; money and the banking system; monetary policy; the debate over monetary and fiscal policy; budget deficits in the short and long run; trade-off between inflation and unemployment.

3 International Economics

Trade Theories: Ricardian Trade Model; Modern Trade Theory; Trade and Income Distribution; Alternative Trade Theories. *Trade Policy*: Commercial Policy: Tariffs and Nontariff Trade Barriers; Political Economy of Trade Policy; Economic Integration (Free Trade Agreements); International Factor Movements and Multinational Enterprises; Balance of Payments; Foreign Exchange Market; Exchange Rate Determination; Modern Exchange Rate System and Policies.

4 Financial Economics

Fundamental Theory of Finance: Absence of Arbitrage and Efficient Markets; Existence of Positive Linear Pricing Rule; Risk Neutral (Martingale) Probabilities and State Pricing. *Preferences and Uncertainty*: Expected Utility Theory; Linear Risk Tolerance Preferences; Jensen's Inequality and Risk Aversion; Ordering Preferences by Risk Aversion; Stochastic Dominance; Insurance and Certainty Equivalence; Alternative Psychological and Behavioral Approaches.

Financial Modelling in Excel

Excel Features and Techniques, Designing Spreadsheet models, Corporate Financial Statements, Cost of Capital, CAPM, Growth Models, WACC, Stock Valuation Models, Stock Mergers, Acquisitions and Corporate Restructuring Analysis, Loan Amortization, Bond Analysis

VBA Programming for Finance

Introduction to Programming, Introduction to VBA Programming Language, VBA Programming in Excel, Introduction to Object Oriented Programming, Advanced VBA Programming, VBA User Forms

Semester 2

Financial Institutions

This introduces the nature and operations of various financial market participants and institutions like Stock and other Exchanges, OTC markets, Intermediaries, Clearing House mechanisms and Clearing Corporation, Commercial Banks, Investment Banks, Broking Houses, Portfolio Management Services, Hedge Funds, Mutual Funds, Insurance Firms, other types of financial institutions.

Econometrics for Finance

This discusses econometric methods for modeling relationships between financial market variables. It includes parametric and non-parametric regressions, cluster analysis, simple and multiple linear regression models (OLS), Generalized Least Squares Regression (GLS), Principal Component Analysis, Logistic Regression, Probit Regression, Robust Regression, Lasso Regression, Ridge Regression, hypothesis testing and detection and treatment of Omitted variables, Multi-Collinearity, Heteroscedasticity, Autocorrelation. This introduces time series methodologies and discusses various models like ARMA, ARIMA, EWMA, ARCH, GARCH, IGARCH, NGARCH / NAGARCH, EGARCH, GJR-GARCH, TGARCH and estimating the model parameters using Maximum Likelihood Estimation (MLE), GMM. The emphasis is on practical applications of the various models in specific contexts.

Probability Theory

This provides a strong foundation to probability theory and includes Probability Space, Probability Measure, Random Variables, Distribution Function of Random Variables, Expectation and Moments, Chebychev's Inequality, Jensen's inequality, Moment Generating Functions, Characteristic Functions, Random Vectors, Joint Distributions, Independence, Correlation, Copulas, Transformations of Random Variables and Random Vectors, Sequences of Random Variables, Law of large numbers, Central Limit Theorem, Conditional Probability, Conditional Expectations, Filtration.

This involves studying some the well-known probability distributions like Discrete and Continuous Uniform, Bernoulli Trials and Binomial, Poisson, Normal, Log-Normal, Student's t, F, Chi-Square, Beta, Weibull, Extreme Value Theory and Extreme Value Distributions. It also includes Multivariate Joint and Marginal Distributions and studies the Multi-variate Normal Distribution.

C/C++ Programming for Finance

Financial programming in C++, R and MATLAB will be introduced.

Stochastic Calculus – I

Basic Stochastic Processes

This introduces stochastic processes and includes the study of Random Walks, Markov Property, Markov Chains, Martingale, Stopping times, Supermartingale and Submartingale Properties, Martingale Convergence Theorems, Doob Decomposition Theorem.

Brownian Motion

Finite-Dimensional Distributions, Filtration, Martingale Property, Quadratic Variation, Markov Property, Exponential Martingale, Reflection Principle, First Passage Time Distribution, Maximum to Date Process, Weiner Process, Geometric Brownian Motion.

Quantitative Trading Strategies

It discusses various quantitative trading strategies like Statistical Arbitrage, Cointegration, Dynamic Trading Strategies - Pair Trading, Delta-Neutral, Delta-Gamma-Neutral Strategies, Gamma Scalping, Index Arbitrage, Conversion Reversal, Risk Reversal, Dispersion Trading, Volatility Trading, Factor Model Strategies, Volume Weighted Average Price, Time Weighted Average Price, Implementation Shortfall.

Performance Attribution Analysis

It discusses about various methods for measurement of portfolio performance like Return-based Performance Measurement and Performance Attribution measures like Sharpe Ratio, Treynor Ratio, Jensen's Alpha, Tracking Error and Information Ratio, Risk-Return metrics specific to hedge funds (Drawdown and Sortino ratio), Portfolio Based Multi-Factor Performance Attribution Analysis like Brinson-Hood-Beebower Model for equity and 3-Factor Model for Fixed Income.

International Finance

1 Introduction and Motivation for International Finance
Key Issues in International Business Finance; Role of an International CFO.
2 Institutional Background of International Finance
International Payment Mechanism; International ("Euro") Money and Bond Markets; Balance of Payments; Exchange-Rate Regimes.
3 Currency Markets
Spot Markets for Foreign Currency; Exchange Rates; Major Markets for Foreign Exchange; Law of One Price for Spot Exchange Quotes; Translating FC Figures: Nominal Rates, PPP Rates, and Deviations from PPP;
4 Forward Exchange Rates for Currency

Introduction to Forward Contracts; Relation between Exchange and Money Markets; Law of One Price and Covered Interest Parity; Market Value of an Outstanding Forward Contract; Forward Forward and the Forward Rate Agreement; Using Forwards for International Financial Management.
5 The Market for Currency Futures
Handling Default Risk in Forward Markets; How Futures Contracts Differ from Forward Markets; Effect of Marking to Market on Futures Prices; Hedging with Futures Contracts; Pros and Cons of Futures Contracts Relative to Forward Contracts.
6 Markets for Currency Swaps
Fixed-for-Fixed Currency Swaps; Interest-Rate Swaps; Cross-Currency Swaps.
7 Currency Options
Concepts and Uses of Currency Options; Institutional Aspects of Options Markets; Options on Futures; Using Options for Arbitrage, Hedging; Speculation; Hedging and Valuation .
8 Exchange Risk, Exposure, and Risk Management
What Makes Forex Markets Tick? Behavior of Spot Exchange Rates; PPP Theory and the Behavior of the Real Exchange Rate; Exchange Rates and Economic Policy Fundamentals; Measuring Exposure to Exchange Rates; Concepts of Risk and Exposure: Measuring and Hedging of Operating Exposure; Accounting Exposure;
10 Managing Credit Risk in International Trade
Payment Modes without Bank Participation; Documentary Payment Modes with Bank Participation; Standard Ways of Coping with Default Risk;
11 Long-Term International Funding and Direct Investment
International Fixed-Income Markets; "Euro" Deposits and Loans; International Bond and Commercial-Paper Markets; Borrowing Alternatives.
12 Cost of International Capital and International Taxation of Foreign Investments

Semester 3

Numerical Computations **University Assessment**

It discusses various numerical methods for solving Partial Differential Equations like Implicit and Explicit Finite Difference methods (FDM), the Crank-Nicholson method. It discusses methods for numerical integration like Simpson's and trapezoidal rule and Gauss Quadrature to evaluate integrals. It also discusses methods for finding roots of a non-linear equation like Newton-Raphson, Regula Falsi, etc.

Random Number Generation Techniques

It builds a strong foundation to the field of numerical simulations, it discusses the concepts of True Random Number Generators (TRNGs), Pseudo Random Number Generators (PRNGs), Quasi Random Number Generators (QRNGs), it includes detailed implementation in VBA/C++ of Uniform Random Number Generators. Then it discusses generation of random numbers of different distributions by transformation of Uniform distribution using methods like Inverse CDF method, Envelop Rejection method, Correlated random numbers generation using Cholesky Decomposition.

Monte Carlo Simulation Methods

It discusses methods for numerical integration of multidimensional integrals using Monte Carlo integration. It discusses practical implementation methods and issues related to Monte Carlo Simulation like variance of Monte Carlo estimators and variance reduction techniques like Antithetic Variates, Control Variates, Importance Sampling, Stratified Sampling.

Applications in Finance

It discusses implementing MCS algorithms in Excel and VBA/C++ for simulation of GBM, correlated GBM, and other processes for simulating stock prices, interest rates, etc. Use of standard libraries like QuantLib, NAG, etc. will be introduced.

Derivative Products and Strategies

This introduces students to various Exotic Options like Asian Options, Bermudan Options, Forward Start Options, Barrier Options, Shout Options, Chooser Options, Lookback Options, Cliquet / Reverse Cliquet Options, Napolean Options, Rachet Options, Exchange Options, Binary / Digital Options, Rainbow Options, Basket Options, Spread Options, Compound Options, etc. This introduces students to various trading strategies involving derivatives for hedging, arbitrage and speculation including spreads, calendars, diagonals, market neutrals, etc.

Fixed Income Securities & Mathematics **University Assessment**

This introduces students with the knowledge of Forward Rates, estimating Forward Rates, building Spot and Forward Rates Curves using curve construction methods like bootstrapping, linear interpolation, polynomial interpolations and splines; pricing Floaters and Inverse Floaters, estimating Durations, Convexity and PVBP, etc.

1 Understanding Forward Rate Analysis and Yield curves

Term structure of interest rates and forward rate analysis; yield measures; analysing changes in the yield curve.

2 Framework for Analysing Bonds

Cash flows for typical bond structures; time value of money; annuities; bond yields: coupon, current, yield to maturity (YTM), yield to call, realised yield; yield conventions; yield decomposition: current yield, interest upon interest, pull-to-maturity; duration; modified duration; convexity and relative convexity. yield curve analysis - coupon yield curve and the spot curve, interpretations of the yield curve, pricing bonds using the yield curve; implications of duration and convexity for bond analysis; using horizon analysis to evaluate bond strategies; analysis of bonds with embedded options; asset and mortgage backed security analysis.

3 Risk Analysis for Bonds

Sources of risk - credit risk; interest rate risks; reinvestment risks; liquidity; calls on bonds; analysis of corporate bond risk; analysing rating agencies criteria – Moodys, Standard and Poors; risks involved in treasury securities; price volatility and interest rate volatility; sources of interest rate volatility; key ratios for interest rate sensitivity.

4 Fixed Income Strategies

Passive fixed income strategies; active fixed income strategies; common strategies - buy and hold, bullets and barbells, butterflies, ladders, immunization, hedging.

5 Fixed Income Fund Management Practice

Constructing a fixed income portfolio, importance of asset allocation, funding liabilities, asset liability management (ALM), balanced fund approach.

Derivatives Valuations and Implementations in C++/VBA

Options Fundamentals in VBA / C++

Option Greeks, Implied Volatility, Volatility Skews, Volatility Smiles/Frowns, Volatility Term Structures, Volatility Surface.

Equity Options Pricing in VBA / C++

It discusses implementing valuation of European options using Binomial Model, Black and Scholes (BS) Model, Computing Black-Scholes Greeks, Valuation of American Options using numerical methods like Binomial Tree, Finite Difference Method, American Monte Carlo Simulation (Longstaff

Schwartz Algorithm) and some analytical approximations like Roll-Geske-Whalley, Barone-Adesi-Whalley, etc. and valuation of path dependent options using Monte Carlo Simulation.

Currency Derivatives Pricing in VBA / C++

It discusses implementing valuation of Forward FX rates, Cross Currency Swaps, Cross Currency Interest Rate Swaps (CIRCUS), Currency Futures, Cross-currency Options.

Interest Rate Derivatives Pricing in VBA / C++

It discusses Interest Rate Term Structure Models, Stochastic Spot Rate Models like Vasicek Model, Cox-Ingersoll-Ross (CIR) Model, LIBOR Market Model (LMM) / Brace-Gatarek-Musiela (BGM) Model, implementing valuation of FRAs, Repo, Implied Repo, Interest Rate Swaps, Cross Currency Swaps, Quanto Swaps, CMS and CMT swaps, Basis swaps, Overnight swaps, Forward starting swaps, Interest Rate Options Valuation like CMS Options, Swaptions, Caps and Floors.

Mortgages and Mortgage-Backed Securities

Underwriting mortgages, Prepayment models, Risks in mortgages and mortgage-backed securities, Valuation of mortgage-backed securities, sub-prime mortgage design, mortgages and securitization, sub-prime CDOs.

Credit Derivatives Pricing in VBA / C++

It discusses Credit Risk and Securitization, implementing valuation of Credit Default Swaps (CDS), Credit Spread Options (CSO), Collateralized Debt Obligations (CDO), Valuation of CDS, Valuation of CDO.

Stochastic Calculus – II

Stochastic Differential Equations, Markov Property of the Solutions to Stochastic Differential Equations, Fokker-Planck Equation / Kolmogorov Forward Equations, Kolmogorov Backward Equations, Feynman-Kac Formula, Stochastic Integral for Simple Integrands, Ito's Lemma, Ito-Doeblin Formula for Brownian Motion, Solving the Stochastic Differential Equations for Generalized GBM, Ornstein-Uhlenbeck Process, Heston Process. Replicating Portfolios, Risk-Neutral Measure, Girsanov's Theorem, Deriving and Solving the Black-Scholes-Merton Pricing Formula.

Financial Risk Management

It discusses some financial disaster case studies, concept of Risk – Business Risk, Non-Business Risk - Strategic Risk, Financial Risk, Coherent measures of risk, Systematic and Non-Systematic Risk, Value-at-Risk, Earning at Risk, Conditional VaR, Downside Semi-Variance, VaR Measurement Methods for Linear Instruments Parametric and Non-Parametric methods, VaR Measurement Methods for Non-Linear Instruments Parametric Delta-Normal, Delta-Gamma-Normal, Non-Parametric Monte-Carlo Simulation, VaR for fixed income securities with embedded options, Mapping financial instruments to risk factors – VaR Mapping, Backtesting VaR, Portfolio VaR, Marginal VaR, Incremental VaR, Component VaR.

Technical Analysis & Portfolio Management

Technical Analysis

1 Background and Basics
Technical analysis as an integral part of market analysis; History of technical analysis.
2 Constructing and Interpreting Charts
Tools - the construction of different types of charts - line chart, bar chart, point and figure chart, candlestick charts etc.; What to Look for on the Charts.
3 Trends
Basics of pattern recognition; determination of price trends; support and resistance levels; real time presentations at end of session; moving averages; gaps; volume; comparative relative strength.
4 Phases of Price Activity and Pattern Recognition
Phases of price activity - pattern recognition on bar charts, pattern recognition on point and figure charts, pattern recognition on candlestick charting; turning points; continuation patterns; climax; candlesticks; volume; point and figure; behavioral; pairs trading / derivatives.
5 Technical Analysis Theories
Dow theory, Elliott wave theory, Fibonacci sequence, Gann analysis, Cycle analysis.
6 Technical Indicators
RSI indicator; Stochastics; Rate of change (RoC) indicator; MACD; Bollinger bands; Moving averages.
7 Sentimental Indicators
Volatility index (VIX), Put/call ratio, Bull/bear indicators, Dow's psychology of bull and bear markets, Insider activity
8 Applying technical analysis to bonds, currencies, futures and options.
9 Technical Analysis and Portfolio Management
Technical analysis tools for sentiment; Efficient market considerations; Short versus long trading strategies; Risk tools; Advanced derivative use and technical analysis; Quant tools.

Portfolio Management

1 Efficient Market Hypothesis (EMH)
Efficient market hypothesis conceptual underpinnings; empirical studies and anomalies of efficiency; implications of the EMH for investment analysis.
2 Modern Portfolio Theory
Measures of uncertainty and risk; Markowitz (Mean Variance) Efficient Frontier; introduction of a risk free asset; Capital Asset Pricing Model – CAPM; Critique of CAPM; arbitrage pricing theory – APT; single index models for portfolio construction.

3 Investment policy and portfolio creation
A framework for investment policy; investment policies and practices for institutions and individuals; monitoring and re-balancing asset allocation with respect to risk, return and investment policy; case studies in investment management; investment strategies - passive to active; structuring an international investment strategy.
4 Performance Attribution Analysis
Evaluation of portfolio performance; traditional measures – Sharpe, Treynor, Jensen; decomposition of portfolio performance; cases in portfolio decomposition; performance attribution support systems; value at risk (VaR) measurement.
5 Measurement and Presentation of Portfolio Returns
Global investment performance standards.
6 Stock Market Indices
Types of indices; Index versions; free-float indices;Weighting, capitalisation-weighted index; Criticism of capitalization-weighting; Indices and passive investment management. Applications - overview of NSE and BSE indices.

Summer Internship Project 100 Marks

Semester 4

High Frequency Finance **University Assessment**

It focusses on various aspects of high frequency market data like Markets Microstructure, Stylized Facts inherent in financial high frequency data like Order Book Dynamics, Bid-Ask bounce, Discreteness and clustering of price changes, Irregularity, asynchrony, clustering and intraday seasonality of the occurrences of orders, trades and trades-through, Signature plot effect, Epps Effect, Lead-lag Effect, Parametric Multidimensional Hawkes Process Modeling of financial high frequency data, Monte Carlo simulation, statistical estimation and goodness-of-fit testing of parametric Multi-dimensional, Hawkes Process Models, Low Latency Trading, Electronic Market Making, etc.

Algorithmic Trading Strategies

It discusses various aspects of algorithmic trading like Market Structures, Algorithmic Trading trends and their impact on the markets, Types of Algorithmic Trading Strategies, Lifecycle of Algorithmic Trading, Algorithm Trading Mechanics, Latency Considerations, Ideation and Strategy Creation, Pseudo-Code Generation, Architecture of a back-testing System, Performance Measurement Statistics, Order Management, Optimizing a back-tester, Architectural design, Basic platform design and architectural setup, Operational considerations and pitfalls, Transaction Cost Analysis, Order Management, Portfolio Management, Risk Management and Error Handling.

Market Risk Management

Focuses on the techniques used to model market risk, identifying Market Risk Exposures, Metrics of Market Risk, Measuring and Managing Market Risk Exposure, Application of Market Risk management, Active Risk and Tracking Error, Risk Decomposition and Risk Attribution, Stress Testing, Scenario Analysis, Hedge fund risk management, Risk management strategies, measuring and managing corporate exposures.

Credit Risk Management

It discusses about credit rating agencies, credit ratings, External & Internal credit ratings, credit transition matrices, Bankruptcy & default, Subprime mortgages and subprime securitization, Securitization & Special purpose vehicles, Counterparty risk and OTC derivatives, Counter-Party Default Risk and Settlement Risk, Probability of Default (PD), Loss Given Default (LGD) and Recovery Rate. Credit Scoring, Credit Spreads, Expected and Unexpected loss, Contingent claim approach and the KMV Model, Default and default-time correlations, Portfolio credit risk, Credit risk management models, Risk mitigation techniques, Economic Capital & Regulatory Capital, Sovereign risk and country risk evaluation.

Operational Risk Management

It discusses about types of operational risk, tools of Operational Risk Management like Audit Oversight, Process Review, Key Control Self Assessment, Key Risk Indicators, Severity and frequency distributions for operational risk, Loss distributions, aggregating loss distributions, insuring and hedging operational risk, differences between market and operational VaRs, definition of risk capital, Economic capital and risk aggregation, Firm-wide risk measurement and management, Allocation of risk capital across the firm, Correlations across market, credit, and operational risk, Evaluating the performance of risk management systems, Regulation and the Basel II Accord

Minimum capital requirements, Credit concentration risk, Liquidity risk, Stress testing, Implementation and Model Risk, Legal risk.

Liquidity Risk Management

It discusses about asset liquidity & cash-flow liquidity, liquidity risk measures like MCO, Stress Testing, LD, WBG & MTF, LVaR

Industry Oriented Dissertation Project 100 Marks

Scheme of Assessments for Subjects of 100 Marks

- The Semester end Examination will be conducted for 60 Marks.
- Internal Assessments will be conducted for 40 Marks.

The allocation of 40 marks shall be on the following basis: -

a) Periodical class tests held in the given semester (20 Marks)

b) Presentations throughout the semester (10 Marks)

c) Attendance and Active participation in routine class instructional deliveries (05 Marks)

d) Overall Conduct as a responsible student, mannerism and articulation and exhibition of leadership qualities in organizing related academic activities. (05 Marks)

Note: A Student has to separately secure minimum 50% marks (i.e 20 out of 40) in the internal assessments and secure minimum 50% marks (i.e 30 out of 60) in the Semester End Examination in every subject to be declared as Pass.

Question Paper Pattern for Semester End Examination (60 Marks)

There will be Seven Questions in all.

Q1 would be compulsory and would carry 20 Marks

In addition to Q1, there would be six questions. Each question would carry 10 Marks. Each of these Six Questions will have three sub – questions and each sub – question would carry 05 Marks

Students have to attempt any four out of the remaining six Questions and within each question; students have to attempt any two out of three sub – questions.

In all, students have to attempt five questions i.e (Q1+Any Four of the remaining)

Q1 – 20 Marks (Compulsory)

Attempt Any Four out of the Remaining Six Questions

Q2 (a) ---------- (5 Marks)
(b) ---------- (5 Marks)
(c) ---------- (5 Marks)
Any two from (a) or (b) or (c) ---------- (5x2) = 10 Marks

Q3 (a) ---------- (5 Marks)
(b) ---------- (5 Marks)
(c) ---------- (5 Marks)
Any two from (a) or (b) or (c) ---------- (5x2) = 10 Marks

Q4 (a) ---------- (5 Marks)
(b) ---------- (5 Marks)
(c) ---------- (5 Marks)
Any two from (a) or (b) or (c) ---------- (5x2) = 10 Marks

Q5 (a) ---------- (5 Marks)
(b) ---------- (5 Marks)
(c) ---------- (5 Marks)
Any two from (a) or (b) or (c) ---------- (5x2) = 10 Marks

Q6 (a) ---------- (5 Marks)
(b) ---------- (5 Marks)
(c) ---------- (5 Marks)
Any two from (a) or (b) or (c) ---------- (5x2) = 10 Marks

Q7 (a) ---------- (5 Marks)
(b) ---------- (5 Marks)
(c) ---------- (5 Marks)
Any two from (a) or (b) or (c) ---------- (5x2) = 10 Marks

Credit Based Grading System for MQF Semester End Examinations

Credit Point:

- A Credit Point denotes the quantum of effort required to be put in by a student, who takes up a course. In other words, it is an index of number of learning hours prescribed for a certain segment of learning.

Learning Hours

Learning Hours for Subjects of 100 Marks (60+40)

Learning Hours consist of Classroom teaching hours and other complementary learning activities indicated here below

1) **Classroom teaching hours ((15 Sessions X 3 Hours = 45 Hours))**

2) **Other Complementary learning activities (30 Hours)**

The learning activities consist of the following:

- Reading, Introspection, Thoughtful Reflection, Group Discussions, Lectures, Field Work, Workshops, Counseling Sessions, Watching Educational and Informative Videos, Assignments, Live Projects, Case Studies, Presentations, Preparation for Examinations, Participation in academic and extra – curricular activities, inculcation of industry specific skills and training & development sessions.

- The total learning hours would be thus equivalent to **45+30=75 Hours for subjects of 100 Marks**

Credit Point Computation

- One credit is construed as equivalent to 30 learning hours.

Credit completion and Credit accumulation:

- Each module of an academic program has been assigned specific credit points defining successful completion of the course under study.

- Credit completion or Credit acquisition may be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course.

- A learner who successfully completes a 2.5 CP (Credit Point) course is treated to have collected or acquired 2.5 credits. His performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired.

- A learner keeps on accumulating more credits as he completes additional courses.

Introduction of Grading System at the University of Mumbai

A well designed evaluation system that integrates the aforesaid parameters having due attention to their relative importance in the context of the given academic programme.

What is Grading?

- Grading, in the educational context is a method of reporting the result of a learner's performance subsequent to his evaluation. It involves a set of alphabets which are clearly defined and designated and uniformly understood by all the stake holders.

- A properly introduced grading system not only provides for a comparison of the learners' performance but it also indicates the quality of performance with respect to the amount of efforts put in and the amount of knowledge acquired at the end of the course by the learners.

The Seven Point Grading System

- A series of meetings of all the Deans & Controller of Examinations were held to discuss the system of grading to be adopted at the post graduate level. Mumbai University, subsequently in its Academic Council meeting and in its Management Council meeting resolved to adopt and implement the **Seven (07) Point Grading System** from the academic year 2012-13.

The Grade Point and the grade allocation shall be as per the Grade Table given below:

Proposed Grades for Post Graduate courses

7 Point Scale for POST GRADUATE Courses

Range of Scores	Grade	Grade Point	CGPA range
75 & above	O	7	6.5 - 7
70 - 74.99	A	6	5.5 - 6.49
65 - 69.99	B	5	4.5 - 5.49
60 - 64.99	C	4	3.5 - 4.49
55 - 59.99	D	3	2.5 - 3.49
50 - 54.99	E	2	2 - 2.49
< = 49.99	F (Fail)	1	< 2

Note: - Consider 1 Grade Point is equal to Zero for CG calculations in respect of failed learner/s in the concerned course/s.

Conversion of Marks to Grades and Calculations of GPA (Grade Point Average)

- In the Credit and Grade Point System, the assessment of individual Courses in the concerned examinations will be only on the basis of marks obtained; however these marks shall be converted later into Grades by a mechanism wherein the overall performance of the Learners can be reflected by the overall evaluation in terms of Grades.

- Abbreviations used for gradation needs understanding of each and every parameter involved in grade computation and the evaluation mechanism. The abbreviations and formulas used are as follows:-

Abbreviations and Formula's Used:-

G: Grade

GP: Grade Points

C: Credits

CP: Credit Points

CG: Credits X Grades (Product of credits & Grades)

∑**CG:** Sum of Product of Credits & Grades points

∑**C:** Sum of Credits points

$$\textbf{SGPA} = \frac{\sum \textbf{CG}}{\sum \textbf{C}}$$

SGPA: Semester Grade Point Average shall be calculated for individual semesters. (It is also designated as GPA)

CGPA: Cumulative Grade Point Average shall be calculated for the entire Programme by considering all the semesters taken together.

Special Point to Note:

While calculating the CG the value of Grade Point 1 shall be considered as Zero (0) in case of learners who failed in the concerned course/s obtaining marks below 50.

After calculating the SGPA for an individual semester and the CGPA for entire programme, the value can be matched with the grade as given in the Grade Point table as per the Seven (07) Points Grading System and expressed as a single designated GRADE such as O, A, B, etc….

The SGPA of learners who have failed in one subject or more than one subjects shall not be calculated.

Illustrations of the Calculations: -

Credit Points and Grading Calculations for MQF First Year First Semester

1 Credit = 30 Learning Hours

Result: - Passing in All Courses with more than 50% Marks

Courses In Semesters	No of Learning Hours	Credits Per Course (C)	Marks Obtained (%)	Grade	Grade Points (G)	∑CG = CxG	SGPA = ∑CG/∑C
Corporate Finance	60	2.5	55	D	3	7.5	
Inferential Statistics	60	2.5	60	C	4	10	
Financial Markets & Products	60	2.5	70	A	6	15	
Multi Dimensional Calculus	60	2.5	80	O	7	17.5	
Linear Algebra	60	2.5	50	E	2	5	**85/20=4.25**
Economics	60	2.5	55	D	3	7.5	
Financial Modelling in Excel	60	2.5	65	B	5	12.5	
VBA Programming for Finance	60	2.5	63	C	4	10	
Total	480	**∑C=20**					
Credit Earned = 20						**∑CG = 85**	**Grade C**
Passes							

Credit Points and Grading Calculations for MQF First Year First Semester

1 Credit = 30 Learning Hours

Result: - Fails in One Course or More than One Courses with Less than 50% Marks

Courses In Semesters	No of Learning Hours	Credits Per Course (C)	Marks Obtained (%)	Grade	Grade Points (G)	∑CG = CxG	SGPA = ∑CG/∑C
Corporate Finance	60	2.5	55	D	3	7.5	
Inferential Statistics	60	2.5	60	C	4	10	
Financial Markets & Products	60	2.5	70	A	6	15	
Multi Dimensional Calculus	60	2.5	80	O	7	17.5	
Linear Algebra	**60**	**2.5**	**45**	**F**	**1**	**0**	--------
Economics	60	2.5	55	D	3	7.5	
Financial Modelling in Excel	30	2.5	65	B	5	12.5	
VBA Programming for Finance	60	2.5	63	C	4	10	
Total	480	**∑C=20**					
Credit Earned = 18						**∑CG =80**	**Grade F**
Fails							

- **Note: - Consider 1 Grade Point is equal to Zero for CG calculations of failed learner/s in the concerned course/s.**
- **The student has been awarded 1 Grade Point, even though he has failed in the subject of Linear Algebra, however, 1 Grade Point is equal to Zero for CG calculations of failed learner/s in the concerned course/s.**
- **The SGPA has not been calculated as the student has failed.**

Credit Points and Grading Calculations for MQF First Year Second Semester

1 Credit = 30 Learning Hours

Result: - Passing in All Courses with more than 50% Marks

Courses In Semesters	No of Learning Hours	Credits Per Course (C)	Marks Obtained (%)	Grade	Grade Points (G)	∑CG = CxG	SGPA = ∑CG/∑C
Financial Institutions	60	2.5	55	D	3	7.5	
Econometrics for Finance	60	2.5	60	C	4	10	**85/20=4.25**
Probability Theory	60	2.5	70	A	6	15	
C/C++ Programming for Finance	60	2.5	80	O	7	17.5	
Stochastic Calculus – I	60	2.5	50	E	2	5	
Quantitative Trading Strategies	60	2.5	55	D	3	7.5	
Performance Attribution Analysis	60	2.5	65	B	5	12.5	
International Finance	60	2.5	63	C	4	10	
Total	480	**∑C=20**					
Credit Earned = 20						**∑CG = 85**	**Grade C**
Passes							

Credit Points and Grading Calculations for MQF First Year Second Semester

1 Credit = 30 Learning Hours

Result: - Fails in One Course or More than One Courses with Less than 50% Marks

Courses In Semesters	No of Learning Hours	Credits Per Course (C)	Marks Obtained (%)	Grade	Grade Points (G)	∑CG = CxG	SGPA = ∑CG/∑C
Financial Institutions	60	2.5	55	D	3	7.5	
Econometrics for Finance	60	2.5	60	C	4	10	
Probability Theory	60	2.5	70	A	6	15	
C/C++ Programming for Finance	60	2.5	80	O	7	17.5	
Stochastic Calculus – I	**60**	**2.5**	**45**	**F**	**1**	**0**	--------
Quantitative Trading Strategies	60	2.5	55	D	3	7.5	
Performance Attribution Analysis	30	2.5	65	B	5	12.5	
International Finance	60	2.5	63	C	4	10	
Total	480	**∑C=20**					
Credit Earned = 18						**∑CG =80**	**Grade F**
Fails							

- **Note: - Consider 1 Grade Point is equal to Zero for CG calculations of failed learner/s in the concerned course/s.**
- **The student has been awarded 1 Grade Point, even though he has failed in the subject of Stochastic Calculus – I, however, 1 Grade Point is equal to Zero for CG calculations of failed learner/s in the concerned course/s.**
- **The SGPA has not been calculated as the student has failed.**