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PREFACE

The Indian Economy has ventured on the path of rapid economic development which is triggered to be US\$ 5 Trillion by 2024. With digitalization in every aspect of the functioning of the economy, the availability of highly professional and skilled manpower is the immediate need of time. The most important sector which will be a game changer in the present time is the financial sector and its implementation/functioning through digital technology. Looking at the need of the market and employability, the Department of Economics, Jamia Millia Islamia, has started a new professional programme - “Masters of Science in Banking and Financial Analytics [M.Sc. (BFA)]”.

It is with this background that the said programme titled “Masters of Science in Banking and Financial Analytics [M.Sc. (BFA)]”, is introduced which is a Post Graduate Professional Programme and Terminal degree, of four semester (two years) duration having very high degree of Employability offered in the evening in Self Financing mode, which is designed in line with University Grants Commission’s guidelines and need of the market.

This present document is a course description, detailed course structure and syllabus of Master’s of Science in Banking and Financial Analytics [M.Sc. (BFA)]. The said programme was approved by various statutory Bodies of the University, starting its approval from BoS (22nd March 2019) of Department of Economics, to Faculty Committee and Academic Council, thereby completed its legitimate process to start a new programme in University system in accordance with the ACT, Statute and Ordinance of Jamia Millia Islamia. The Course Structure and detailed Syllabus was developed by discussions of a dedicated sub-committee, comprising of Senior Professors, Subject experts and Scholars prior to placing it for the said approval.

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(Dr. Halima Sadia Rizvi)
Professor and Head

ACKNOWLEDGEMENTS

Introducing a new digitally oriented programme, viz., **M.Sc. (BFA)** requires the work and commitment of a dedicated team without which an effective outcome cannot be achieved. Many people were involved in the development of the present course. The programme was designed after numerous discussions of the sub-committees, Board of studies, Faculty Committee and Academic Councils for design and approval of course structure of **M.Sc. (BFA)**. It is hence important to acknowledge and congratulate all those involved, when the programme is being formally launched.

First and foremost, the entire idea was born in view of the current economic situation. The design process was started with the formation of a committed sub-committee comprising of Professors, subject experts and scholars to develop the details of the course and its syllabus. It comprised of Prof. Shahid Ashraf, Dr. Mirza Allim Baig and Dr. Abdul Quadir as members; Prof. S.A.M Rizvi and Prof. Rashma Nasreen as external expert members; and Ms. Shivangi Chandel, Mr. Bilal Khan and Ms. Mansi Vinaik as special invitees, whose contribution is immensely acknowledged.

Many senior Professors of various departments of Jamia Millia Islamia and other institutions of repute have also contributed to this initiative for which we are thankful to them.

Thanks also to all the Faculty Members including Guest Faculty Members and Non-teaching staff of our Department for their continuous support throughout the process.

I shall be failing in my duties, if I do not mention my special thanks to my family members for their continuous encouragement and enthusiasm at every stage of this effort.

Although the attempts are made to bring the best in terms of content as well as format and presentation of this curriculum, however, it is still very much possible that it may have errors, shortcomings and omissions, for which the undersigned is entirely responsible. Suggestions, comments and constructive criticisms are welcome to improve this document further keeping in mind the objective of the **M.Sc. (BFA)** programme in the present time.

Dr. Halima Sadia Rizvi
Professor and Head

M.Sc. (BFA) Curriculum

The Department of Economics is a premier Department of the Faculty of Social Sciences of Jamia Millia Islamia (A Central University), was established in the year 1986 with the objective of developing competent professionals in Economics and researchers for higher studies of international standard and to be part of Indian Economics and Civil Services besides the professional needs of Banking and Financial Institutions. It is one of the well-established departments of Faculty of Social Sciences with competent faculty and state of the art infrastructure Laboratory and Departmental Library. The Department offers three programmes, viz., Ph.D. in the subject of Economics and the regular programmes M.A. (Economics), B.A Hon. (Economics).

The newly inducted programme **M.Sc. (BFA) is a Professional Master Terminal Degree Programme of four-semester (two- years)** where the last semester is totally to be spend in the Industry/Financial Institutions including Banks for **Industrial / Institutional Major Project** (Capstone Course), while still academically connected and evaluated by the Department and the University. The programme is having very high degree of Employability offered in the evening in Self Financing mode, which is designed in line with University Grants Commission's guidelines and need of the market.

The programme is specially designed to have 100% employability in digital era, which is heavily focused on application of technology, recent advancement and practices needed in the Banking sector, financial institutions, Statutory and Government Institutions, UN Organization for advising, policy making institutions on economic and financial sector at global level. It will also provide the students a platform to venture into research as M.Phil./Ph. D. Scholar in varied institutions across the globe including Department of Economics, Jamia Millia Islamia.

M.Sc. (BFA) programmes has to serve professional world of Financial Institutions / Banks and academic organizations both, bound to cover variety of subject in its curriculum to produce competent Financial / Industrial Professional and University Teacher, therefore Courses of M.Sc. (BFA) programme under different categories, besides Core Economics, Courses, viz., from Computer Science, Management, Mathematics and other allied subjects.

The structure of **M.Sc. (BFA)** programme consists of four-semester where each semester, barring fourth are having four courses each of 4 credit hours, and two Laboratories each of 2 credit hours except the fourth semester which is of 20 credit hours. The total credit hour therefore for **M.Sc. (BFA)** programme is = **82 Cr Hours** (1st and 2nd Semesters of 20 credits each and 3rd Semester of 22 credits while final / fourth Semester of 20 credits for 4th Semester for **Major Project**).

Moreover, Industry-Institutions Seminars are suggested frequently to be held throughout the Academic year as a part of Academic activity which enables the students of **M.Sc. (BFA)** to appreciate the Industrial development which is going on in Industries and Financial institutions

in India. These seminars will help the students to face interviews having latest knowledge and skill prevalent in Industries with higher degree of confidence.

It is designed to be a good blend of both the practical and theoretical aspects of Economics and Finance keeping in mind that they have to be Financial Professionals needed in the Indian Industries and Financial Institutions beside they should also be effective teachers in Indian University or Higher Education System. For further details one must refer Salient Feature of the Programme and the Details of the Courses offered in the Structure of **M.Sc. (BFA)**.

The Department conveys its best wishes to the students enrolled in M.Sc. (BFA) programme.

(Dr. Halima Sadia Rizvi)
Professor and Chairperson
BoS (Economics)

Basic Salient Features of PG Programme: M.Sc. (BFA)

Title: “Masters of Science in Banking and Financial Analytics [M.Sc. (BFA)]”

Duration: Four-semesters (Two years);

Mode: Self Finance.

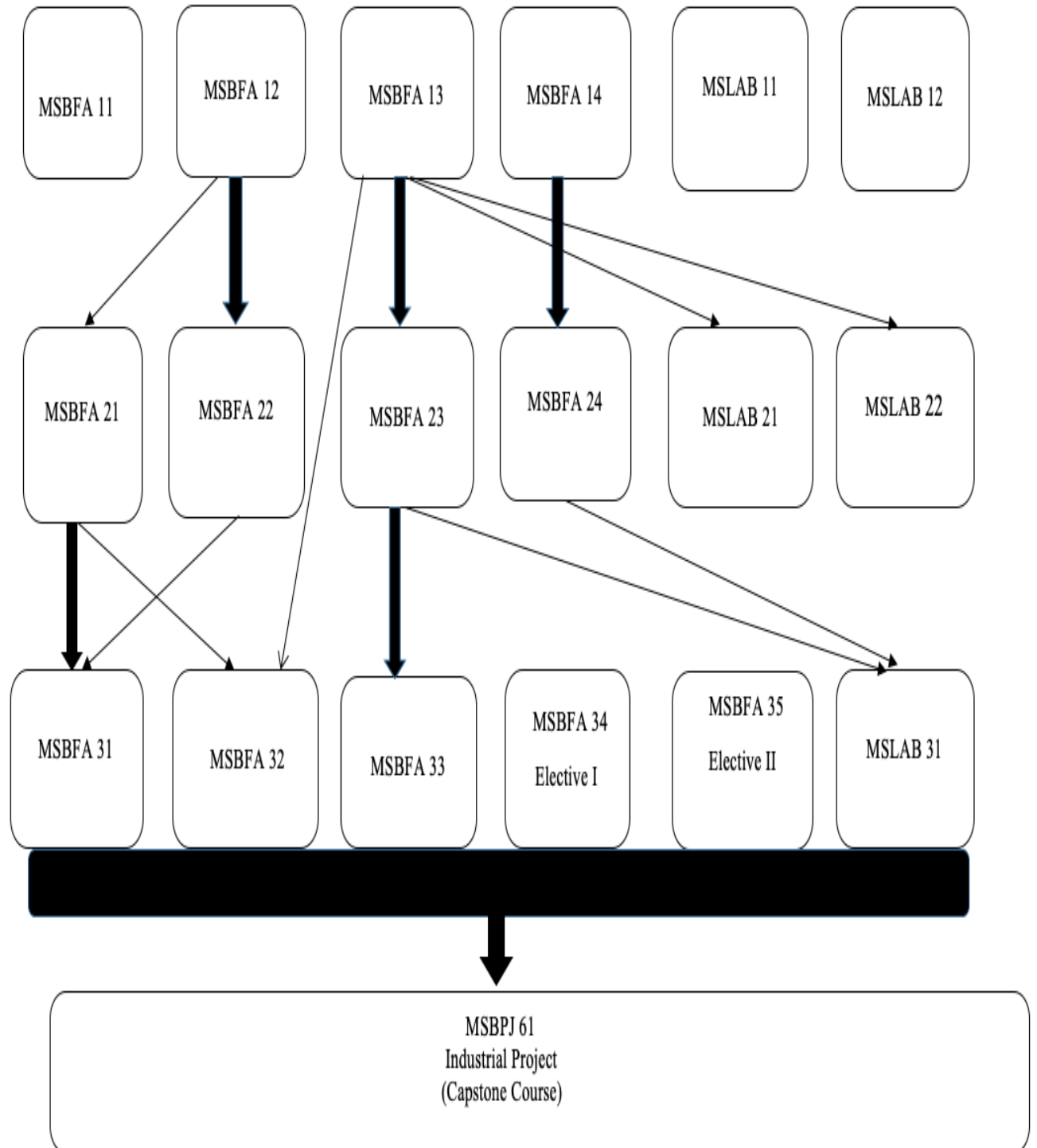
Intake: 40 + Over and above ICCR / NRI, Industry/Institution Sponsored, etc.

Admission/Eligibility: Through Entrance Examination (80%) followed by Interview (20%) and Eligibility criteria will be having Degree in any subject from the recognized Universities / Institutions with 55% marks in aggregate and Mathematics/Statistics/ Mathematical Economics/ Econometrics as one of the subjects/papers at intermediate / 10+2 level or at a higher level degree.

Future Scope / Openings: Eligible for Faculty Members and/or research / PhD. Programmes and/or scientists positions in equivalent grade, subject to fulfilling other eligibility requirements, such as percentages, age, entrance examinations, etc., of Jamia Millia Islamia and other National and International Universities / Institutions, Public and Private organizations.

Fees Structure (Per Semester): Tution fees: Rs. 32,300/- ; Total Fees: Rs 40,950/- ; Fees will for NRI / ICCR, Industry/Institution Sponsored candidates will be \$ 800 or equivalent currency in INR. (Subject to the revisions from time to time by Jamia Millia Islamia).

PRE-REQUISITE CHART



PROGRAMME STRUCTURE AND DETAIL SYLLABI

MASTERS OF SCIENCE IN BANKING AND FINANCIAL ANALYTICS

[M.Sc. (BFA)]

Semester I

Sr No	Course Code	Course Title / Name	Pre-requisite	L T P	Credit	Marks	Page No
1	MSBFA11	Financial Economics	NIL	3 1 0	4	100	10
2	MSBFA12	Banking Operations and MIS Implementation in Digital Era	NIL	3 1 0	4	100	12
3	MSBFA13	Problem Solving and Computer Programming in C	NIL	3 1 0	4	100	14
4	MSBFA14	Mathematics and Statistics for Banking and Finance	NIL	3 1 0	4	100	16
5	MSLAB 13	C – Programming in Banking and Finance	NIL	0 0 4	2	50	
6	MSLAB 14	R-programming in Banking and Finance-1	NIL	0 0 4	2	50	
					20	500	

Semester II

Sr No	Course Code	Course Title / Name	Pre-requisite	L T P	Credit	Marks	Page No
1	MSBFA21	Risk Analysis and Insurance	12	3 1 0	4	100	18
2	MSBFA22	Corporate Finance	12	3 1 0	4	100	20
3	MSBFA23	Advance Statistical Analysis for Finance using Python/R	14	3 1 0	4	100	22
4	MSBFA24	Optimization and Quantitative Analysis	14	3 1 0	4	100	24
5	MSLAB 21	Python-Programming in Banking and Finance-1	13	0 0 4	2	50	
6	MSLAB 22	R-Programming in Banking and Finance-2	14	0 0 4	2	50	
					20	500	

Semester III

Sr No	Course Code	Course Title / Name	Pre-requisite	L T P	Credit	Marks	Page No
1	MSBFA31	Portfolio Management and Investment Analysis	21,22	3 1 0	4	100	26
2	MSBFA32	IT ACT and Cyber Security for Banking and Finance	13	3 1 0	4	100	28
3	MSBFA33	Applications of Artificial Intelligence in Banking and Finance	13	3 1 0	4	100	30
4	MSBFAE1	Elective I	N.A.	3 1 0	4	100	32
5	MSBFAE2	Elective II	N.A.	3 1 0	4	100	32
6	MSLAB 31	Practice Problems of MSBFA33 using Prolog / Python / Perl	13	0 0 4	2	50	
					22	550	

Semester IV

Sr No	Course Code	Course Title / Name	Pre-requisite	L T P	Credit	Marks	Page No
1	MSBPJ61	***Industrial Major Project (Capstone Course)	Must clear 50% (10 Credits) Courses of Semesters I and II	N.A.	20	500	

*****Industrial Major Project may be developed preferably from Industries, Banks, Financial Institutions, RBI, Government and Public Bodies, HEIs and even from JMI as well.**

Note: The above Self-Financing Programme M.Sc. (BFA) will be of **Total 82 Credit Hours**. The programme is expected to start from the Academic Year 2019-20 onwards.

List of Electives (MSBFAE1/E2)

Sr No	Course Code	Electives (Course Title / Name)
1	MSBFAE1/E2	Islamic Finance
2	MSBFAE1/E2	Merger and Acquisitions
3	MSBFAE1/E2	Modelling and Simulation
4	MSBFAE1/E2	Data Analytic and Machine Learning
5	MSBFAE1/E2	Game Theory and Behavioural Finance
6	MSBFAE1/E2	Global Practices in Bank and Finance
7	MSBFAE1/E2	Applied Probability and Stochastic Analysis
8	MSBFAE1/E2	Business Ethics and Corporate Governance
9	MSBFAE1/E2	Advanced Financial Reporting and Analysis
10	MSBFAE1/E2	International Financial Market and Instruments
11	MSBFAE1/E2	Learning Organization and Knowledge Management
12	MSBFAE1/E2	Creativity and Innovation for Entrepreneur Excellence

DETAILED SYLLABI

SEMESTER I

MSBFA 11: FINANCIAL ECONOMICS

Course Code	:	MSBFA 11
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	NIL
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description

Financial Economics provides students with an in-depth introduction to the fundamentals related to modern finance. The theory of choice under certainty and uncertainty will arm students with strong micro foundations to analyse investors' behaviour and market equilibrium. The topics in asset pricing will encompass portfolio choice under complete and incomplete markets, mean-variance portfolio theory and equilibrium asset pricing and pricing with no arbitrage. The students will also be introduced to the theory of market efficiency and evaluation of the same.

Objectives

At the end of the course and having completed the essential reading and activities students should be able to:

- Understand the fundamentals of finance and role of transaction costs and information asymmetry theories in providing an economic justification for return on different asset
- Discuss whether stock prices reflect all available information, and evaluate the empirical evidence on informational efficiency in financial markets
- Handle the problems on interest rate, market efficiency and risk using various computer tools and software packages

Unit-wise Syllabus

Unit 1. Theory of Uncertainty

Axioms of choice under uncertainty; utility functions; expected utility theorem; Certainty equivalence, measures of risk-absolute and relative risk aversions; Stochastic dominance-first order, second order and third order; Measures of investment risk-variance of return, semi-variance of return, Shortfall probabilities; forward and future contracts and markets.

Unit 2. Mean-Variance Portfolio Theory

Measuring portfolio return and risks, effect of diversification; Minimum variance portfolio, perfectly correlated assets; Minimum variance opportunity set; optimal portfolio choice; Mean-variance frontier of risky and risk-free asset; portfolio weights; Equilibrium models - capital asset pricing model; Arbitrage pricing theory.

Unit 3. Market Efficiency and Financial Inclusion

Defining capital market efficiency; relationship between the value of information and efficient; rational expectations and market efficiency; Market efficiency with costly information; Efficient capital market theory and empirical models; Efficient Market Hypothesis (EMH) & Implications for financial markets; Financial Inclusion: Technology and financial inclusion; Financial Literacy and frauds; Case studies on financial inclusion and financial literacy

Basic Text Books

1. Brealey, R., S. Myers, F. Allen, and P. Mohanty (2014), *Principles of Corporate Finance*, Eleventh Edition, New McGraw Hill Education (India) Pvt. Ltd.
2. Z. Bodie, Robert Merton and David Cleeton (2012), *Financial Economics*, Second Edition, Pearson Learning Solutions.
3. Bailey, R.E. (2005), *The Economics of Financial Markets*, Cambridge University Press, UK.

References

1. Hull, J.C. (2002), *Options, Futures, and Other Derivatives*, Fifth Edition, Prentice-Hall of India Private Limited, New Delhi.
2. Cuthbertson, Keith and Dirk Nitzsche (2004), *Quantitative Financial Economics: Stocks, Bonds and Foreign Exchange*, Second Edition, John Wiley & Sons Ltd., England.
3. Alexander, G.J., W.F. Sharpe and J.V. Bailey (2002), *Fundamentals of Investments*, Third Edition, Prentice-Hall of India Private Limited, New Delhi.
4. Copeland, T. E. and J. F. Weston (1992), *Financial Theory and Corporate Policy*, Addison Wesley.
5. Campbell, Y.J., Andrew W. Lo, and A. Craig MacKinlay (1997), *The Econometrics of Financial Markets*, Princeton University Press, USA.
6. Ross, S.M. (2003), *An Elementary Introduction to Mathematical Finance: Options and Other Topics*, Second Edition, Cambridge University Press, U.K.
7. Thaler, Richard H. (2015), *The Making of Behavioral Economics: Misbehaving*, W.W. Norton & Company, Inc., USA.
8. Houthakker, H.S. and P.J. Williamson (1996), *Economics of Financial Markets*, Oxford University Press.

MSBFA 12: BANKING OPERATIONS AND MIS IMPLEMENTATION IN DIGITAL ERA

Course Code	:	MSBFA 12
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	NIL
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description

The Course deals with complete banking operations, including MIS implementation a bank does through its various channels like Branch, ATM, phone banking, home banking, internet banking and POS, depending upon the customers' convenience to save time and money. It is an important paper to cover the functioning of Banks and integrated operations through branches and sister bodies and MIS and online transactions in digital era. The course will also cover the MIS implementation, internet banking and other contemporary issues in digital era.

Objectives

The objective of the course is to build a pool of competent banking professionals, who can sustain the growing momentum of the banking sector and help to breach new standards of profit margins and customer responsiveness. More specifically, its focus will be on understanding of core banking, understanding of banking channels and payments, practices on banking technology to enhance business of banking sector.

Unit-wise Syllabus

Unit 1.

Branch Operation and Delivery Channels- Introduction and Evolution of Banking Management- Technological Impact in Banking Operations- Total Branch Computerisation- Concept of Opportunities- Centralised Banking- Concept, Opportunities, Challenges and Implementation. Delivery channels- Overview of delivery channels- Automated Teller Machine (ATM)- Phone Banking- Call Centres- Internet Banking- Mobile Banking- Payment Gateways- card technologies- MCR electronic clearing.

Unit 2.

MIS Implementation and Financial Management of Bank- Bank back office management- Inter branch reconciliation- Treasury Management- FOREX Operations- Risk Management- Data centre Management- Network Management (MIS/DSS/EIS)- Customer Relationship Management (CRM). Macroeconomic and financial stability-linkage-financial services-the financial crisis; Bank's financial statements: Bank Liabilities- Bank Assets- Contingency liabilities – the income statements of Indian Banks- Analysing Bank Financial Statements- Key performance indicators (KPI)- Bank financial statement analysis models- interest income and non-interest income.

Unit 3.

Internet Banking and Contemporary issues: : Inter bank payment system-interface with Payment system Network- Structured Financial Messaging system- Electronic Fund transfer- RTGS- Negotiating dealing systems and securities settlement systems- electronic money- E- cheques: Contemporary Issues in Banking Techniques- Analysis of Rangarajan Committee Reports- E Banking- Budgeting- Banking Softwares- Case Study: Analysis of Recent Core Banking Software.

Basic Text Books

1. Jessica Keyes (2005), Financial Services Information Systems, Auerbach publication; 2nd edition.
2. Kaptan S.S. & Choubey N.S. (2003) E-Indian Banking in Electronic Era, Sarup & Sons, New Delhi.

References

1. Vasudeva (2005), E- Banking, Common Wealth Publishers, New Delhi
2. Turban Rainer Potter, Information Technology, John Wiley & Sons Inc
3. Banking Technology- Indian Institute of Bankers Publication.
4. James F. Kurose, Keith W. Ross (2005) Computer Networking – A Top -Down Approach Featuring the Internet, Pearson Education.
5. W.S. Jawadekhar (2003), Management Information Systems, Tata McGraw Hill Publishing Company Limited.

MSBFA 13: PROBLEM SOLVING AND COMPUTER PROGRAMMING IN C

Course Code	:	MSBFA 13
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	NIL
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description:

This course teaches C programming by solving a variety of standard problems. Learning programming is never a theoretical exercise; it is augmented by some basic as well as advanced programming problems. The students will be trained to develop logical solutions of problem in hand by developing flowchart and algorithm and run them in C-Programming during laboratory hours.

Objectives:

By the end of this course, the student must be able to:

- To introduce C as a foundation for further study of programming languages such C++, C#, Python, and Java in particular.
- To use Array, Structure and Union data structures to represent lists and table of values.
- To be able to use pointers to fetch and process data at run-time and to dynamically allocate memory at run-time.
- To implement one player and two player games such as Tic-Tac-Toe, NIM, and Sudoku etc.
- To be able to design applications involving database stored at back-end in the form of text file.

Unit-wise Syllabus

UNIT 1: Problem Solving Approach and Basics of C

Introduction to Programs and Algorithms; Problem Solving Aspect (Algorithm Devising); Algorithm AND Flowchart Design Aspect, Top-down Design; Algorithm Implementation; Program Verification. Fundamental Algorithms – Exchanging the Values of Two Variables, Counting, Summation of a Set of Numbers, Factorial Computation, Sine Function Computation, Generation of the Fibonacci Sequence, Reversing the Digits of an Integer, Base Conversion, etc. Flowchart. Basics of C: Character Set; Keywords; Identifier, Constants, and Variables; Constant Types – Numeric and Character Constants; Data Types and Range of Values – Character, Integer and Floating Point; Signed, Unsigned, Short, and Long Integers; Data Declaration and Definition, Operator & Expression–Arithmetic, Relational, Logical, Increment, Decrement, Assignment, Conditional, and Bitwise Operators; Precedence & Associability of Operators.

UNIT 2: I/O & Control Structures and User-Defined Functions & Arrays

Managing Console, I/O–Reading and Writing Characters, Integers, Floating Point Numbers and Strings; Formatted I/O, Decision Making (Branching) Structures–If Statement, If-Else Statement, Nested If-Else Statement, Else-If Ladder, Switch Statement, Goto Statement; Looping Structures – While Statement, Do-While Statement, For Statement, Continue and Break Statements. Functions: Library Functions; Function Declaration (Prototype) and Function Definition; Function Arguments – Dummy, Actual and Formal Arguments; Local and Global Variables; Function Calls – Call by Value and Call by Reference; Returning Multiple Values from a Function, Recursion and Recursive Functions, Storage Class & Scope of Variables – Automatic Storage, Extern Storage, Static Storage, Register Storage, Single Dimensional Arrays; Accessing Array Elements; Initializing an Array; Multidimensional Arrays; Initializing Multidimensional Arrays; Memory Representation; Accessing Multidimensional Array Elements;

UNIT 3: Strings & Pointers and Structure, Union, Enumeration and Files

Array of Characters; String Manipulation Functions; Introduction to Pointers; Pointer Variable Declarations and Initializations; Null Pointer; Constant Pointers; Void Pointer; Pointer Operators; Pointer Arithmetic; Application of Pointers; Dynamic Memory Allocations: malloc, calloc, realloc and free functions; Implementation of One Dimensional Array Using Pointers; Implementation of Two Dimensional Array Using Pointers: Array of Pointers and Pointers to Arrays Representations; Pointers and Strings; De-Referencing Pointers; Pointer to Pointer; Pointer to Functions; Structure Declaration and Initialization; Accessing Structure Members, Structure Assignments; Array of Structures and Arrays within Structures, Nested Structures; Structure as Function Arguments; Structure Pointer; Unions; Difference between Structure and Union; Bit-Fields; Introduction to File; Text and Binary Files; Defining, Opening and Closing Files; I/O Operations on Files, Error Handling During I/O Operations, Random Access to Files, Command Line Arguments.

Text Books:

1. R. G. Dromey. How to Solve it by Computer, 2nd Ed., Pearson Education
2. Deitel&Deitel. C – How to Program, 6th Ed., Pearson Education.

References Books:

1. E. Balagrusamy. Programming in ANSI C(2013), 7th Ed., Tata McGraw Hill,
2. Gottfried. Programming in C(2014) – Schaum Series, 3rd edition, TMH publication,
3. Mike Banahan. Declan Brady and Doran(1991): The C Book, 2nd ed., Addison Wesley,.
4. Brian W. Kernighan, Dennis M. Ritchie(1988). The C Programming Language, 2nd Edition, Prentice Hal,.
5. Forouzan and Gilberg. Computer Science(2000): A Structured Programming Approach using C, Publisher: Course Technology; 3rd edition.

MSBFA 14: MATHEMATICS AND STATISTICS FOR BANKING AND FINANCE

Course Code	:	MSBFA 14
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	NIL
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description:

This course introduces the basic mathematical and statistical skills which are required to understand financial theory and analytics. The course is abstract in nature but will show the directions of their usage in finance, data analytics and statistical modeling. The course deals with basic concepts from linear algebra, analysis, probability distribution and mathematical statistics. The course will prepare the students to undertake advanced courses in finance, analytics and optimization. The course assumes the familiarity of the notion of probability.

Objectives:

1. To introduce the required mathematical and statistical skills for understanding financial theory and analytics.

2. To make the students master the abstract ideas.
3. To prepare the students to take advanced courses.

Unit-wise Syllabus

Unit 1: Linear Algebra and Elementary Analysis

Vectors: vector spaces, vector operations, Independence and dependence of vectors, rank and basis, inner product and norm; Matrices: matrix operation, some special matrices, rank of a matrix, inverse of a matrix, simultaneous linear equations, existence and uniqueness of solution, calculation of solutions, determinants and its properties, matrix inversion, Cramer's rule; Characteristic Value Problem: Eigenvalues, eigenvectors, trace and determinant of matrix; spectral decomposition of symmetric matrices, quadratic forms, characterization of quadratic Forms, Basis concepts of real analysis: sequences and limits in \mathbb{R} and \mathbb{R}^n , subsequences, open sets, closed sets, compact sets, limit of a function, continuous functions.

Unit 2: Probability

Random Variables: discrete and continuous random variables, probability density function, distribution functions, expectation, variance, moment generating function; Special Distribution: binomial distribution; Poisson distribution, normal, uniform and gamma distributions; Multivariate distribution: Joint distribution of two or more discrete or continuous random variables; Marginal and conditional distributions; Independence; properties of expectation, variance, covariance and correlation.

Unit 3: Sampling Distribution and Estimation

Standard sampling distribution: χ^2 , t and F distributions and their properties; Estimation of parameters: basic concepts - parameter and statistics, estimator and estimate, sampling distribution, sampling variance and mean squared error; properties of an estimator - unbiasedness, consistency, efficiency, sufficiency; Cramer-Rao inequality; point and interval estimations.

Basic Text Books:

1. Mathematics for economists by Carl P Simon and Lawrence Blume, (1994), W. W. Norton & Company.
2. Rudin, W. Principles of Mathematical Analysis, Third Edition, McGraw Hill International.
3. Robert V Hogg, Joseph W. McKean and Allen T. Craige, Introduction to Mathematical Statistics, Seventh Edition, Pearson.

References:

1. J. E. Freund and R. E. Walpole (1987), Mathematical Statistics, Prentice-Hall inc.,
2. P.G. Hoel, S.C. Port and C.J. Stone, (1984) Introduction to Mathematical Statistics, Wiley, Fifth Edition, .
3. J. A. Rice, (1995) Mathematical Statistics and Data Analysis, 2nd Edition, Duxbury Press,.
5. S. Ross, A (1976) First Course in Probability, Macmillan, V.K. Rohtagi, (1976) An Introductory to Probability Theory and Mathematical Statistics, Wiley-Blackwell,.

SEMESTER II

MSBFA 21: RISK ANALYSIS AND INSURANCE

Course Code	:	MSBFA 21
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	MSBFA 12
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description:

Companies must take risks if they are to survive and prosper and the risk management function's primary responsibility is to understand the portfolio of risks that the company is currently taking and the risks it plans to take in the future. It must then decide whether the risks are acceptable and, if they are not acceptable, what action should be taken. The course starts with an introduction to the classification of risk. Then we will discuss the methods to manage market risk. The students will learn about rigorous modeling for risk analysis like Value at Risk (VaR) and its applications to risk management practices. Furthermore, the course introduces the concept of endogenous risks and demonstrates how financial risks originate within the financial system. The course also highlights behavioral aspects of risk and discusses important limitations of current risk management practices. Next, we turn to credit risk, with a focus on ratings based and structural models. In addition to credit risk on portfolios the role of insurance in risk management will be covered.

Objective:

- The risk analysis involves identification of risks and associated potential costs, analysis of the causes of risk of financial loss, determination of various strategies to treat risk, selection of strategies appropriate to the goals and objectives of the business
- The objective of the course is to develop the knowledge and understanding of risk management practices for participants aiming to advance their careers in financial risk management.
- The course will focus on how to model the risk of portfolios emanating from fluctuations in market prices, or market risk, while the main focus of the course is on the management of financial risks. Participants will become familiar with the main tools and practices needed to assess and evaluate financial risks, they will understand the risk management practices in an industry setting and will be able to critically assess risk management reports and research.

Unit-wise Syllabus

UNIT I: Market Risk Analysis

Conceptual Framework: Linear Portfolio, Quadratic Portfolio, Simulation Based Valuation; Market Risk Models: Risk Measure, Risk Contribution, and Risk Information, Modeling the Stylized facts of financial time series; Time Scaling VaR and VaR with Trading, Market Liquidity Risk, Scenario Analysis and Stress Testing; Portfolio Optimization; Development in the Market Risk Internal Models Capital Regulation.

UNIT II: Credit Risk Analysis

Conceptual Framework: Loss Variable, Exposure at Default (EAD), Loss Given Default (LGD), Expected Loss (EL), Unexpected Loss (UL), Portfolio and Constant Severities, Value at Risk (VaR) Economic Capital ($EC\alpha$), Economic Capital ($EC\alpha$), Economic Capital based on Shortfall Risk, Loss Distribution (Monte-Carlo Simulation and Analytical Approximation: Credit Risk), Today's Industry Models (Credit Metrics and KMV-Model, Credit Risk⁺ Credit-Portfolio View, **Credit Risk Models:** Dynamic Intensity Models, Credit Metrics and the KMV-Model, Global Correlation Model, Credit-Portfolio View, Dynamic Intensity Models, The Credit Risk⁺ Model, The Standard CR⁺ Model, The Compound Gamma CR⁺ Model, The Two Stage CR⁺ Model (SKI, AD).

UNIT III: Insurance in Risk Management

Modeling risk in insurance and methodologies of premium calculations, Risks transfers via reinsurance, Elements of traditional life insurance, Risk modeling and pricing in innovative life insurance.

Text books:

1. Skoglund, J., & Chen, W. (2015). *Financial risk management: Applications in market, credit, asset and liability management and firm wide risk*. John Wiley & Sons.
2. Bluhm, C., Overbeck, L., & Wagner, C. (2016). *Introduction to credit risk modeling*. Chapman and Hall/CRC.
3. Melnikov, A. (2011). *Risk analysis in finance and insurance*. Chapman and Hall/CRC.

References:

1. Skoglund, J., & Chen, W. (2015). *Financial risk management: Applications in market, credit, asset and liability management and firm wide risk*. John Wiley & Sons.
2. Bluhm, C., Overbeck, L., & Wagner, C. (2016). *Introduction to credit risk modeling*. Chapman and Hall/CRC.
3. Duffie, D., & Singleton, K. J. (2012). *Credit risk: pricing, measurement, and management*. Princeton university press.
4. Giesecke, K. (2004). *Credit risk modeling and valuation: An introduction*. Available at SSRN479323. <http://www.stanford.edu/dept/MSandE/people/faculty/giesecke/introduction.pdf>, 2004
5. Hull, J. C. (2003). *Options futures and other derivatives*. Pearson Education India.
6. Melnikov, A. (2011). *Risk analysis in finance and insurance*. Chapman and Hall/CRC.

MSBFA 22: CORPORATE FINANCE

Course Code	:	MSBFA 22
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	MSBFA 12
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description

This course is designed to provide an applied and practical approach to corporate finance, enabling to use the concepts and tools to address topical issues. The emphasis on learning basic capital structure and valuation techniques and decisions in presence of taxation, agency frictions, and asymmetric information. The course will then take students beyond the analysis of capital structure and valuation techniques, by focusing on market breakdown, monitoring and takeover in corporations.

Objectives

On successful completion of this course, students should be able to:

- Understand the interaction between financial and strategic decisions of corporations.
- Understand and explain different capital structure theories and capital budgeting techniques.
- Understand the trade-off firms face between tax advantages of debt and various costs of debt, including information asymmetry and agency conflict
- Understand how companies issue new shares, and calculate related price impact in security offerings
- Analyse corporate finances by handling financial data of different companies.

Unit-wise Syllabus

Unit 1 Corporate Finance & Borrowings

Modigliani-Miller theorem; Credit analysis and Loan Covenants; Credit rationing Models- fixed investment model and inside equity and outside debt model; Capital structure and impact of taxes; Determinants of Corporate borrowing- diversification, collateralization; Group lending; Liquidity management model; Debt overhang; optimal debt maturity; Cash flow and investment sensitivity; Liquidity- Accountability trade-off

Unit 2. Asymmetric Information and Corporate financing

Lemons problem and market break down; Pecking order hypothesis; Market breakdown and cross subsidisation; Signalling; contract design by an informed party; Incentives Compensation; Agency problem in Capital Budgeting; Creative accounting and earning manipulation

Unit 3 Monitoring and Lending Relationship

Anglo-Saxon and GJ model; Market Monitoring and limits; Monitoring and reputation; Costs of monitoring; Investor activism; Share concentration; learning by lending; Takeover theories- positive and pure; managerial resistance

Basic Text Books

1. Tirole, J. (2006), *The Theory of Corporate Finance*, Princeton University Press, Princeton, UK.
2. Brealey, R., S. Myers, F. Allen, and P. Mohanty (2014), *Principles of Corporate Finance*, Eleventh Edition, New McGraw Hill Education (India) Pvt. Ltd.
3. Ross, S.A., R.W. Westerfield and Jeffrey Jaffe (2005), *Corporate Finance*, Seventh Edition, Tata McGraw-Hill Publishing Company Limited, New York.

References

1. Berk J. and De Marzo (2016), *Corporate Finance: The Core*, Fourth Edition, Pearson Global Edition.
2. Campbell, Y.J., Andrew W. Lo, and A. Craig MacKinlay (1997), *The Econometrics of Financial Markets*, Princeton University Press, USA.
3. Grinblatt M. and S. Titman (2001), *Financial Markets and Corporate Strategy*, Second Edition, McGraw-Hill.
4. Cuthbertson, Keith and Dirk Nitzsche (2004), *Quantitative Financial Economics: Stocks, Bonds and Foreign Exchange*, Second Edition, John Wiley & Sons Ltd., England.
5. Copeland, T. E. and J. F. Weston (1992), *Financial Theory and Corporate Policy*, Addison Wesley.

MSBFA 23: ADVANCED STATISTICAL ANALYSIS FOR FINANCE USING PYTHON/R

Course Code	:	MSBFA 23
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	MSBFA14
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description:

This course introduces the statistical skills to deal with the financial time series data. The amount of financial data available is huge. Moreover, the development of computational technology and data storing capacity have made many things easier.

Thus, it is required to marry the data with right statistical techniques. The course will expose the statistical models for these purposes rigorously. The students are required to have MSBFA 14 or a solid working knowledge of probability and statistics. Simple regression, estimation and testing from the applied perspective are crucial notions assumed known for this course. We will use R throughout the course so a running knowledge of it is welcome, but not needed.

Objectives:

1. To introduce various statistical models to analyze financial data.
2. To understand and appreciate the abstract statistical models.
3. To equip the students to be able to think plausible statistical models after looking at data.
4. To be able to use linear or non-linear models while dealing with actual data.
5. To be able to understand parametric and non-parametric econometrics techniques and use them sensibly.

Unit-wise Syllabus

Unit 1: Statistical Models and Linear Time Series Analysis

Introduction to Statistical Methods, Visual descriptors, Numerical Descriptors; Simple and multivariate regression; diagnostic checks; Stationarity, autocorrelation function; Autoregressive models; moving average models; ARMA models; unit-root non-stationarity; exponential smoothing; seasonal model; Regression models with time series data, long memory models; Characteristic of volatility; the ARCH model; The GARCH model; EGARCH.

Unit 2: Non-linear models

Bilinear model, threshold autoregressive (TAR) model, smooth transition AR (STAR) model; Nonlinearity tests, modeling, forecasting; Nonsynchronous trading, bid-ask spread, empirical characteristics of transactions data; Ordered probit model, a decomposition model, the ACD Model, simulation, estimation. Nonlinear Duration Models, bivariate models for price change and duration.

Unit 3: Continuous Time Models

Introduction to some continuous processes like Wiener Process, generalized Wiener processes, and Ito Processes; Review of differentiation, stochastic Differentiation, Estimation of and Distributions of stock prices and log returns; Derivation of Black-Scholes Differential Equation, Black-Scholes Pricing Formulas, Estimation of Continuous-Time Models; Value at risks, risk metrics, non-parametric econometric, Quantile estimation, extreme value theory; Extreme value approach to VaR; a new approach based on the extreme value theory.

Basic Textbooks

1. RueyS.T. (2010), Analysis of Financial Time Series, Third Edition, Wiley, 2010.

References:

1. Peter Daalgard(2008), Introductory Statistics with R, Second Edition, Springer
2. JefferyWoolridge, (2012), Introductory Econometrics: A Modern Approach, Fifth Edition, Cengage Learning, Inc.
3. James H. Stock and Mark W. Watson(2007), Introduction to Econometrics, Third Edition, Pearson/Addison Wesley.
4. James D. Hamilton(1994), Time Series Analysis, First Edition, Princeton University Press,.
5. Walter Enders(2013), Applied Econometric Time Series, Third Edition, Wiley.
6. William H. Greene(2011), Econometric Analysis, Seventh Edition, Prentice-Hall,.
7. Jack Johnston and John Dinardo,(1997), Econometric Methods, Fourth Edition, McGraw Hill Higher Education,.

MSBFA 24: OPTIMIZATION METHODS FOR BANKING AND FINANCE

Course Code	:	MSBFA 24
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	MSBFA14
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description:

This course introduces the required mathematical tools to understand optimization techniques. The course takes the approach of modeling financial decisions as optimization problems and then developing appropriate optimization techniques to solve them. The course deals with the class of optimization problems both linear and non-linear: linear and non-linear programming and integer programming.

Optimization is ubiquitous in almost every decision-making process financially or otherwise. In finance, for instance what portfolio one should choose, how can we construct an index fund? etc. require deep understanding of optimization methods. This course will equip the students to use them appropriately and correctly. MSBFA 14 is the prerequisite for this course. This course also assumes familiarity with differential calculus.

Objectives:

- To cultivate a basic understanding of optimization methodologies used in financial decision making.
- To introduce required mathematics for understanding optimization methods.
- To equip the students to use linear and non-linear optimization methods most appropriate for a particular financial optimization problem.

Unit-wise Syllabus

Unit 1: Convex Sets

Convex sets, convex combination, continuous and differentiable functions on convex sets, concave and convex functions, Separating hyperplane theorem. Polyhedral and polytopes Farkas Lemma, Caratheodery theorem Application.

Unit 2: Linear Programming

Formulation of the problems, geometry of optimal solution, Simplex method. Writing and interpreting the dual; duality theorems; Applications: short-run financing and asset pricing; Linear relaxation of integer programs, branch and bounds. Totally unimodular matrices; Application: construction of an index fund, assignment problems, prices

Unit 3: Non-linear Optimization

Unconstrained optimization: existence and uniqueness of solution, global maximum and minimum and their sufficient conditions, local maxima and minima and their necessary and sufficient conditions; Constrained Optimization: global maximum and minimum and their sufficient conditions, local maxima and minima and their necessary and sufficient conditions, Lan-grangian Method with several equality and inequality constraints, saddles points, Slater' condition, Kuhn-Tucker conditions, meaning of Langrange multiplier, envelopes theorem, Application: mean-variance optimization.

Basic Text Books :

1. RakeshVohra (2004) Advanced Mathematical Economics First Edition, Routledge,.
2. Cornuejols, G., Tutuncu, R , (2018), Optimization Methods in Finance Second Edition, Cambridge University Press,.
3. Rangarajan K. Sundaram(1996), A Course in Optimization Theory by 1996, Cambridge University Press.

References:

1. Vanderbei, J. Robert Linear Programming: Foundations and Extensions, Third Edition, Springer, 2008.
2. Boyd, S., and Vandenberghe, L., (2004), Convex Optimization, First Edition, Cambridge University Press, 2004.
3. Simon Carl and Blume, Lawrence,(1994),Mathematics for Economists, , W. W. Norton & Company.
4. Hohn, Franz E., Elementary Matrix Algebra, New Delhi: Amerind.
5. Gale, David, (1986), The Theory of Linear Economic Models, New York: McGraw-Hill

SEMESTER III

MSBFA 31: PORTFOLIO MANAGEMENT AND INVESTMENT ANALYSIS

Course Code	:	MSBFA 31
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	MSBFA 21, MSBFA 22
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description

The course is designed to study the theory and empirical evidence relevant for investing, particularly in the context of portfolio management. The major topics will include: security markets and the investment industry, optimal portfolio selection, the relation between risk and return in one way or another. The course is geared mostly towards the understanding and implementation of “modern portfolio theory,” which is a general approach for maximizing the expected return of a portfolio given a certain amount of risk. The course is also designed to prepare students to do quantitative and statistical analysis in a broad range of settings.

Objectives

The successful completion of this course will help students:

- in understanding the theories of portfolio selection and recent development in the field.
- in understand risk, hedging, and numerous financial securities as tools to manage risk
- in handling mathematical and statistical tools.

Unit-wise Syllabus

Unit 1. Optimum Portfolio Selection & Analysis

Mean variance Portfolio Theory; Input to portfolio analysis; single index model; Multi index models; International Diversification of Portfolio; Aggregate asset Allocation; Forecasting individual security returns; Risk tolerance function; Value at risk and Exercise on above topics

Unit 2. Basics of Investment Analysis

Basic theory of interest; discounting and present value; Internal rate of return; evaluation criteria; Fixed-income securities; bond prices and yields; Interest rate sensitivity and duration; immunization; The term structure of interest rates; yield curves;

Unit 3. Options and Other Derivatives

Introduction to derivatives and options; forward and futures contracts; Forward and future prices Stock index futures & the use of futures for hedging; Interest rate futures & duration-based hedging strategies; Option markets; call and put options; factors affecting option prices; put-call parity option trading strategies: spreads; straddles; strips and straps; The principle of arbitrage; discrete processes and the binomial tree model; risk neutral valuation model

Basic Text Book

1. Alexander, G.J., W.F. Sharpe and J.V. Bailey (2002), *Fundamentals of Investments*, Third Edition, Prentice-Hall of India Private Limited, New Delhi.
2. Elton, Edwin J., M.J. Gruber, S.J. Brown, and W.N. Goetzmann (2014), *Modern Portfolio Theory and Investment Analysis*, Wiley Student Edition, Eighth Edition, UK.

References

1. Hull, J.C. (2002), *Options, Futures, and Other Derivatives*, Fifth Edition, Prentice-Hall of India Private Limited, New Delhi.
2. Brealey, R., S. Myers, F. Allen, and P. Mohanty (2014), *Principles of Corporate Finance*, Eleventh Edition, New McGraw Hill Education (India) Pvt. Ltd.
3. Bhole, L.M. and J. Mahakud (2017). *Financial Institutions and Markets*, Sixth Edition, McGraw Hill Education (India) Pvt. Ltd.
4. Luenberger, David G. (2012), *Investment Science*, Indian Edition, OUP.

MSBFA-32: IT ACT AND CYBER SECURITY FOR BANKING AND FINANCE

Course Code	:	MSBFA 32
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	MSBFA 13
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description:

The course will cover the basics of information security & spread appropriate level of awareness, knowledge and skill on the disciplines of technology, business and law to allow them to minimize the occurrence and severity of information security incidents and to understand the importance of security in their daily lives in the IT field.

Objectives

- The students will learn techniques used to detect, respond to, and prevent network intrusions.
- The course would provide the students with an in-depth understanding of core concepts with major thrust on functional competencies related to real life situations.
- The course bears a strong adherence to computer based technological skills and capabilities, and thereby resulting in efficiency to handle a variety of issues related to Information and Cyber Security in any organization in the purview of IT ACT and its recent amendments.

Unit-wise Syllabus

UNIT 1: Introduction to Cyber Security, Vulnerabilities and Safeguards:

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats: - Cyber Warfare-Cyber Crime-Cyber Terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

UNIT 2: Securing Web Application, Services and Servers, Intrusion Detection and Prevention:

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

UNIT 3: Cryptography and Network Security, Cyberspace and IT ACT:

Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography in banks/Financial Institutions. Overview of Firewalls-Types of Firewalls, User Management, VPN Security; Security Protocols: - security at the Application Layer- PGP & S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

Evolution of the IT Act, Genesis and Necessity, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013, IT Act: Salient Feature of IT Act 2000, Legal Provisions under the Information Technology Act, Recent amendments by the IT (Amendment Act) 2008, ActSection66(A, B, C, D, E, F), ITActSection67(A,B,C).

Books:

1. William Stallings, Cryptography & N/W Security
2. Anirudh Rastogi., Cyber Law of Information Technology and Internet (LexixNexis)

References:

1. EMC, Information Storage Management (2009): —Storing, Managing and Protecting Digital Information□, Wiley.
2. Farooq Ahmad, Cyber Law in India, Pioneer Books
3. Eoghan Casey (2004), Digital Evidence and Computer Crime, 2nd Ed. Academic Press.
4. Rukmani Krishnamurthy, Introduction to Forensic Science in Crime Investigation
5. P.M. Bukshi and R.K. Suri, Guide to Cyber and E – Commerce Laws

MSBFA 33:APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN BANKING AND FINANCE

Course Code	:	MSBFA 33
L-T-P	:	3-1-0
Credit	:	4
Course Prerequisite	:	MSBFA 13
Course Status	:	Core Course
Instructor's name	:	
Tel. No.	:	
Office Location	:	
Office Hours	:	
Class Location	:	
Class Time	:	

Course Description:

This course presents AI as a coherent body of ideas and methods to acquaint the student with the classic programs in the field and their underlying theory. This course will introduce and familiarize students with the field of Artificial Intelligence (AI). AI is one of the oldest disciplines in computer science. A primary goal of this course is to build intelligent entities/systems. This course is structured to give an overview of the area, as well as provide necessary depth to fundamental AI techniques and applications. Main emphasis will be on investigations as what it means to be intelligent and how to incorporate intelligence in problem solving, throughout the course. Attempt will be made to attain an understanding on the contributions AI has made to the field of computer science. By the end of the course, students are expected to possess a general and in-depth knowledge of the field of AI. Students will explore this through problem-solving paradigms, search, logic and theorem proving, prolog language and non-monotonic reasoning, and learning. It is an applications course and will focus on problems in the field of AI and techniques and algorithms for solving those problems using PROLOG. Prolog encourages a different programming style to Java or ML and particular focus is placed on programming to solve real problems that are suited to this style.

Objectives:

By the end of this course, the student must be able to:

- Use various symbolic knowledge representations to specify domains and reasoning tasks of a situated software agent.
- Use different logical systems for inference over formal domain representations, and trace how a particular inference algorithm works on a given problem specification.
- Understand the conceptual and computational trade-offs between the expressiveness of different formal representations.
- To recognize when AI techniques are necessary, to apply standard AI techniques to solve problems
- To introduce programming in the Prolog language and use key logic-based techniques for solving different AI problems
- To understand non-monotonic reasoning or reasoning under uncertainty.

Unit-wise Syllabus**UNIT 1: AI history and applications and Problem solving using Search**

Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Defining AI: Acting Humanly (Turing Test Approach), Thinking Humanly (Cognitive Modeling Approach), Thinking Rationally (laws of thought approach), Acting Rationally (Rational Agent Approach); Foundations of Artificial Intelligence; AI techniques, Expert Systems, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Introduction to Computer vision, Natural Language Processing, Machine learning, Soft Computing etc.

Searching for solutions, Uninformed Search Strategies: Breadth-first Search, Depth-first Search, Depth-limited Search, Iterative Deepening depth-first search, Comparing uninformed search strategies; constraint satisfaction problems, Heuristic Search Techniques: Hill Climbing, Simulated Annealing, Best First Search: OR Graphs, Heuristic Functions, A* Algorithm, AND-OR Graphs, AO* Algorithm, Adversarial Search: Zero-sum perfect information Games, Optimal Decisions and Strategies in Games, Mini-max Algorithm, Alpha-beta Pruning, Imperfect Real-time decisions, Games that include chance, State of the art game programs.

UNIT 2: Knowledge Representation & Reasoning

Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Representations and mappings, Approaches to Knowledge Representation, Procedural versus Declarative Knowledge; Predicate Logic: Representing Simple facts, Instance and is-a relationships in Logic, Proposition versus Predicate Logic, Computable Functions and Predicates, Rules of Inferences and Resolution-refutation, Logic Programming and Horn Clauses; Weak Slot-and-Filler Structures: Semantic Nets, Frames; Introduction to Semantic Web and ontologies, Strong Slot-and-Filler Structures: Conceptual Dependency, Scripts.

UNIT 3:AI Programming Language (PROLOG) and Probabilistic/Statistical Reasoning

Introduction, How Prolog Works, Backtracking, CUT and FAIL operators, Built-in Goals, Negation, Lists, Syntax and built-in Functions, Basic list manipulation functions in PROLOG, Predicates and Conditionals, Input, Output and Local Variables, Iteration and Recursion, recursive Lists processing, Search in Prolog: Breadth-first, depth-first, Best-first search for AI problem solving.

Probability and Bayes' Theorem, Certainty Factors and Rule-Based Systems, Bayesian Networks, Exact and approximate inference in Bayesian networks, Markov chains, Dempster-Shafer theory, Quantifying uncertainty, Intro to Fuzzy Logic; Non-monotonic Reasoning, Truth Maintenance Systems, probabilistic reasoning over time.

Text Books

1. Stuart Russel and Peter Norvig. Artificial Intelligence–A Modern Approach, 3rd Ed., 2012, Pearson Education, ISBN: 0-13-790395-2.
2. Elaine Rich, Kevin Knight and B. Nair. Artificial Intelligence, 2009, Tata McGraw Hill, 3rd Ed, ISBN-10: 0-07-008770-9.

References Books

1. Michael Negnevitsky, Artificial Intelligence-A guide to intelligent systems”, 2nd edition, Pearson Education.
2. Ivan Bratko. PROLOG Programming, 3rd Ed., 2001, Pearson Education, ISBN: 81-7808-257-8.
3. E. Charniak and D McDermott. “Introduction to Artificial Intelligence”, Pearson Education.
4. Dan W. Patterson. “Artificial Intelligence and Expert Systems”, Prentice Hall of India.
5. David Poole, Alan Mackworth, Randy Goebel. “Computational Intelligence: a logical approach”, Oxford University Press, 2004.
6. George F. Luger. “Artificial Intelligence: Structures and Strategies for complex problemsolving”, Fourth Edition, Pearson Education, 2002.
7. J. Nilsson. “Artificial Intelligence: A new Synthesis”, Elsevier Publishers, 1998.

MSBFAE1: ELECTIVE I

MSBFAE2: ELECTIVE II

SEMESTER IV

Sr No	Course Code	Course Title / Name	Pre-requisite	L T P	Credit	Marks
1	MSBPJ61	Industrial Major Project (Capstone Course)	Must clear 50% Courses of Semesters I and II	N.A.	20	500
