Course Name: M.Sc (Data Science)

Course Structure:

Summary:

Semester No	Total Credit
1	25
2	26
3	26
4	19
Total	96

Year	**Semester**	**Paper Code**	**Paper**	**Marks**	**Credit**
1	1	MDS101	Statistical Methods	100	4
		MDS102	Data Base Management System	100	4
		MDS103	Operating System	100	4
		MDS104	Fundamentals of Analytics	100	4
		MDS191	Analytics Lab I	100	3
		MDS192	DBMS Lab	100	3
		MDS193	OS Lab using Linux/Unix	100	3
				700	25

1	2	MDS201	Modeling Techniques	100	4
		MCS201	Object Oriented Analysis and Design	100	4
		MDS202	Modern Computing Scenario	100	4
		MCS204	Data Communication and Networking	100	4
		MCSE401A	Cloud Computing	100	4
		MDS291	Object Oriented Programming Lab	100	3
		MDS292	Analytics Lab II	100	3
				700	26

2	3	MDS301	Time Series Analysis and Forecasting	100	4
		MDS302	Data Mining	100	4
		MDS303	Big Data Technology	100	4
		MDS304	Design and Analysis of Algorithm	100	4
		MDS305	Machine Learning	100	4
		MDS391	Data Mining Lab	100	3
		MDS392	Big Data Technology and OLTP Lab	100	3
				700	26

2	4	MDSE401A/B/C	Elective-I	100	4
		MDSE402A/B/C	Elective-II	100	4
		MDS481	Major Project	100	7
		MDS482	Grand Viva	100	4
				400	19

Elective Set	Course Code	Topic
1	MDSE401A	Internet Of Things
	MDSE401B	Green Computing
	MDSE401C	Optimization Techniques
2	MDSE402A/MCSE402B	Soft Computing
	MDSE402B	Data Security and Authentication
	MDSE402C	Game Theory

Course Content:

Semester 1

MDS101: Statistical Methods

Descriptive statistics
Classical and axiomatic definitions of Probability and consequences. Law of total probability, Conditional probability, Bayes' theorem and applications. Discrete and continuous random variables. Distribution functions and their properties. Standard discrete and continuous probability distributions - Bernoulli, Uniform, Binomial, Poisson, Geometric, Rectangular, Exponential, Normal. Random vectors, Joint and marginal distributions, Conditional distributions, Distributions of functions of random variables.
Mathematical expectation and conditional expectation.
Central limit theorem.

Hypothesis testing, Estimation and sampling techniques

Sampling distributions of sample mean, sample variance, t, chi-square and F tests of significance based on them, Small sample tests

Text Books:

1. Outline of statistics 1 and 2 by Goon-Gupta-Dasgupta
2. Fundamentals of mathematical statistics by Gupta and Kapoor
3. Complete Business Statistics Book By Amir Aczel

MDS102: Data Base Management System

Overview of Database Management, Conceptual Database Design, Logical Database Design,Physical Database Design.
Introduction to Relational Database : Relation, Optimization, The Catalog, Base Relvars and Views, Transactions, The Suppliers and Parts Database.
Relational Model Concepts, Relational Model, Constraining, Referential Integrity Constraints, Defining Referential Integrity Constraints, Update Operations on Relations, Structured Query Language (SQL), Data Definition Language Commands, Data Manipulation Language Commands, Transaction Control Commands, SQL Command Syntax and Usage, The Basic Query Block, Querying Data with Multiple Conditions, Basic Relational Algebra Operations, The Select Operation, Additional Relational Operations.
ER- and EER-to-Relational Mapping: ER- to Relational Mapping Algorithm, Summary of Mapping for Model Constructs and Constraints Mapping EER Model Concepts to Relations, Query, Processing and Optimization: Query Processing, Query Optimization, Database Tuning.
Object Oriented Database Systems: Characteristics of an Object-relation Database Management System (ORDBMS), Complex Objects, Inheritance, Function Overloading, Rules.
Distributed Database : Distributed Database System, Distributed Database Design, Data Fragmentation, Data Replication, Data Allocation, Query Processing in Distributed Databases.
Recovery : Transactions, Transaction Recovery, System Recovery, Media Recovery, Two-phase Commit.
Database Models, Introduction to HDFS, Graph based Modeling,

Text Books:

1. Database System Concepts – 6th Edition by Silberschatz, Korth and Sudarshan
2. Fundamentals of Database Systems – 5th Edition by R.Elmasri, S. Navathe
3. Database Design and Relational Theory: Normal Forms and All That Jazz by C.J. Date

MDS103: Operating System

OS services and components, multitasking, multiprogramming, time sharing, buffering, Spooling
Process & thread management, context switching, multithreading
Concurrency control, mutual exclusion requirements, semaphores, monitors, Dead locks - detection, recovery, avoidance and prevention
Memory management, partitioning, swapping, paging, segmentation, virtual memory, Demand paging, page replacement and allocation algorithm
Introduction to Distributed Systems, Architectures of Distributed Systems, communication networks, Mutual Exclusion in Distributed Systems, RMI, concept of Replication, Distributed File Systems (NFS, AFS, coda) overview, security in Distributed Systems.
HDFS File and Storage Management.

Text Books:

1. Advanced Concepts In Operating Systems by Mukesh Singhal and Niranjan Shivaratri
2. Distributed Operating systems by Andrew s.Tanenbanm
3. Operating System Concepts, 5th ed. by Silberschatz and Galvin

MDS 104: Fundamentals of Analytics

Introduction to Data Structure and Algorithm:
Use of Big O and Small o notations, Use of Big Omega and small omega notations. Efficiency of algorithms. Analysis of recursive programs.Solving recurrence equation, Implementation of Abstract Data Types(ADT), list, stack, queue, hashing. Tree Structure binary trees, AVL trees, B and B+ trees, Red-Black Trees, heap, Tree-Traversal Algorithms, Graphs and algorithms, Prim's and Kruskal's algorithms, Dijkstra's method, backtracking, minimum spanning trees, Sorting and searching algorithms.
Introduction to Data modeling:
Conceptual, Logical and physical modeling, Top down and Bottom Up modeling, ER Modeling with different methodologies, Generic data modeling, Semantic data modeling, Data modeling with different techniques (finite state machine, UML, state charts, Markov Chain, Decision table and decision tree), Data Dictionary.

Text Books:

1.Data structure using c and c++ - Tanenbaum
2.Fundamentals of Data structure in c++ - E.Horwitz,Sahni,D.Mehta
3.Tha data model resource book – Len Silverston
4. Data modeling essentials – Graeme Simsion

MDS191: Analytics Lab I

Installation, Basic Data type, functions for reading and writing data, control structures, functions, loops, debugging tools, simulation and profiling, str function, R environment, Descriptive statistics and graphics, probability and distribution.

MDS192: Advanced DBMS Lab

Introduction to SQL constructs. Review of Basic SQL statements Select, Project, Join, Describing
Oracle tables ,Restricting row returns Creating basic reports, Using the set commands, Adding prompts to queries
Joining Oracle tables -Equi-join, Outer join Hiding joins by creating views,Using IN, NOT IN, EXISTS and NOTEXISTS, Subqueries, Exercise – write a subquery,Correlated subquery, Non-correlated subqueries
Advanced SQL operators -Between operator ,IN and NOT IN operators, Sub-queries-EXISTS

clause, Using wildcards in queries (LIKE operator),Aggregation in SQL -Count(*),Sum, Avg, Min and max. Using the group by clause, SQL access methods ,Review of Basic joining methods-Merge join, Hash Join, Nested Loop join.

MDS193: OS Lab using Unix/Linux

Shell Programming-creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands).
Process-starting a process, conditions, control structures, functions, commands),waiting for a process, zombie process Semaphore-programming with Semaphore.

Semester 2

MDS201: Modelling Techniques

Non-parametric tests- Goodness of fit, Test of independence, sign, run, Wilcoxon, Mann-Whitney, Wald-Wolfowitz.

Linear Modelling:
Theory of linear estimation, Gauss-Markov linear models, estimable functions, error and estimation space, normal equations and least square estimators, estimation of error variance, estimation with correlated observations, properties of least square estimators, generalized inverse of a matrix and solution of normal equations, variances and covariances of least square estimators.
Stochastic models
One way and two-way classifications,
fixed, random and mixed effects models. Analysis of variance and Design of Experiment, Multivariate Analysis. Elements of Decision Theory and Bayesian approach.

Text Books:

1. Basic Business statistics Book by David Levine,Mark Berenson and Timothy C Krehbiel
2. Business Statistics : Contemporary Decision making Book by Jacquelyn G Black
3. Complete Business Statistics Book By Amir Aczel

MCS201: Object Oriented Analysis & Design

An Overview of Object Oriented Systems Development, Object Oriented Systems Development Life Cycle. Object Oriented methodologies, Rumbaugh Methodology - Booch Methodology - Jacobson Methodology, UML, Object Oriented Analysis & Design, software Quality and Usability, Case Studies
Object Oriented Languages, Java and its features, Inheritance, exception handling, multithreading, Input/Output, Applet, Event Handling, Swing components, concept of JDBC

Text Books:

1. Object-Oriented Analysis and Design by Sarnath Ramnath, Brahma Dathan, Springer
2. Object-Oriented Analysis And Design With Applications, 3/E by Booch
3. Java: The Complete Reference 7/E by Herbert Schildt, TMH

MDS 202: Modern Computing Scenario

Basic structure of Computer, Overview of von Neumann and Harvard architecture,Overview on Arithmetic Unit, Processing Unit.
Memory Devices – RAM, ROM, Cache memory, Virtual memory, Secondary Storage.
IO Organization - Accessing I/O devices, Interrupts, Direct Memory Access, Buses, Interface circuits, Standard I/O Interfaces - PCI, SCSI, USB
Basic Parallel Processing Architecture, Taxonomy- SISD. MISD, SIMD, MIMD structures, Serial, Parallel & Concurrent Computation, CISC Vs RISC
Concepts of pipelining, Hierarchical Memory Technology: Inclusion, Coherence and locality properties
Multiprocessor Architecture, Taxonomy of parallel architectures; Centralized shared-memory architecture, synchronization, memory consistency, interconnection networks, Distributed shared-memory architecture, Cluster computers.
Non von Neumann Architectures, Data flow Computers, Reduction computer architectures, Systolic Architectures.
Basic Features of Current Architectural Trends. Dual core Technology

Text Books:
1. Digital Design, 3.edition by M. Morris Mano, PHI publication
2. Computer Organization and Architecture – Designing for Performance, 6th Edition by William Stallings
3. Advanced Computer Architecture: Parallelism, Scalability and Programmability by Kai Hwang

MCS204: Data Communication & Networking

Fundamentals of data transmission, wired and wireless media, digital and analog transmission, data coding techniques, multiplexing, overview on OSI layers and TCP/IP model
Local Area Networks and data link protocols, point-to-point links and sliding window flow control, CSMA/CD, Ethernet, wireless LAN, cellular networks, and advanced multi-user communication (CDMA, SDMA/MIMO), mobility
Internetworking using TCP/IP: network programming using socket API, network client/server design
Packet/circuit switching and wide-area networks: store-and-forward networks, source routing, virtual/permanent, circuits and call set-up, LAN/WAN addressing, hop-by-hop vs. end-to-end control
Routing techniques - intra-domain routing (OSPF, RIP), inter-domain policy routing

(BGP) and network connectivity
Transport protocols - TCP and UDP, Congestion control, TCP window control, multimedia Streaming
High-level network services - DNS, HTTP, SMTP, network management (SNMP), network Security

Text Books:
1. Computer Networks by AS Tanenbaum, Fourth Edition, 2002, Pearson Education
2. Data Communication and Networking by B. Forouzan
3. Data and Communication by W. Stallings

MCSE401A: Cloud Computing
Introduction: Cloud computing definition, reference model, Characteristics, Benefits, Challenges, Distributed Systems, Virtualization, Service-oriented computing, Utility-oriented computing, Overview on computing platforms & technologies – AWS, Google AppEngine, MS Azure, Hadoop, Saleforce.com, Manjrasoft Aneka
Parallel & Distributed Computing: Parallel vs. Distributed computing, Elements of parallel computing, Parallel processing - hardware architecture & approaches, Concept & Component of Distributed Computing, RPC, Service-oriented computing
Virtualization: Cloud reference model – IaaS, PaaS, SaaS, Types of clouds – Public, Private, Hybrid, Community, Cloud interoperability & standards, scalability & fault tolerance, Security, trust & privacy
Concurrent Computing, High-throughput Computing and Data-Intensive Computing: Programming applications with Threads, Thread API, Parallel computation with Threads, Task computing, Frameworks for Task computing, Task-based application model, Data-intensive computing, characteristics, technology.
Cloud Platforms and Applications: Overview on Amazon Web Services, Google AppEngine and Microsoft Azure, Cloud applications in scientific, business and consumer Domain

Text Books:
1. Buyya, Vecciola and Selvi, Mastering Cloud Computing: Foundations and Applications Programming, Tata McGraw Hill
2. Rittinghouse and Ransome, Cloud Computing: Implementation, Management, and Security, CRC Press
3. Aravind Doss, Cloud Computing, Tata McGraw Hill
4. Kris Jamsa, Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More, Jones & Bartlett Learning

MDS291: Object Oriented Programming Lab

Object Oriented Programming Fundamentals, The Java environment, class, object, constructor, garbage collection, array, access control, method overloading, nested & inner class, inheritance & interface, package, exception handling, thread, I/O, applet & GUI, event handling, network (Socket) programming, RMI, JDBC, J2EE overview, Servlet

& JSP.

MDS292: Analytics Lab II

Functions, Some guideline of writing good functions, functional programming, debugging and profiling, Object oriented programming, Linear modeling, ANOVA and DOE, Tiem series Analysis.

Semester 3

MDS301: Time Series Analysis and Forecasting

Economic time series
Different components,illustration, additive and multiplicative models, determination of trend, seasonal and cyclical fluctuations.
Time-series as discrete parameter stochastic process, auto covariance and autocorrelation functions and their properties.
Exploratory time Series analysis, tests for trend and seasonality, exponential and moving average smoothing.
Detailed study of the stationary processes: (1) moving average (MA), (2) auto regressive (AR), (3) ARMA and (4) AR integrated MA (ARIMA) models.
Box-Jenkins models, choice of AR and MA periods.
Discussion (without proof) of estimation of mean, auto covariance and autocorrelation functions under large sample theory, estimation of ARIMA model parameters.
Spectral analysis of weakly stationary process, periodogram and correlogram analyses, computations based on Fourier transform,non stationary process, introduction to forecasting.
Text Books:

1. Introduction to time series and forecasting Book by Rob J. Hyndman
2. Time series analysis, forecasting and control Book by George E.P.Box

MDS302: Data Mining

Introduction: Data Mining Concept, Origin, Process, Applications, Techniques, Challenges
Data Preprocessing: Data types, Quality, Descriptive data summarization – central tendency and dispersion measure, Data cleaning, Data integration & transform, Data reduction
Association Rule Mining: Market-basket analysis basics, Naïve algorithm, Apriori algorithm, Direct Hashing and Pruning (DHP), Software for Association Rule Mining
Classification and Prediction: Decision Tree, Classification by decision tree induction, Bayesian classification, Rule-based classification, Prediction – Linear and Nonlinear Regression, Classification software

Cluster Analysis: Types of data in cluster analysis, Partitioning methods, Hierarchical methods, Density-based methods, Quality & Validity of clustering methods
Cluster analysis software
Web Data Mining: Web content mining, Web usage mining, Web structure mining, Hubs and Authorities, HITS algorithm, Web mining software
Text Mining, Support Vector Machine.
Data Mining Application & Information Privacy: Applications and trends in data mining such as Web, finance, telecommunication, biology and medicine, science and engineering retail industry etc. Social impacts of data mining, information privacy and data security, IT Act overview.

Text Books:

1. Tan, Steinbach and Kumar, Introduction to Data Mining, Pearson
2. Han and Camber, Data Mining: Concepts and Techniques, Morgan Kaufmann
3. Foreman, Data Smart:Using Data Science to Transform Information into Insight, John Wiley
4. Dunham, Data Mining : Introductory and Advanced Topics, Pearson

MDS303: Big Data Technology

Big data definition, structured and unstructured data.

Need for analytics, Big data programming (Hadoop, Map-Reduce), Application Data store (NoSQL), OLAP.

Optimization Techniques, Data flow framework.

Programming Map-Reduce, Best practices.

Text Books:

1. Handbook of big data technology by Zomaya and Sakr.
2. Real time Big Data Analytics Book by Sumit Gupta

MDS304: Design and analysis of algorithm

Basic Computational Model and analyzing Algorithms, Asymptotic Notation and recurrence relations.
Fundamental design methodologies and their implementations: Dynamics Programming, Greedy algorithms, Divide and Conquer, Branch and Bound, Backtracking, Randomized Techniques.
Algorithms for set manipulations, their implementations and applications: Union-Find, Priority Queues. Graph Algorithms with implementation issues; Depth-First Search and its applications, minimum Spanning Trees and Shortest Paths.
Matrix multiplication, Pattern Matching, polynomial arithmetic and FFT.
Introduction to the Theory of Lower Bounds, NP-Completeness and Reductions.

Text Books

1. E. Horowitz & S. Sahani : Fundamental of Computer Algorithm (Galgotia)
2. Coreman, Leiserson & Rivest : Introduction to Algorithm (MIT)
3. Brassard & Brately : Algorithm- Theory and Practice (PHI)

MDS305: Machine Learning

Supervised Learning, Decision Tree, Linear Discriminant Functions (SVM)

Neural Network, Deep belief network, Density elimination Methods

Bayes Decision Theory

Expectation and Minimization

Ensemble Methods

Feature Engineering

Association Rule Mining

Clustering Techniques

Text Books:

1. Machine Learning and Knowledge Discovery edited by Walter Daelemans, Katharina Morik
2. Pattern Recognition and Machine Learning by Christopher Bishop
3. Introduction to Machine learning with python by Andreas C. Müller and Sarah Guido

MDS391: Data Mining Lab

Manipulating strings, Processing Files, Manipulating Lists, Lists and Strings, Dictionarys, Counting with Dictionaries, Dictionaries and Files, Tuples, Tuples and Sorting, Regular Expressions, Networked programs, Sockets and Applications, parsing HTML with Beautifulsoup, parsing XML by python, REST,JSON and APIs, Extracting data from JSON, Using database by python, Object oriented python, Geocoding, Page rank and web searching, Gmane.

MDS392: Big Data Technology and OLTP Lab

A. NoSQL Lab using (MongoDB/Redis/Cassandra/CouchDB/Hbase using HDFs etc):

Introduction to Nosql,Difference between RDBMS to NOSQL,JSON and BSON documents,Introduction to MongoDB/.. and its Features,Database, Collection and Documents,Various Data Types in MongoDB/..,Introduction to mongo/.. shell,CRUD Operations,Database Operations,Read and Write Operations,Aggregation,Data Modeling Introduction,Data Modeling Concept,Storage Engine,Indexing,Replication Concept,Failover & Recovery

B. Multidimensional Data Modeling using OLAP:
Introduction of Datawarehousing and OLAP, example of a DataWarehouse and Data mart, Data Cleaning and integration, Data analysis techniques, Transformation algorithms, Integrations.

Semester 4

Elective Set 1:

MDSE401A: Internet of Things (IoT)

Internet in general and Internet of Things: layers, protocols, packets, services, performance parameters of a packet network as well as applications such as web, Peer-to-peer, sensor networks, and multimedia.
Transport services: TCP, UDP, socket programming.
Network layer: forwarding & routing algorithms (Link, DV), IP-addresses, DNS, NAT, and routers.
Local Area Networks, MAC level, link protocols such as: point-to-point protocols, Ethernet, WiFi 802.11, cellular Internet access, and Machine-to-machine.
Mobile Networking: roaming and handoffs, mobile IP, and ad hoc and infrastructure less networks.
Real-time networking: soft and real time, quality of service/information, resource reservation and scheduling, and performance measurements.
IoT definitions: overview, applications, potential & challenges, and architecture.

Text Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.

2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.

MDSE401B: Green Computing

Logistics, Introduction to Green Computing & Background, Energy Management in Embedded Systems and Sensor Networks, Energy Management in Mobile Systems and Smartphones, Greening Desktop and Laptop PCs, Energy Efficient Networking and Communication, Greening Data Centers and Servers, IT Enabled Smart Buildings, Sensing within Buildings (Occupancy), Sensing within Buildings (Energy and Water), Managing the Data Deluge and "App Platforms" for Smart Buildings, Energy Management in Smart Homes, Modeling, Prediction and Control for Smart Buildings, Security and Privacy.

Text Books:

1. The Green Computing Book: Tackling Energy Efficiency at Large Scale by Wu Chun Feng
2. Green Computing: Tools and Techniques for Saving Energy, Money, and Resources by Bud E. Smith

MDSE401C: Optimization Techniques

Introduction and Basic Concepts: Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems, Classification of optimization problems, Optimization techniques – classical and advanced techniques

Optimization using Calculus: Stationary points; Functions of single and two variables; Global Optimum, Convexity and concavity of functions of one and two variables, Optimization of function of one variable and multiple variables; Gradient vectors; Examples, Optimization of function of multiple variables subject to equality constraints; Lagrangian function, Optimization of function of multiple variables subject to equality constraints; Hessian matrix formulation; Eigen values, Kuhn-Tucker Conditions; Examples

Linear Programming: Formulating maximization/minimization problems, Graphical solution, simplex methods, Special cases of LP, Duality of LP and its interpretation, Dual simplex methods, Post Optimality/sensitivity analysis, Applications of LP.

Transportation and Assignment problems: VAM method, Checking for optimally using MODI method, Unbalanced problem and degeneracy, Hungarian method for assignment problem, Traveling salesman problem.

Waiting lines: Characteristics of a queuing system, Arrival and service patterns, Single and multiple channel, Queue models with Poisson arrival and exponential service times.

Simulation Modeling: Monte Carlo simulation, Using random numbers, Applications in inventory analysis, Waiting lines, Maintenance and finance areas.

Replacement models: Types of replacement problems, Replacement of assets that deteriorate with time

Markov Analysis: Brand switching analysis, Prediction of market shares for future periods, Equilibrium conditions, Uses of Markov analysis.

Network Analysis: Network definition and Network diagram, probability in PERT analysis, project time cost trade off, introduction to resource smoothing and allocation.

Text Books:

1. Operations Research by A Ravindran, Don T Philips and James J Solberg.
2. Operations Research by Hamdy A Taha

3. Engineering Optimization: Theory and Practice", by SS Rao, New Age International Pvt Ltd., New Delhi, 2000.

Elective Set 2:

MDSE402A/ MCSE402B: Soft Computing

Neural Networks: Supervised Learning Neural Networks – Perceptrons - Adaline – Back propagation Multilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning NetworksHebbian Learning.
Fuzzy Set Theory: Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules,Introduction to Fuzzy Reasoning – Extension Principle and Fuzzy Relations
Genetic Algorithm: Difference between Traditional Algorithms and GA, The basic operators, Schema theorem, convergence analysis, stochastic models, applications in search and optimization. Encoding, Fitness Function, Reproduction, Cross Over, Mutation, Application of Genetic Algorithm.
Neuro Fuzzy Modeling: Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

Text Books:

1. M. Mitchell, An Introduction to Genetic Algorithms, Prentice-Hall, 1998.
2. D. E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley, 1989.
3. S. V. Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications, IEEE Press - PHI, 2004.

4. S. Rajasekaran & G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, PHI, 2003.
5. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2007

MDSE402B: Data Security and Authentication

Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms , A Model for Network Security, Classical Encryption Techniques, Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography, Cryptographic Tools, Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Public-Key Encryption, Digital Signatures and Key Management, Random and Pseudorandom Numbers, Practical Application: Encryption of Stored Data, User Authentication, Means of Authentication, Password-Based Authentication, Token-Based Authentication, Biometric Authentication, Remote User Authentication, Security Issues for User Authentication, Malicious Software, Types of Malicious Software (Malware), Propagation—Infected Content—Viruses, Propagation—Vulnerability Exploit—Worms, Propagation—Social Engineering—SPAM Email, Trojans, Payload—System Corruption, Payload—Attack Agent—Zombie, Bots, Payload—Information Theft—Key loggers, Phishing, Spyware, Payload—Stealthing— Backdoors, Rootkits, Countermeasures, Firewalls and Intrusion Prevention Systems, the Need for Firewalls, Firewall Characteristic, Types of Firewalls, Firewall Basing, Firewall Location and Configurations, Intrusion Prevention Systems.

Text Books:

1. Cryptography and Network Security: Principles and Practice by William Stalings 6th Edition published by PHI (2011)
2. Computer security principles and practice, William Stallings, Lawrie Brown, third edition, Prentice-Hall, 2011

MDAE402C: Game Theory

Mathematical formulation of conflict decision problems as a game, extensive and normal forms of a game, finite games and linear programming, the minimax theorem and the value of game, optimal strategies, finite games of perfect information, games with an infinite number of moves, games of timing, games of sequence generation and prediction, differential games, management games for decisionmaking under conditions of competition and uncertainty.

Text Books:

1. Introduction to Game Theory by Martin J Osborne
2. Game theory an introduction by Steven Tadilis