DEPARTMENT OF COMPUTER APPLICATIONS, MIT Manipal
M.C.A (MASTER OF COMPUTER APPLICATIONS)
Course Structure (Applicable to 2019-20 admission onwards)

Year	First Semester						Second Semester					
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
I	MAT 4151	Computational Mathematics	4	0	0	4	**MCA 4251**	Data Analytics	4	0	0	4
	MCA 4151	Database Management System	4	0	0	4	**MCA 4252**	Data Structures and Algorithms	4	0	0	4
	MCA 4152	Object Oriented Programming	4	0	0	4	MCA 4253	Java Programming	4	0	0	4
	MCA 4153	Operating Systems	3	0	0	3	**MCA 4254**	Web Technologies	4	0	0	4
	MCA 4154	Software Engineering	3	0	0	3		Program Elective I	3	0	0	3
	MCA 4161	Database Management System Lab	0	0	3	1	**MCA 4261**	Data Structures and Algorithms Lab	0	1	3	2
	MCA 4162	Linux Programming Lab	0	1	3	2	MCA 4262	Java Programming Lab	0	0	3	1
	MCA 4163	Object Oriented Programming Lab	0	1	3	2	**MCA 4263**	Web Technologies Lab	0	0	3	1
		Total	**18**	**2**	**9**	**23**			**19**	**1**	**9**	**23**
II	**Third and Fourth Semesters**											
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
	MCA 5151	Computer Networks	4	0	0	4	MCA 5298	**Project Work**	**0**	**0**	**0**	**12**
	MCA 5152	Machine Learning	4	0	0	4						
		Program Elective II	3	0	0	3						
		Program Elective III	3	0	0	3						
	MCA 5164	Seminar	0	0	6	2						
	MCA 5161	Machine Learning Lab	0	1	3	2						
	MCA 5162	Mobile Application Development Lab	0	1	3	2						
	MCA 5163	Network Lab	0	1	3	2						
		Total	**14**	**3**	**15**	**22**		**Total**	**0**	**0**	**0**	**12**
											Total Credits	**80**

Program Electives			
Code	**TITLE**	**Code**	**TITLE**
Program Electives - I			**Program Electives - II & III**
MCA 5036	Internet of Things	MCA 5042	Semantic Web
MCA 5039	Object Oriented Analysis and Design	MCA 5043	Service Oriented Architecture
MCA 5037	Management Information Systems	MCA 5030	Cyber Forensics
MCA 5028	Computational Intelligence	MCA 5026	Big Data Analytics
MCA 5029	Computer Organization and Architecture	HUM 5043	Human Resource Management
MCA 5038	NoSQL Database Systems	MCA 5034	Information and Network Security
		MCA 5035	Information Storage and Management
		MCA 5041	Pattern Recognition Techniques and Applications
		MCA 5040	Optimization Techniques
		MCA 5027	Cloud Computing
		MCA 5031	Design and Analysis of Algorithms
		MCA 5044	Software Project Management
		MCA 5033	Game Programming
		MCA 5032	Ethical Hacking

I SEMESTER

MAT 4151 COMPUTATIONAL MATHEMATICS [4 0 0 4]

Mathematical Logic: Statement (Proposition), Logical Connectives, Conditional, Bi-conditional, Converse, Inverse, Contra positive, Exclusive OR, NAND, NOR, Tautology, Contradiction, Satisfiable, Duality Law, Algebra of propositions, Mathematical Induction; Set Theory: sets, types of sets, cardinality of a set, subset and superset, comparability of sets, power set, operations on sets, disjoint sets, application of set theory, Graphs: Graphs, Computer Representations of Graphs, Isomorphic Graphs, Paths, Cycles and Circuits, Eulerian and Hamiltonian Graphs, Planar Graphs, Graph Coloring, Digraphs, Dags, Weighted Diagraphs; Trees: Trees, Spanning trees, Minimal Spanning Trees, Rooted Trees, Binary Trees, Binary Search Trees, Combinatorics and Discrete Probability: The Fundamental Counting Principles, Permutations, Combinations, Permutations and Combinations with Repetitions.

References:

1. Thomas Koshy, *Discrete Mathematics with Applications*, Academic Press, Reprint 2005.
2. D.P. Acharjya, Sreekumar, *Fundamental Approach to Discrete Mathematics*, New Age International (P) Limited, 2005.
3. Kenneth H Rosen, *Discrete Mathematics & its Applications with Combinatorics and Graph Theory*, 6th Edition, McGraw Hill, 2007.
4. Martin Aigne, *Discrete Mathematics*, American Mathematical Society, USA, 2007.

MCA 4151 DATABASE MANAGEMENT SYSTEM [4 0 0 4]

Database System Applications, Advantages, View of data, Database languages, Architecture, users and Administrator, SQL, Data Definition, Basic structure of SQL queries, Basic operations, Set operations, Null values, Aggregate Functions, Nested subqueries, Modification of the database, Intermediate SQL, Join, Views, Transactions, Integrity Constraints, Data types and schemas, Authorization, Advanced SQL, PL/SQL, Cursors, Functions, Procedures, Triggers, Entity-Relationship Model, Basic Concepts, Constraints, Design of ER database schema, Reduction of ER to schema, Relational model structure, Keys, Schema Diagram, Relational Database design, Functional dependencies, Normal forms, Closure, Canonical cover, Lossless joins , dependency preserving decomposition, Storage and File structure, File organization, Organization of records in files, indices-ordered, dense, sparse indices, secondary index, B+-trees, static hashing Query Processing, Overview, Measure of query cost, Join operation, Evaluation of expressions, Query Optimization, Join ordering, Estimating statistics of expression results, Materialized Views.

Transactions, Concepts, Simple transaction model, Transaction atomicity and durability, Schedules-serial, concurrent, serializability. Concurrency Control, Lock based protocols, Deadlock handling, Timestamp-based Protocols, Recovery System: Failure classification, Storage structure, atomicity, algorithm, Unstructured database, Introduction to NoSQL, RDBMS vs NoSQL, NoSQL databases.

References:

1. Abraham Silberschatz, Henry Korth, S. Sudarshan, *Database System Concepts*, 6th Edition, McGraw Hill, 2010.
2. Ramez Elmasri, Shamkant Navathe, Fundamentals of Database System, 6th Edition, Addison Wesley Publications Co., 2010.
3. Raghu Ramakrishnan, Johannes Gehrke, *Database Management System*, 3rd Edition, WCB/McGraw Hill Publisher, 2014.
4. Ivan Bayross, *SQL, PL/SQL-The Programming Language of Oracle*, 4th Edition, BPB Publications, 2010.
5. Shashank Tiwari, *Professional NOSQL*, Wiley, 2015.

MCA 4152 OBJECT ORIENTED PROGRAMMING [4 0 0 4]

Introduction: Object Oriented paradigm, Structured vs. Object Oriented Paradigm. Elements of Object Oriented Programming: Object, Classes, Encapsulation & data abstraction, Inheritance, Polymorphism. Programming Basics, Type conversion, Loops and Decision, Structures, Enumerated Data Types. Simple functions, Passing arguments to functions, Returning values from the functions, Reference arguments, Overloaded functions, Inline functions, Default arguments, variables and storage classes, Returning by reference. Objects and Classes. Array fundamentals, Arrays as class member data, Arrays of objects, String handling, Addresses and pointers, Pointers and arrays, Pointers and functions, Pointers and strings, Memory management using new and delete, Pointers to objects, Pointers to pointers. Operator Overloading, Data conversion, Inheritance, Virtual Functions & Polymorphism: Derived classes and Base classes, Levels of inheritance, Ambiguity in multiple inheritance, Containership, Classes within classes, Virtual functions, Friend functions, Static functions, this pointer. Files and Streams: Streams, String I/O, Character I/O, Object I/O, File pointers. Generic programming: Templates, Exception Handling & STL: Exception handling fundamentals, Exception handling options, STL: An overview, containers, vectors, lists, maps.

References:

1. Herbert Schildt, *The Complete Reference C++*, 4th Edition, Tata McGraw Hill, 2017.
2. Robert Lafore, *Object Oriented Programming in C++*, 4th Edition, Pearson Education, 2008.

3. Bjarne Stroustrup, *A Tour of C++*, 2nd Edition, Pearson Education, 2018.
4. Bjarne Stroustrup, *The C++ Programming Language*, 3rd Edition, Pearson, 2002.
5. E Balaguruswamy, *Object Oriented Programming with C++*, 7th Edition, Tata McGraw Hill, 2017.

MCA 4153 OPERATING SYSTEMS [3 0 0 3]

Introduction: Simple, multi-programmed batch systems, distributed systems, time-sharing & real time systems, hardware protection CPU Scheduling: Process concept, process state transitions, process control block, operations on processes, inter-process communication, scheduling criteria, scheduling algorithms, multilevel feedback queues. Concurrent Process: Mutual exclusion, Precedence graphs, critical section, Dekker's algorithm, hardware solution to mutual exclusion, semaphores, process synchronization with semaphores Memory management: Address binding, dynamic loading, dynamic linking, Overlays, swapping, contiguous allocation, paging, segmentation, segmentation with paging Virtual Memory: Demand paging, page replacement algorithms, thrashing, Algorithms thrashing Deadlocks: Deadlock characterization, resource allocation graph, deadlock prevention, avoidance, detection, Bakers algorithm and recovery from deadlock File Systems: Free space management, allocation methods, Directory structure, Disk scheduling methods.

References:

1. A Silberschartz, Peter B. Galvin and Greg Gagne, *Operating Systems Concepts*, 8th Edition, John Wiley & Sons, 2012.
2. H. M. Deitel, *An Introduction to Operating Systems*, 3rd Edition, Addison Wesley, 2004.
3. Milan Milankovic, *Operating Systems Concepts and Design*, 7th Edition, Tata McGraw Hill, 2004.

MCA 4154 SOFTWARE ENGINEERING [3 0 0 3]

Software Product, Process models and SRS: Various Process models, Development approaches and team structures, Requirements Functional and non-Functional, Software Document, Requirement Engineering Process, Feasibility Studies, Software Prototyping, Functional models, Structured Analysis, Design Concepts and Principles: Coupling, Cohesion, Span of control, Systems Engineering, Analysis Concepts, Design Process And Concepts, Modular Design, Monitoring And Control System, Cyclomatic complexity and good coding practices, Testing: Taxonomy Of Software Testing, Types Of S/W Test, Software Implementation Techniques, Software Validation, Static and Dynamic Analysis, Symbolic Equation,

Mutation Analysis, Dynamic Testing, Unit Testing, White-box and Black-box Testing, Test Case Generation, Integration Testing, Bottom-up and Top-down Testing, System Testing, Function Testing, Performance Testing, Acceptance Testing, Installation Testing, Regression testing, Theoretical Foundation of Testing.

References:

1. Ian Sommerville, *Software Engineering*, 9th Edition, Pearson Education Asia, 2011.
2. Roger S. Pressman, *Software Engineering – A practitioner's Approach*, 8th Edition, McGraw-Hill International Edition, 2014.
3. Richard Fairley, *Software Engineering Concepts*, 9th Edition, McGraw-Hill Inc. New York, 2017.
4. Pankaj Jalote, *Software Project Management in Practice*, 7th Edition, Addison, Wesley, 2014.
5. Waman S Jawadekar, *Software Engineering Principles and Practice*, 3rd Edition, Tata McGraw Hill, 2010.

MCA 4161 DATABASE MANAGEMENT SYSTEM LAB [0 0 3 1]

Labs will be conducted as per the exercise given in the lab manual. Lab manual consists of exercises related to implementation/realization of database concepts such as SQL, Queries, Join, Views, Advanced SQL, PL/SQL, Cursors, Functions and Procedures, Triggers

1. Ivan Bayross, *SQL, PL/SQL-The Programming Language of ORACLE*, 4th Edition, BPB Publications, 2010.
2. Satish Asnani, *Oracle Database 11g*, PHI, 2010.
3. Scott Urman, Ron Hardman and Michael Mclaughlin, *Oracle Database 10g PL/SQL Programming*, Oracle Press, McGraw-Hill Education, 2004.

MCA 4162 LINUX PROGRAMMING LAB [0 1 3 2]

Labs will be conducted as per the lab manual. Lab manual consists of exercises related to implementation/realization of concepts discussed in the theory class. Also an addition Basic Linux Commands, the vi Editor and Simple Shell Programs, file-related commands and Shell Programs, Additional Linux Commands and Shell Programs, Processes, Process Scheduling, Process Synchronization and Deadlocks, Page replacement, File Handling, Disk Scheduling,

References:

1. Richard Blum and Christine Bresnahan, *Linux Command Line Shell Scripting Bible*, 3rd Edition, Wiley, 2015.
2. Mark Sobel. *A Practical Guide to Linux commands Editor and shell programming*, Prentice Hall, 2nd Edition, 2010.
3. A Silberschartz, Peter B. Galvin and Greg Gagne, *Operating Systems Concepts*, 8th Edition, John Wiley & Sons, 2012.

MCA 4163 OBJECT ORIENTED PROGRAMMING LAB [0 1 3 2]

Apply algorithms/ flow charts to develop programs using C++ programs on decision making, looping and switch conditions. Write programs to implement concept of structures, classes and objects, construction and destruction of objects, compile-time polymorphism with function and operator overloading. Develop programs for array of objects, manipulation using pointers, dynamic memory allocation. Write and execute C++ programs to implement different types of inheritance, dynamic binding, virtual functions, file I/O and exception handling.

References:

1. Herbert Schildt, *The Complete Reference C++*, 4th Edition, Tata McGraw Hill, 2017.
2. Robert Lafore, *Object Oriented Programming in C++*, 4th Edition, Pearson Education, 2008.
3. Bjarne Stroustrup, *A Tour of C++*, 2nd Edition, Pearson Education, 2018.
4. E Balaguruswamy, *Object Oriented Programming with C++*, 7th Edition, Tata McGraw Hill, 2017.
5. Paul J. Deitel and Harvey Deitel, *C++ How to Program*, 10th Edition, Pearson International, 2017.

OBJECT ORIENTED PROGRAMMING TUTORIAL

The tutorial will include sessions that will focus on the implementation of the advanced concepts of C++ (which is a part of the standardized versions of C++) including the Standard C++ class library and the Standard Template Library (STL) which is part of the Standard C++ class library, and can be used as a standard approach to storing and processing data. STL, Container classes, STL Algorithms, Iterators, Allocators and function objects. Description of Standard C++ that includes its own built-in container class library.

II SEMESTER

MCA 4253 JAVA PROGRAMMING [4 0 0 4]

Java Development Kit (JDK), Java Run Time Environment (JRE), Java Virtual Machine (JVM), Bytecode. Java datatypes, keywords, operators, Type conversion, Arrays, Ragged arrays, ArrayLists. The Scanner class, The String Class, Command-line arguments, Variable-length arguments. Classes & Objects, Access specifiers, Constructors, Inner classes, Static fields and methods, Inheritance, calling superclass constructor, Method overriding, Dynamic method dispatch, Abstract class, preventing inheritance: final classes and methods, The Object class, Wrapper classes, Autoboxing and Unboxing. Enumeration, Annotation. Packages, creating and importing packages, Interfaces, partial implementations, Object cloning, Cloneable interface. Exception handling, Exception types, throws & finally statements, User-defined exceptions. Multithreaded programming, The Java thread model, The Thread class and runnable interface, creating multiple threads, Synchronization, Inter-thread communication. Garbage collection, finalize method. Streams and Files. The stream classes, The Byte Streams, The Character streams. Event handling, event sources, event listeners, event classes. The Collection classes, generic programming, defining a generic class, creating a generic method, Database programming - JDBC packages.

References:

1. Herbert Schildt, *Java The Complete Reference*, 11th Edition, McGraw Hill, 2019.
2. Cay S. Horstmann. *Core Java: Volume I - Fundamentals*. 11th Edition, Pearson Education, 2018.
3. Cay S.Horstmann, *Core Java: Volume II – Advanced Features*, 11th Edition, Pearson Education, 2019.
4. Herbert Schildt and Dale Skrien, *Java Fundamentals*, Tata McGraw-Hill Education, 2015.

MCA 4262 JAVA PROGRAMMING LAB [0 0 3 1]

Labs will be conducted as per the lab manual. Lab manual consists of exercises related to implementation/realization of concepts that include: basic Java Programming, Arrays, Strings, Inheritance, Exception handling, Packages, Multithreaded programming, Collections, File handling and JDBC.

References:

1. Herbert Schildt, *Java The Complete Reference*, 11th Edition, McGraw Hill, 2019.

2. Cay S. Horstmann. *Core Java: Volume I - Fundamentals*. 11th Edition, Pearson Education, 2018.
3. Cay S.Horstmann, *Core Java: Volume II – Advanced Features*, 11th Edition, Pearson Education, 2019.
4. Herbert Schildt and Dale Skrien, *Java Fundamentals*, Tata McGraw-Hill Education, 2015.

MCA 4252 DATA STRUCTURES AND ALGORITHMS [4 0 0 4]

Basic Concepts: Pseudocode, The Abstract Data Type, Model for an Abstract Data Type, ADT Implementation, Algorithm Efficiency, Time and Space Complexities, Asymptotic Notations. Recursion: Factorial – A Case Study, Designing Recursive Algorithms, Recursive Examples. Stacks: Basic Stack Operations, Stack ADT, Stack Applications. Queues: Queue Operations, Queue ADT, Queue Applications. General Linear Lists: Basic Operations, List ADT, Singly-Linked List, Doubly Linked List, Circular Linked List. Introduction to Trees: Basic Concepts, Binary Trees. Binary Search Trees: Basic Concepts, BST Operations, Binary Search Tree ADT, BST Applications, AVL Search Trees: Basic Concepts, Balance Factor, AVL Tree ADT, Applications. Heaps: Basic Concepts, Heap Implementation, Heap ADT, Heap Applications. Multiway Trees: M-way Search Trees, B-Trees, B-Tree ADT, Simplified B-Trees, B-Tree Variations, Lexical Search Trees. Graphs: Basic Concepts, Operations, Graph Storage Structure, Graph ADT, Graph Algorithms – BFS and DFS. Sorting: Sort Concepts, Selection Sorts, Insertion Sorts, Exchange Sorts, External Sorts. Searching: List Searches, Hashed List Searches, Collision Resolution.

References:

1. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures – A Pseudocode Approach with C*, Second Edition, Cenage Learning, 2009.
2. S. Sridhar, *Design and Analysis of Algorithms*, Oxford University Press, 2015.
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, *"Fundamentals of Algorithms*, 2nd Edition, Universities Press, 2010.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *"Introduction to Algorithms*, 3rd Edition, PHI Publications, 2009.

MCA 4261 DATA STRUCTURES AND ALGORITHMS LAB [0 1 3 2]

Labs will be conducted as per the lab manual. Lab manual consists of exercises related to implementation/realization of concepts discussed in the theory class. The concepts included are Searching and Sorting algorithms, Stacks and Queues, Conversion of mathematical expressions, Evaluation of mathematical expressions, Singly- and doubly-linked lists, Trees, Graph algorithms.

References:

1. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures – A Pseudocode Approach with C*, Second Edition, Cenage Learning, 2009.
2. S. Sridhar, *Design and Analysis of Algorithms*, Oxford University Press, 2015.
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, *"Fundamentals of Algorithms*, 2nd Edition, Universities Press, 2010.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *"Introduction to Algorithms*, 3rd Edition, PHI Publications, 2009.

DATA STRUCTURES AND ALGORITHMS TUTORIAL

Discussion and implementation strategies (using C language) of different searching and sorting methodologies through pseudocode and compare their performance. Explanation of memory representation in data structures like sparse and polynomials. Advanced data structure implementation details for stack, queue, linked list, tree and graph. Applications and implementation details of various data structures like stack, queue and tree.

MCA 4254 WEB TECHNOLOGIES [4 0 0 4]

Introduction to HTML, Structure of HTML Document, Semantics of HTML Elements and Attributes, HTML Tables and Forms, Introduction to CSS, Types of Styles, Selectors, Style Cascade, The Box Model, Text Styling, Background Styling, Table Styling, Box Styling, Normal Flow of Elements, Positioning and Layering Elements, Floating Elements, Approaches to CSS Layout, Responsive Design, Introduction to Client-Side Programming with Javascript, Basics of Programming, Data Types and Objects, Javascript Events, Form Validation, Introduction to Server-Side Programming with PHP, What is Server-Side Development, PHP Controls, PHP Functions, PHP Arrays, Superglobal Arrays, File Uploading, Server-Side Validation, PHP Error and Exception Handling, State Management using Cookies and Sessions, JSON, Database Operations with PHP, Introduction to AJAX, Angular: Fundamental Architecture, Set-Up and Deployment, Components, Templates, Binding, Forms and Web API.

References:

1. Randy Connolly, Ricardo Hoar, *Fundamentals of Web Development*, 1st Edition, Pearson Education India, 2015.
2. Luke Welling, Laura Thomson, *PHP and MySQL Web Development*, 5th Edition, Pearson Education, 2016.

3. Nicholas C Zakas, *Professional JavaScript for Web Developers*, 3rd Edition, Wrox/Wiley India, 2012.
4. John Kocer, "Angular 7: By Example (Part One Book 1)", 2019.
5. Nate Murray, Felipe Coury, Ari Lerner, Carlos Taborda, *ng-book- The Complete Book on Angular*, 2019.

MCA 4263 WEB TECHNOLOGIES LAB [0 0 3 1]

The students are required to implement and realize web page development. The static web page development using HTML elements including text, images, links and tables. The web forms are modelled and designed using necessary form-based elements. Responsive web layouts are implemented using media elements and advanced CSS. Dynamic HTML concepts are realized through DOM implementation using client-side JavaScript. The data-driven server-side applications are implemented on server-side environment using PHP and Angular JS.

References:

1. Randy Connolly, Ricardo Hoar, *Fundamentals of Web Development*, 1st Edition, Pearson Education India, 2015.
2. Luke Welling, Laura Thomson, *PHP and MySQL Web Development*, 5th Edition, Pearson Education, 2016.
3. Nicholas C Zakas, *Professional JavaScript for Web Developers*, 3rd Edition, Wrox/Wiley India, 2012.
4. John Kocer, *"Angular 7: By Example (Part One Book 1)",* 2019.
5. Nate Murray, Felipe Coury, Ari Lerner, Carlos Taborda, *ng-book- The Complete Book on Angular*, 2019.

MCA 4251 DATA ANALYTICS [4 0 0 4]

Introduction: data science, need for analytics, steps in data analysis projects, Data- sources of data, data sets, data warehouses, data types, privacy and confidentiality, samples vs. population, Data summarization and visualization: tables and graphs, Data Preprocessing: cleaning, transformation, dimensionality reduction, Data Analysis and Visualization: descriptive, inferential statistics, uni-variate and multi-variate analysis, Grouping: Cluster Analysis: distance measures, partitioning, hierarchical, density based methods, Market Basket Analysis, Association Analysis, Market Basket Analysis, Classifiers: Bayesian, k-nearest neighbor, neural network, Support Vector Machine, Decision Trees, Prediction: Regression models, Evaluating Classification and Predictive performance, ensemble methods, Anomaly Detection, Forecasting models,

Applications in Data Analytics: Case studies, Web Mining, Text Mining, Business Intelligence, Supply Chain Analytics, Time series, Spatial Data Analysis.

References:

1. Glenn J. Myatt, Wayne P. Johnson, *Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining*, 2nd Edition, John Wiley & Sons Publication, 2014.
2. Glenn J. Myatt, Wayne P. Johnson, *Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications*, John Wiley & Sons Publication, 2009.
3. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, *Data Mining for Business Intelligence*, John Wiley and Sons, 2014.
4. Ian H. Witten, Eibe Frank, Mark A. Hall, *Data Mining: Practical Machine Learning Tools and Techniques*, Morgan Kaufmann, 2011.
5. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, *Introduction to Data Mining*, Pearson Addison Wesley, 2005.

PROGRAM ELECTIVE – I **[3 0 0 3]**

III SEMESTER

MCA 5152 MACHINE LEARNING [4 0 0 4]

Introduction, Applications, Probability: Random Variables, Supervised Learning: Learning a Class, Vapnik-Chervonenkis Dimension, PAC Learning, Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, Supervised Machine Learning, Bayesian Decision Theory: Classification, Losses and Risks, Discriminant Functions, Utility Theory, Association Rules, Parametric Methods: Maximum Likelihood Estimation, Evaluating an Estimator: Bias and Variance, Bayes' Estimator, Parametric Classification, Regression, Tuning Model Complexity: Bias/Variance Dilemma Model Selection Procedures, Dimensionality Reduction: Subset Selection, PCA, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis, Clustering: Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Latent Variable Models, Supervised Learning after Clustering, Hierarchical Clustering, Nonparametric Methods: Density Estimation, Generalization to Multivariate Data, Nonparametric Classification, Condensed Nearest Neighbor, Nonparametric Regression: Smoothing Models, Smoothing Parameter, Decision Trees: Univariate Trees, Pruning, Rule Extraction from Trees, Learning Rules from Data, Multivariate Trees, Linear

Discrimination: Generalizing Linear Model, Geometry of Linear Discriminant, Pairwise Separation, Parametric Discrimination, Gradient Descent, Logistic Discrimination, Discrimination by Regression, Multilayer Perceptrons: Perceptron, Training a Perceptron, Learning Boolean Functions, MLP as a Universal Approximator, Backpropagation Algorithm, Training Procedures, Tuning Network Size, Bayesian View of Learning, Dimensionality Reduction, Learning Time.

References:

1. Ethem Alpaydin, *Introduction to Machine Learning*, 3rd Edition, PHI Learning Private Limited, 2018.
2. Kevin P. Murphy, Machine *Learning: A Probabilistic Perspective*, MIT Press, 2012.
3. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, *"Foundations of Machine Learning*, MIT Press, 2012.
4. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2007.

MCA 5161 MACHINE LEARNING LAB [0 1 3 2]

Labs will be conducted as per the lab manual. Lab manual consists of exercises related to implementation/realization of concepts discussed in the theory class. The concepts included are Probability-based problems, Dimensionality reduction, Supervised Learning, Regression, Ensemble methods – classifiers and clusters and Unsupervised Learning.

References:

1. Ethem Alpaydin, *Introduction to Machine Learning*, 3rd Edition, PHI Learning Private Limited, 2018.
2. Kevin P. Murphy, Machine *Learning: A Probabilistic Perspective*, MIT Press, 2012.
3. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, *"Foundations of Machine Learning*, MIT Press, 2012.
4. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2007.

MACHINE LEARNING TUTORIAL

The tutorial will include sessions that will focus on the use of IDE, programming concepts in python, use of various packages for various Machine Learning functionalities, performance evaluation, visualization and understanding of datasets.

MCA 5151 COMPUTER NETWORKS [4 0 0 4]

Basic concepts of computer networks, need for layered architecture and comparison between ISO/OSI, TCP/IP layered models. Significance of Datalink layer and protocols. Network layer functionalities, classful, classless IP addressing, address allocation and role of forwarding module in forwarding the packet using routing table. Roles played by IP, ARP, RARP, ICMP & IGMP protocols in network layer. Discussing different inter-domain and intra-domain routing algorithms which help in building routing tables. Importance of transport layer in achieving process-to-process communication. Insight of connection oriented protocol TCP and connectionless protocol UDP. Features of TCP in achieving flow control, error control and congestion control. Requirement of different timers in TCP. Drawbacks of IPv4 addressing and new IP addressing scheme IPv6. Issues to be considered in migrating from IPv4 to IPv6. Introduction to application layer, a client/server application program and a case study client-server application program-Dynamic Host Configuration Protocol (DHCP).

References:

1. Behrouz A. Forouzan, *TCP/IP Protocol Suite*, 4th Edition, Tata McGraw Hill, 2010.
2. Tannenbaum, A.S, *Computer Networks*, 5th Edition, Prentice Hall of India EE Edition, 2011.
3. Behrouz A. Forouzan, *Data Communications and Networking*, 5th Edition, Tata McGraw Hill, 2013.
4. Leon Garcia and Widjala, *Communication Networks*, 5th Edition, Tata McGraw Hill, 2017.

MCA 5163 NETWORK LAB [0 1 3 2]

Labs will be conducted as per the lab manual. Lab manual consists of exercises related to implementation/realization of inter-process communication and socket programming concepts. Also an additional tutorial class will be conducted as per the prerogative of the faculty who is handling the lab.

References:

1. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, *Unix Network Programming*, The *Sockets networking API*, Volume-1, 3rd Edition, Prentice Hall of India EE Edition, 2010.

2. Richard Stones, Neil Matthew, *Beginning Linux Programming*, 4th Edition, Wiley, 2007.

PROGRAM ELECTIVE II **[3 0 0 3]**

PROGRAM ELECTIVE III **[3 0 0 3]**

MCA 5164 SEMINAR [0 0 6 2]

It is mandatory for the students to give two technical seminars on trending technical topics, one individual and one group. Students have to prepare a report to be submitted a week ahead of the seminar. Groups are created and students are informed about the groups they belong to in the previous semester. The seminar would be graded based on the presentation skills and technical content.

MCA 5162 MOBILE APPLICATION DEVELOPMENT LAB [0 1 3 2]

Labs will be conducted as per the lab manual. Lab manual consists of exercises related to implementation/realization of concepts discussed in the theory class. Also an additional tutorial class will be conducted as per the prerogative of the faculty who is handling the lab.

IV SEMESTER

MCA 5298 PROJECT WORK [0 0 0 12]

Students are required have to undertake full time projects which not only reflect their knowledge gained in the previous two semesters but also reflects additional knowledge gained from their own effort. The project work can be carried out in the institution/ industry/ research laboratory or any other competent institutions. The duration of project work should be a minimum of 16 weeks. There will be a mid-term evaluation of the project work done after about 8 weeks. An interim project report is to be submitted to the department during the mid-term evaluation. Each student has to submit to the department a project report in prescribed format after completing the work. The final evaluation and viva-voice will be after

submission of the report. Each student has to make a presentation on the work carried out, before the departmental committee for project evaluation. The mid-term and end semester evaluation will be done by the departmental committee including the guides.

MCA PROGRAM ELECTIVES I

MCA 5036 INTERNET OF THINGS [3 0 0 3]

Internet of Things, Physical Design, Logical Design, IoT Enabling Technologies, IoT Levels & Deployment Templates, Domain Specific IoTs, IoT and M2M, IoT System Management, M2M high-level ETSI architecture, IETF architecture for IoT, OGC architecture, IoT reference model, Domain model, information model, functional model, communication model, IoT reference architecture, Protocol Standardization for IoT, Efforts, M2M and WSN Protocols, SCADA and RFID Protocols, Unified Data Standards, Protocols: IEEE 802.15.4, BACNet Protocol, Modbus, Zigbee Architecture, Network layer, 6LowPAN, CoAP, Security, Building IOT with RASPERRY PI: IoT Systems, Logical Design using Python, IoT Physical Devices and Endpoints, IoT Device, Building blocks, Raspberry Pi, Board, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry Pi with Python, other IoT Platforms, Arduino.

References:

1. Arshdeep Bahga, Vijay Madisetti, *Internet of Things – A hands-on approach*, Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian, *Architecting the Internet of Things*, Springer, 2011.

3. Jan Ho, ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, *From Machine-to-Machine to the Internet of Things-Introduction to a New Age of Intelligence*, Elsevier, 2014.
4. Honbo Zhou, *The Internet of Things in the Cloud: A Middleware Perspective*, CRC Press, 2012.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, *The Internet of Things – Key applications and Protocols*, Wiley, 2012.

MCA 5039 OBJECT ORIENTED ANALYSIS AND DESIGN [3 0 0 3]

Complexity: Structure, Five Attributes of a complex system, The Object Model: Evolution, Foundations, Elements and Applications, Classes and Objects: Nature and relationship between objects, Nature and relationship between classes. Importance of classification, Notation: Unified modelling language, Class diagram, Use case diagram, Sequence diagrams, Activity diagram, Object Diagrams, Component diagram, Deployment diagram and Package diagrams, The Process: First Principles, The Macro Process: The Software Development Lifecycle, The Micro Process: The Analysis & Design Process, Pragmatics: Management & Planning, Staffing, Release Management, Reuse, Quality Assurance and Metrics, Documentation, Tools and special tools, Risks of Object Oriented Development, Applications: System Architecture: Satellite Based Navigation, Control System: Traffic Management, Artificial Intelligence: Crptyanalysis, Web Application: Vacation Tracking System.

References:

1. Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen and Kelli A. Houston, *Object-Oriented Analysis And Design With Applications*, 3rd Edition, Pearson Education Inc., 2007.
2. Grady Booch,, *Object-Oriented Analysis And Design With Applications*, 2nd Edition, Pearson Education Inc., 2007.
3. Michael Blaha and James R Rumbaugh, *Object-Oriented Modeling And Design with UML 2.0*, 2nd Edition, Pearson Education, India, 2007.
4. Brahma Dathan, Sarnath Ramnath, *Object-Oriented Analysis, Design and Implementation*, Universities Press, 2013.
5. Grady Booch, James Rumbaugh, Ivar Jacobson, *The Unified Modeling Language Reference Manual*, 2nd Edition, Addison Wesley, 2004.

MCA 5037 MANAGEMENT INFORMATION SYSTEM [3 0 0 3]

System Concepts, Definitions, Computer based user machine system, Open and Close Systems, Integrated system, Need for a database, Utilization of models, Evolution, Subsystems, Organizational subsystems, Activities subsystems, Organizational Structure, Basic model, Hierarchical, Specialization, Formalization, Centralization, Modifications of basic organizational structure, Project organization, Lateral relations, Matrix

organization, Organizational culture and power organizational change, Structure of MIS, Operating elements, Physical components, Processing functions, Outputs, MIS support for decision making, Structured programmable decisions, Unstructured non-programmable decisions, MIS structure based on management activity and organizational functions, MIS pyramid structure, Synthesis of MIS structure, Development and Management, A contingency approach to choosing an application, Developing strategy, Lifecycle definition stage, Lifecycle development stage, Lifecycle installation and operation stage.

References:

1. Gordan B Davis, Margrethe H. Olson, *Management Information Systems: Conceptual foundations, Structure and development*, 5th Edition, Tata-Mc Graw Hill International Book Company, 2012.
2. E.Wainright Martin, Carol V. Brown, Denial W. DeHayes, Jeffrey A. Hoffer, William C Perkins, *Managing Information Technology*, 7th Edition, Prentice Hall International, 2011.
3. A.K. Gupta, *Management Information Systems*, 4th Edition, S. Chand and Company Ltd., 2010.

MCA 5028 COMPUTATIONAL INTELLIGENCE [3 0 0 3]

Artificial Neural Networks: The Artificial Neuron, Activation Functions, Artificial Neuron Geometry, Artificial Neuron Learning; Supervised Learning, Neural Network Types, Supervised Learning Rules; Unsupervised Learning, Hebbian Learning Rule, Principal Component Learning Rule, Self-Organizing Feature Maps; Reinforcement Learning, Learning through Awards, Model-Free Reinforcement Learning Model, Neural Networks and Reinforcement Learning; Performance Issues, Performance Measures, Analysis of Performance, Performance Factors. Evolutionary Computation: Generic Evolutionary Algorithm, Representation-the Chromosome, Initial Population, Fitness Function, Selection, Reproduction Operators, Stopping Conditions, Evolutionary Computation Versus Classical Optimization, Genetic Algorithms, Genetic Programming, Evolution Strategies. Swarm Intelligence: Basic Particle Swarm Optimization, Social Network Structures, Basic Variations, Basic PSO Parameters, Single-Solution Particle Swarm Optimization, Ant Colony Optimization; Fuzzy Systems: Fuzzy Sets, Fuzzy Logic and Reasoning, Fuzzy Inferencing, Fuzzy Controllers, Mamdani Fuzzy Controller, Takagi-Sugeno Controller, Rough Sets.

References:

1. Andries P. Engelbrecht, *Computational Intelligence*, 2nd Edition, Wiley Publications, 2007.
2. Russell Eberhart and Yuhui Shi, *Computational Intelligence: Concepts to Implementations*, Morgan Kaufmann Publishers, 2009.
3. Janusz Kacprzyk, Witold Pedrycz, *Springer Handbook of Computational Intelligence*, Springer, Heidelberg, 2015.
4. Lakhmi Jain, Philippe De Wilde, *Practical Applications of Computational Intelligence Techniques*, Springer, New York, 2001.

MCA 5029 COMPUTER ORGANISATION AND ARCHITECTURE [3 0 0 3]

Number Systems and Conversions, Boolean Algebra and Simplifications, Minimization of Boolean Functions, Karnaugh Map, Quine McClusky Method. Logic Gates: NAND NOR implementation. Design of Circuits: Adder /Subtracter , Encoder, Decoder, MUX /DEMUX – Comparators, Flip flops, Triggering, Master: Slave Flip Flop, State Diagram and Minimization, Counters, Registers Functional Units, Basic Operational Concepts: Bus structures, Performance and Metrics, instruction and instruction sequencing, Hardware Software Interface, Addressing modes, Instruction Sets, RISC and CISC, ALU Design, Fixed point and Floating point Processor basics, CPU Organization, Data Path Design, Control Design, Basic concepts, Hardwired control, Micro Programmed control, Pipe control, Hazards super scale operations Memory technology, Memory Systems: Virtual Memory, Caches, Design Methods, Associative memories, Input /output system, Programmed I/O, DMA and interrupts, I/O devices and Interfaces, Fundamental of Parallel Processing: Introduction, parallelism in conventional computers, general classification of computer architecture, Array processors: systolic arrays and wave front array processors, processing: Basic concepts, Arithmetic, pipelines, multiprocessors: Single bus, Multi-bus, cross bar, multiport memory.

References:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, *Computer Organization and Embedded Systems*, 6th Edition, Tata McGraw Hill, 2012.
2. David A. Patterson and John L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface*, Morgan Kaufmann, 2010.
3. Morris Mano, *Digital Design*, 5th Edition, Prentice Hall of India, 2013.
4. John P. Hayes, *Computer Architecture and Organization*, 3rd Edition, Tata McGraw Hill, 2012.
5. William Stallings, *Computer Organization & Architecture – Designing for Performance*, 10th Edition, Pearson Education, 2016.

MCA 5038 NOSQL DATABASE SYSTEMS [3 0 0 3]

The significance of Relational databases, impedance mismatch, the emergence of NoSQL, definition and history, Aggregate model, Four Types of NoSQL Database, scheme less databases, materialized Distribution models-single server, Sharding, Master-Slave replication, Peer-to-Peer Replication, combinations, relaxation consistency, Brewer's cap theorem, Document Databases, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, CRUD operations using Mongo DB, Column- oriented NoSQL databases HBASE, a, Architecture of HBASE, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, CRUD operations using HBase/Cassandra. NoSQL Key/Value databases Redis, Key-Value Databases, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, CRUD operations using Redis, Graph Databases, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, CRUD operations using Neo4j, Schema migrations, schema changes in RDBMS, schema changes in NoSQL, Incremental migration, migration in Graph Databases, Case Study-Document Database MongoDB.

References:

1. Pramod J Sadalage, Martin Fowler, *NoSQL Distilled*, Addison-Wesley, 1st Edition, 2012.
2. Shashank Tiwari, *Professional NOSQL*, John Wiley & Sons Inc., 1st Edition, 2011.
3. Kyle Banker, Peter Bakkum, Shaun Yerch, Douglas Garrett, Tim Hawkins, *MongoDB in Action*, 2nd Edition, Manning Publications, 2016.
4. Lans George, *HBase: The Definitive Guide*, 1st Edition, O'Reilly Media, Inc., 2011.
5. Ian Robinson, Jim Webber and Emil Eifrem, *Graph Databases*, 2nd Edition, O'Reilly Media, Inc., 2015.

MCA PROGRAM ELECTIVES - II & III

MCA 5042 SEMANTIC WEB [3 0 0 3]

Semantic Web Vision: technologies, layered approach, Structured Web Documents: XML, Describing Web Resources: RDF-data model, syntaxes, RDFS-adding semantics, RDF schema, RDF and RDF schema in RDFS, Axiomatic schematics for RDF and RDF schema, Direct inference system for RDF and RDFS, querying in SPARQL, Web Ontology Language: OWL and RDF/RDFS, Requirement of ontology language, Compatibility of OWL2 features, Logic and Inference: Rules, monotonic rules, OWL2 RL, Rule interchange format (RIF), Description Logic Programs (DLP), Semantic Web Rules Language(SWRL) , Rule Markup Language (RuleML), Ontology Engineering: constructing ontologies, reusing existing ontologies, semiautomatic ontology acquisition, Ontology Mapping, On-To-Knowledge Semantic Web Architecture.

References:

1. Grigoris Antoniou, Paul Groth, Frank van Harmelen, Rinke Hoekstra, *A Semantic Web Primer*, MIT Press, 2012.
2. Michael C. Daconta, Leo J. Obrst and Kevin T. Smith, *The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management*, Wiley, 2003.
3. Jorge Cardoso, Martin Hepp and Miltiadis D. Lytras, *The Semantic Web: Real-World Applications from Industry*, Springer, 2008.

MCA 5043 SERVICE ORIENTED ARCHITECTURE [3 0 0 3]

Fundamental SOA, Common Characteristics, misperception, tangible benefits and pitfalls of adopting; SOA timeline, The continuing evolution of SOA, roots of SOA, Comparing SOA to past architecture, Web Services and Primitives: The web service framework, Service roles, Service models, Service descriptions, Messaging with SOAP, Planning and Analysis: SOA delivery lifecycle phases, The top down strategy, The bottom up strategy, The agile strategy, Service oriented analysis: Objectives and process of SOA, Service modelling and its guidelines, Classifying service model logic, Technology and Design: Service Oriented Design: Introduction to service oriented design, WSDL and related XML schema, SOAP language basics, Service interface design tools, SOA Composition: Steps to composing SOA, Choosing service layers, Considerations for positioning core SOA standards, Considerations for choosing SOA extensions, SOA Service design: Entity centric business service design, Task centric business service design, Application service design, Service design guidelines, Business process design: Service oriented business process design, SOA Platforms: Basics, SOA support in J2EE, SOA support in .net.

References:

1. Thomas Erl, *Service Oriented Architecture (SOA): Concepts, Technology and Design*, Pearson Education, 2016.
2. Eric Newcomer and Lomow, *Understanding SOA with Web Services*, Pearson Education, 2009.
3. Sandeep Chatterjee and James Webber, *Developing Enterprise Web Services*, Pearson Education, 2007.

MCA 5030 CYBER FORENSICS [3 0 0 3]

Introduction to Computer Forensics, Computer Forensics in Law enforcement, Computer Forensics assistance to human resources, Computer Forensics services, Benefits of Professional Forensics methodology, Steps taken by Computer Forensics specialists, Who can use Computer Forensics evidence, Types of Computer Forensics Technology, Types of law enforcement, Occurrence of Cyber Crime, Cyber Detectives, Fighting Cyber Crime with Risk-Management Techniques, Computer Forensics Investigation Services, Forensics process Improvement, Data Recovery, The role of Back-up in Data Recovery, The Data Recovery solutions, Evidence, Collection options, Obstacles, Types of Evidence, The rules of Evidence, Volatile Evidence, Procedure, Collection and Archiving, Methods of collection, Artifacts, Collection Steps, Controlling Contamination, Preserving The Digital Crime Scene, Computer Evidence processing steps, Legal Aspects of Collecting and preserving Computer Forensic Evidence, Special needs of Evidential Authentication, Practical consideration, Practical Implementation, How to become a Digital Detective, Useable File Formats, Unusable File Formats, Converting Files, Network Forensic scenario, A technical approach, Destruction of E-mail, Damaging Computer Evidence, Documenting the intrusion on destruction of data.

References:

1. John R. Vacca, *Computer Forensics, Computer Crime Scene Investigation*, 3rd Revised Edition, Jones and Bartlett Publishers, Inc., 2019.
2. Bill Nelson, Amelia Phillips, *Guide to Computer Forensics and Investigations: Processing Digital Evidence*, Fifth Edition, CENGAGE Learning, 2015.
3. Keith J. Jones, Richard Bejtiich, Curtis W. Rose, *Real Digital Forensics*, Addison Wesley Pearson Education, 2006.

MCA 5026 BIG DATA ANALYTICS [3 0 0 3]

Introduction to Big Data: evolution, structuring, elements, big data analytics, distributed and parallel computing for big data, Hadoop, Cloud computing and big data, in-memory computing technology for big data, Big Data Stack, Virtualization and Big Data, Hadoop: ecosystem, Hadoop

Distributed File System (HDFS), MapReduce: MapReduce Framework, optimizing MapReduce jobs, MapReduce Applications, Understanding YARN architecture, HBase, Exploring Hive, Analyzing data with Pig, Using Oozie, Introduction to Mahout, role of HBase in Big Data Processing, RHadoop: Data Analysis Using the MapReduce Technique in RHadoop, Spark: Core Concepts, Spark's Python and Scala shells, Programming with RDD: RDD Operations, Passing Functions to Spark, Common Transformations and Actions, Mining Data Streams: Streams Concepts, stream Data Model and Architecture, stream computing, filtering Streams, estimating Moments, decaying window, Real time Analytics Platform (RTAP) Applications, Case studies: Real Time Sentiment Analysis, Stock Market Predictions.

References:

1. Vignesh Prajapathi, *Big Data Analytics with R and Hadoop*, Packt Publishing, 2013.
2. Holden Karau, Andy Konwinski , Patrick Wendell, Matei Zaharia, *Learning Spark: Lightning-Fast Big Data Analysis*, 1st Edition, O'Reilley Media Inc, 2015.
3. Michael Minnelli, Michele Chambers, *Big Data Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses*, Wiley India Pvt. Ltd., 2013.
4. Arvind Sathi, *Big Data Analytics*, MC Press, LLC, 2012.

HUM 5043 HUMAN RESOURCE MANAGEMENT [3 0 0 3]

HRM: HR and HRM, Role in organization, HR in Technical and Knowledge domain, Acquisition of HR, HR Planning, HRM vs. Personal Management, Development of HR, Motivation and Maintenance of HR Leadership: Technical Leadership, Leader's Goal, Conviction, Leader's Vision, Transformational and Transactional Leadership, Commitment and Professionalism, Importance of Professionalism, Manager's Role in Professionalism, Respect, Managing Technical and Professional people: Goals of Engineers and Scientists, Work Assignment and Need for Influence, Professional Career and Goals, Career Risks, Technical Competence, Training and Survival of Best fit, Performance and Motivation, Role of PMS evaluation, Professional Discipline, Manager's Role in Professional Discipline, Identification and Development of Talented people: Talented Professionals, Importance of Talent, Assessment and Recognizing Talent, Developing Technical Talent, Developing Managerial Talent, Development Needs, Planning and Counseling, Innovation: Importance of Innovation, Risk of Failure, Creativity from Imagination, Need of Creative Teams, Team environment and recognition: Team Dynamics, Innovative team Environment, Managing Innovative Teams, Manager's Responsibility in Innovation, Team's Personal Needs, Political versus Technical Solutions, Rewards and Recognition, Case studies in Indian Organizations.

References:

1. Jim Collins, *Good to Great*, Harper Collins Publishers, Volume 2, 2011.
2. Armstrong, *Handbook of Human Resource Management Practice*, Emerald Group Publishing limited, 2009.
3. K. Aswathappa, *Human Resource and Personnel Management text and cases*, Tata Mc-Graw Hill publishing Co. Ltd., 2002.
4. Wiseman and Grey, *Multipliers How the Best leaders make everyone smarter*, Harper Business Publishers, 2010.

MCA 5034 INFORMATION AND NETWORK SECURITY [3 0 0 3]

Introduction: The OSI Security Architecture, Security Attacks, Services and Mechanisms, Model for Network Security, Number theory Cryptographic Hash Functions, Digital Signatures, System Security, Symmetric Encryption and Message Confidentiality, Substitution ciphers, Stream ciphers, Public-key cryptography and Message Authentication, Key Distribution and Authentication, Transport Layer Security, Wireless Network Security, E-mail Security, IP Security, Security Management Systems, Need for IT Security, Intrusion Prevention and Detection Systems, Cyber Security.

References:

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, 7th Edition, Pearson Education, 2017.
2. William Stallings, *Network Security Essentials: Applications and Standards*, 6th Edition, Pearson Education, 2014.
3. Atul Kahate, *Cryptography and Network Security*, 3rd Edition, Tata McGraw-Hill Publishing Company Limited, 2013.
4. Bruce Schneier, *Applied Cryptography: Protocols, Algorithms and Source Code in C*, 2nd Edition, Wiley Publications, 2007.
5. V. K. Pachghare, *Cryptography and Information Security Paperback*, 2nd Edition, PHI Publications, 2015.

MCA 5035 INFORMATION STORAGE MANAGEMENT [3 0 0 3]

Information storage, evolution of storage architecture, ILM. Storage System Environment: Disk components and performance measurement. Data Protection RAID: techniques, types, Intelligent storage system. Block: based Storage System: Components of block: based storage system. Storage provisioning and storage tiering, File-based Storage System: NAS, file sharing methods, File-level virtualization, Object-based and Unified Storage: Key features of OSD, Content addressed storage (CAS), unified storage architecture, Software-defined Storage: architecture of software-defined storage, Fibre Channel SAN: components and architecture, Internet Protocol SAN, iSCSI protocol, network components, and connectivity, link and switch aggregation, and VLAN, Fibre Channel over Ethernet SAN: FCoE SAN, FCoE SAN connectivity. Introduction to Business Continuity, Backup and Archive, Replication, Storage virtualization: forms of virtualization, EMC Products and tools: A Case study CLARiiON Architecture, Snap view, Mirror view, Power path and SANCOPY.

References:

1. Marc F. Osborne, *Building Storage Networks*, 2nd Edition, Tata McGraw Hill, 2001.
2. Marc Farley, *Storage Networking Fundamentals*, 1st Edition, CISCO Press, 2004.
3. Robert Spalding, *Storage Networks: The Complete Reference*, Tata McGraw Hill, 2003.
4. G. Somasundaram, A. Shrivastava, *EMC Corporation, Information Storage and Management*, 2nd Edition, Wiley Publication, 2012.

MCA 5041 PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS [3 0 0 3]

Introduction: Definitions of data sets for Pattern Recognition (PR), Different paradigms of PR, Representations of Patterns and Classes, Metric and Non-metric proximity measures, Applications of PR, Feature extraction and feature selection: Feature extraction, different approaches to feature selection, Feature ranking. Statistical Decision Making: Introduction, Bayes theorem, multiple features, conditionally independent features, decision boundaries, the leaving-one-out technique, characteristic curves, estimating the composition of populations. Naïve Bayes classifier, Bayesian Belief Networks, Supervised and unsupervised Classification: Introduction to supervised and unsupervised classifications, Classification in High dimension, Random forests, SVM classifications. Introduction to clustering, clustering large datasets and combination of classifiers.

References:

1. Devi V. S, Murthy M. N, *Pattern Recognition: An Introduction*, Universities Press, Hyderbad. 2011.
2. Earl Gose, Richard Johnsonbaugh and Steve Jost, *Pattern Recognition and Image Analysis*, Prentice Hall of India, 2003.
3. R.D. Duda, P.E. Hart and D.G. Stork, *Pattern Classification*, 2nd Edition, John Wiley Inc., 2001.

MCA 5040 OPTIMIZATION TECHNIQUES [3 0 0 3]

Linear Programming: Graphical Solution, Simplex Method, Big M Method, Transportation and Assignment Model. Network flow: Max Flow - Min Cut Theorem, Ford – Fulkerson's algorithm and Edmond Karp's algorithm, CPM and PERT Networks. Dynamic Programming: Introduction, Equipment Replacement Model, Allocation Problem, Inventory Models, Production Scheduling. Decision Theory: Decision under certainty: Analytic Hierarchy Process (AHP), decision under risk: decision trees, expected value criterion, Variations of the Expected value criterion, decision under uncertainty: Laplace, MinMax, Savage, Hurwicz method. Game Theory: Introduction, Minmax – Maxmin pure strategies, Optimal solution of two person zero sum games, solution of mixed strategy games, 2 x 2 games, 2 x n games, m x 2 games. Heuristics and approximation algorithms: approximation algorithms for Travelling Salesman Problem (TSP), Vertex cover problem. Randomized local search heuristics: Evolutionary algorithm for optimization. Application to real world optimization problems

References:

1. Taha H, *Operation Research: An Introduction*, 10th Edition, McMillan, 2017.
2. Ravindra K. Ahuja, Thomas L. Magnanti, James B. Orlin, *Network Flows: Theory, Algorithms, and Applications*, Pearson New International Edition, 2014.
3. Teofilo F. Gonzalez, *Handbook of Approximation Algorithms and Metaheuristics*, Chapman & Hall/CRC Computer and Information Science Series, 1st Edition, 2007.
4. S.S. Rao, *Engineering Optimization: Theory and Practice*, New Age International Pvt. Ltd., New Delhi, 2013.

MCA 5027 CLOUD COMPUTING [3 0 0 3]

Cloud Computing Overview: Technologies for Network-Based System, System Models for Distributed and Cloud Computing, NIST Cloud Computing Reference Architecture. Cloud Models: Characteristics, Cloud Services models (IaaS, PaaS, SaaS), Cloud Deployment model, Computing on demand, Cloudonomics: Economics of Cloud Computing, The 10 Laws of Cloudonomics, Laws of Behavioral Cloudonomics,

Service level agreements, Case study on SLA; Virtualization: Basics of Virtualization, Types of Virtualization, Implementation Levels of Virtualization, Virtualization Structures, Tools and Mechanisms, Virtualization of CPU, Memory, I/O Devices, Virtual Clusters and Resource management, Virtualization for Data-center Automation, Programming Model: Parallel and Distributed Programming Paradigms, MapReduce, Twister and Iterative MapReduce, Hadoop Library from Apache, Mapping Applications, Programming Support, Google App Engine, Amazon AWS, Cloud Software Environments, Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim; Security In The Cloud: Security Overview, Cloud Security Challenges and Risks, Software-as-a-Service Security, Security Governance, Risk Management, Security Monitoring, Security Architecture Design, Data Security, Application Security , Virtual Machine Security, Identity Management and Access Control, Autonomic Security.

References:

1. Sartaj Sahani, *Fundamentals of Data structures using C*, 2nd Edition, Silicon Press, 2007.
2. J. P. Trembly and Sorenson, *An Introduction to Data Structures with Applications*, 2nd Edition, McGraw Hill, 36th Reprint, 2008.
3. J. E. Aho, A.V. Hopcroft and Ullman, *Data structures and algorithm*, 4th Edition, Addison Wesley, 2009.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, 3rd Edition, PHI Publications, 2009.

MCA 5031 DESIGN AND ANALYSIS OF ALGORITHMS [3 0 0 3]

Introduction: Need for Algorithmic Thinking, Need for Algorithm Efficiency, Fundamental Stages of Problem Solving, Classification of Algorithms. Basics of Algorithm Analysis: Basics of Algorithm Complexity, Introduction to Time Complexity, Analysis of Iterative Algorithms, Rate of Growth, Asymptotic Analysis and Space Complexity Analysis. Mathematical Analysis of Recursive Algorithms: Introduction to Recurrence Equations, Formation of Recurrence Equations, Techniques for Solving Recurrence Equations, Divide-and-conquer Recurrences. Brute Force Approaches: Introduction, Computational Geometry Problems, Exhaustive Searching. Divide-and-conquer Approach: Introduction, Merge Sort, Quick Sort, Closest-pair Problem. Greedy Algorithms: Introduction to Greedy Approach, Suitability of Greedy Approach, Coin Change Problem, Scheduling Problems, Knapsack Problem, Optimal Graph Problems. Dynamic Programming: Basics of Dynamic Programming, Fibonacci Problem, Computing Binomial Coefficients, Floyd-Warshall All Pairs Shortest-path problem, Bellman-Ford Algorithm, Traveling Salesperson Problem, Knapsack Problem. Backtracking: Introduction, Basics of Backtracking, N-queen Problem, Sum of subsets, Vertex Coloring Problem, Hamiltonian Circuit Problem. Branch-and-Bound technique: Introduction, Search Techniques for Branch-and-Bound Technique,

Traveling Salesperson Problem, Knapsack Problem. Basics of Computational Complexity: Introduction to Computational Complexity, Algorithmic Complexity, Complexity Classes, Theory of NP-complete Problems, Example Problems for Proving NP-completeness.

References:

1. S. Sridhar, *Design and Analysis of Algorithms*, 1st Edition, Oxford University Press, 2015.
2. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures – A Pseudocode Approach with C*, 2nd Edition, Cenage Learning, 2009.
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, *Fundamentals of Algorithms*, 2nd Edition, Universities Press, 2010.
4. Thomas H. Cormen, Charles, E. Leiserson, Ronald L. Rivest and Clifford Stein *Introduction to Algorithms*, 3rd Edition, PHI Publications, 2009.

MCA 5044 SOFTWARE PROJECT MANAGEMENT [3 0 0 3]

Managing Software Projects: Processes and Project Management, Process Planning: Case Study Example, Requirement Change Management: Change Management Process, Effort Estimation and Scheduling: Estimation and Scheduling Concepts, Effort Estimation: Bottom-up & Top-down Estimation, Use case Points, Effectiveness, Example, Scheduling: Overall, Effectiveness, Detailed, Quality Planning: Concepts, Quantitative Quality Management Planning, Example, Risk Management: Concepts, Assessment, Control, Example of Configuration Management, Measurement and Tracking Planning: Concepts, Measurements, The Project Management Plan: Process Database, Process Capability Baseline, Process Assets and Body of Knowledge System, The Project Management Plan, Team Management, Project Monitoring and Control: Tracking, Milestone Analysis, Defect Analysis and Prevention, Process Monitoring and Audit, Project Closure: Analysis, Report.

References:

1. Pankaj Jalote, *Software Project Management in Practice*, 1st Edition, Addison, Wesley, 2014.
2. Bob Hughes, Mike Cotterell, Rajib Mall, *Software Project Management*, 6th Edition McGraw Hill Education, 2017.
3. Roger S. Pressman, *Software Engineering: A Practitioner's Approach*, 8th Edition, McGraw Hill Publication, 2014.
4. Normal E Fenton, Shari Lawrence, *Software Metrics*, 5th Edition, Pfleeger Thompson, 2010.

MCA 5033 GAME PROGRAMMING [3 0 0 3]

3D Graphics for game programming: Coordinate Systems, Ray Tracing, Modeling in Game Production, Vertex Processing, Rasterization, Fragment Processing and Output Merging, 3D Transformations, Quaternions, 3D Modeling and Rendering, Ray Tracing, Shader Models, Lighting, Color, Texturing, Camera and Projections, Culling and Clipping, Character Animation, Physics-based Simulation, Scene Graphs. Game engine design: Game engine architecture, Engine support systems, Resources and File systems, Renderers, Software Rendering, Hardware Rendering, and Controller based animation, Spatial Sorting, Level of detail, collision detection, standard objects, and physics, Human Interface devices, Collision and rigid body dynamics, Game Programming: Application layer, Game logic, Game views, managing memory, controlling the main loop, loading and caching game data, User Interface management, Game event management, Introduction to Games development tools: Milk Shape - 3D, Unity – 3D, Light wave 3D.

References:

1. Mike Mc Shaffrfy and David Graham, *Game Coding Complete*, 4th Edition, Cengage Learning, PTR, 2012.
2. Jason Gregory, *Game Engine Architecture*, CRC Press / A K Peters, 2009.
3. Kenneth C. Finney, *Advanced 3D Game Programming All in One*, Premier Press, 2011.
4. Mike McShaffry, David Rez Graham, *Game Coding Complete*, Course Technology PTR, 2012.
5. Joseph Hocking, *Unity in Action: Multiplatform Game Development in C# with Unity 5*, 2nd Edition, Manning Publications, 2018.

MCA 5032 ETHICAL HACKING [3 0 0 3]

Introduction to Ethical Hacking: Important Terminologies, Penetration Testing and Tools: Phases involved in Ethical Hacking, Types of Hackers. Foundations of Information Security, Network Security: Introduction, Protocols, IP Security, SSL/TLS, DNS, Firewalls, Intrusion Detection, Linux Basics: File structure, permissions, scheduler, users, backtrack, Footprinting and reconnaissance, Social Engineering, Trojans, backdoors, viruses and worms, Web Hacking, Attacking the authentication, Brute force and dictionary attacks, types of authentication, Sniffers, Introduction, Types of sniffing, MITM attacks, ARP attacks, DOS attacks, SQL injection and Buffer overflows.

References:

1. Harper Allen, *Gray Hat Hacking: The Ethical Hackers HandBook*, 3rd Edition, McGraw Hill, 2011.
2. Rafay Baloch, *Ethical Hacking and Penetration Testing Guide*, Auerbach Publications, 2014.
3. Himanshu Sharma, *Kali Linux - An Ethical Hacker's Cookbook*, Packt Publishing Limited, 2017.
4. Dafydd Stuttard and Marcus Pinto, *The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws*, 2nd Edition, 2011.
5. Lester Evans, *Ethical Hacking: The Ultimate Guide to Using Penetration Testing to Audit and Improve the Cybersecurity of Computer Networks for Beginners, Including Tips on Social Engineering*, 2019.