Babu Banarasi Das University, Lucknow
School of Computer Applications
Master of Computer Applications
Evaluation Scheme (w. e. f. Academic Session 2021-22)

SEMESTER I									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
Theory									
F	MCA4101	Fundamental of Computer and Programing Concepts	3	1	0	40	60	100	4
C	MCA4102	Computer Organization & Architecture	3	1	0	40	60	100	4
C	MCA4103	Discrete Mathematics	3	1	0	40	60	100	4
C	MCA4104	Relational Database Management System	3	1	0	40	60	100	4
C	MCA4105	Data Structures Using JAVA Programming	3	1	0	40	60	100	4
C	MCA4106	Principles of Management	3	1	0	40	60	100	4
Practical									
C	MCA4151	Relational Database Management System Lab	0	0	4	40	60	100	2
C	MCA4152	Data Structures Using JAVA Programming Lab	0	0	4	40	60	100	2
	GP4101	General Proficiency	-	-	-	100	-	100	1
Total			18	6	8			900	29

SEMESTER II									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
Theory									
C	MCA4201	Design & Analysis of Algorithms	3	1	0	40	60	100	4
C	MCA4202	Data Communication and Networks	3	1	0	40	60	100	4
C	MCA4203	Programming in PYTHON	3	1	0	40	60	100	4
C	MCA4204	Web Technologies and Application Development	3	1	0	40	60	100	4
C	MCA4205	Software Project Management	3	1	0	40	60	100	4
C		Generic Elective I	3	1	0	40	60	100	4
Practical									
C	MCA4251	Programming in PYTHON Lab	0	0	4	40	60	100	2
C	MCA4252	Web Technologies and Application Development Lab	0	0	4	40	60	100	2
	GP4201	General Proficiency	-	-	-	100	-	100	1
Total			18	6	8			900	29

SEMESTER III									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
Theory									
C	MCA4301	.NET Framework & C#	3	1	0	40	60	100	4
C	MCA4302	Mobile Application Development and OSS	3	1	0	40	60	100	4
C	MCA4303	Data Security and Cryptography	3	1	0	40	60	100	4
C	MCA4304	Data Mining and BigData	3	1	0	40	60	100	4
C	MCA4305	Computer Based Numerical and Statistical Techniques	3	1	0	40	60	100	4
C		Generic Elective II	3	1	0	40	60	100	4
Practical									
C	MCA4351	.NET Framework & C# Lab	0	0	4	40	60	100	2
C	MCA4352	Mobile Application Development and OSS Lab	0	0	4	40	60	100	2
	GP4301	General Proficiency	-	-	-	100	-	100	1
Total			18	6	8			900	29

SEMESTER IV									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
Theory									
C	MCA4401	Internet of Things (Online)	2	0	0	40	60	100	2
Practical									
C	MCA4451	Industrial Training-cum-Project	-	-	-	350	450	800	28
	GP4401	General Proficiency	-	-	-	100	-	100	1
Total			2	0	0			900	31

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Credit Summary Chart

Course Category	Semester				Total Credits	%age
	I	II	III	IV		
Basic Sciences	4		4		8	6.8
Humanities						
Professional Subject - Core	24	24	20	2	70	59.3
Professional Subject – Generic Elective		4	4		8	6.8
General Proficiency	1	1	1	1	4	3.4
Project Work, Seminar and/or Internship in Industry or elsewhere				28	28	23.7
Total	29	29	29	31	118	100

Discipline wise Credit Summary Chart

Course Category	Semester				Total Credits	%age
	I	II	III	IV		
F	4				4	3.4
C	24	24	24	30	102	86.4
GE		4	4		8	6.8
OE						
GP	1	1	1	1	4	3.4
Total	29	29	29	31	118	100

Category of Courses:

F Foundation Course
C Core Course
GE Generic Elective
OE Open Elective

Generic Elective Subject List

Generic Elective I

MCA4211: Theory of Computation
MCA4212: Data Science with Machine Learning
MCA4213: Cloud Computing

Generic Elective II

MCA4311: Pattern Recognition
MCA4312: Artificial Intelligence
MCA4313: Mobile Communication System
MCA4314: Distributed Systems

ANNEXURE V

I Semester

MCA4101: Fundamental of Computer and Programing Concepts

Course Objective:

1. The subject provides the fundamental concepts of Computer and latest trends in Emerging Technologies.
2. Subject introduces Basics to Computer, Concept of Operating System, Programming Concepts and Emerging Technologies.

Learning Outcome: Upon successful completion of the course student will be able to:

1. Demonstrate the knowledge of the basic structure, components, features and generations of computers.
2. Compare and contrast features, functioning & types of Operating System.
3. Describe the Concept of Computer Languages, Language Translators and construct algorithms to solve problems using Programming Concepts.
4. Illustrate the Emerging Trends and Technologies in the field of Information Technology.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction to Computer:** Definition; History of Computer; Types of Computer; **Components:** Hardware – Introduction, Input devices, Output devices, Central Processing Unit, Software - Introduction, Types– System and Application; **Storage Devices:** Primary, Secondary, Auxiliary Storage Devices, Cache Memory, Memory Hierarchy, Buffering and Spooling.	15 Hours	1
II	**Operating System:** Introduction; Structure of Operating System; Services; Components; Functions; Types of Operating System; Command based and GUI based operating system; **Popular Operating Systems**: Android, Windows, Linux, Unix, iOS	15 Hours	1
III	**Introduction to Programming Concept:** Introduction; History of Programming Languages; **Programming Approach**: Top-down Approach, Bottom-up Approach; **Translator:** Compiler, Interpreter & Assembler; SDLC; **Design Tools**: Flowchart, Algorithms, Pseudo-code	15 Hours	1
IV	**Emerging Trends & Technologies:** Introduction, Features, Limitations and Application areas of Augmented Reality , Virtual Reality, Grid computing, Green computing, Cloud Computing, Big data analytics, Block Chain, Crypto currencies; **Internet of Things (IoT):** Definition, Sensors, their types and features, Smart Cities.	15 Hours	1

Suggested Readings:

1. E. Balagurusamy, “Fundamentals of Computers”, McGraw Hill Education.
2. Peter Norton’s., “Introduction to Computers”, McGraw Hill Education.

3. Raja Raman .V, “Fundamentals of Computers”, PHI Publications, 3rd Edition, 2004.
4. Goel A., “Computer Fundamentals”, Pearson.
5. Thareja R., “Fundamentals of Computers”, Oxford University Press.
6. Bindra J., “The Tech Whisperer- on Digital Transformation and the Technologies that Enable it ”, Penguin

MCA4102: Computer Organization & Architecture

Course Objective: Provide a better understanding of Computer Organization, its designing & implementation.

1. Explain Computer performance measurement methods.
2. Student should learn how to quantitatively evaluate different designs and organizations.
3. Student should be able to articulate design issues in the development of processor or other components that satisfy design requirements.

Learning Outcome: Upon successful completion of the course the student will:

1. Describe software and hardware interaction layers in computer architecture.
2. Describe various machine language instructions.
3. Be familiar with the terminology and basic principles of Digital electronics and Computer organization systems.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction to Digital Electronics:** Number System & Binary Codes, Boolean Algebra**,** Minimization of Boolean Expressions using K-Map; Logic Gates:; Implementations of Logic Functions using Gates; **Combinational Circuits:** Introduction to combinational circuits, Adders & Subtractors; Magnitude Comparator; Multiplexer & De-Multiplexer; Decoder **Sequential Circuit:** Introduction to Flip Flops, Types of Flip flop, Excitation table of Flip flop, Introduction of Registers; Classification of Registers, Introduction of Counter; Synchronous and Asynchronous counter.	15 Hours	1
II	**Register Transfer and Micro-operation:** Register Transfer Language: Register Transfer, Bus and Memory Transfer; Micro operations: Arithmetic, Logical, Shift micro- operations; Arithmetic logic shift unit; Timing and control; Instruction codes; Computer instructions; Machine language instructions. **Basic Computer Organizations and Design:** Instruction Cycle; Memory Reference Instructions; Register Reference Instructions; Input-Output Instructions; Design of Accumulator Logic Shift Unit; Instructions Format. **Central Processing Unit:** Accumulator based organization; General register organization; Stack organization; Addressing modes; RISC vs. CISC, Hard wired & micro programmed control Unit	15 Hours	1
III	**I/O Organizations:** Introduction to system buses; Input/ output interface; Interrupt and Interrupt handling: S/W Interrupt, Vectored Interrupt, Daisy Chaining, Priority Interrupt; Device Polling; Serial Vs Parallel communications; I/O Processor; Synchronous Data Transfer; Asynchronous Data Transfer methods: Strobe Control, handshaking; Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O. DMA; DMA: DMA Controller, DMA Transfer; CPU-IOP Communication.	15 Hours	1

IV	**Memory organizations**: Memory hierarchy; Main Memory: RAM Chips, ROM Chips; Concept of address space & Memory Space; Address Mapping; Auxiliary Memory; Cache memory: Mapping Techniques: Direct mapping, Associative mapping, Set associative mapping; Associative memory; Cache Basics-Measuring and improving Cache performances **Concepts of Parallel Processing:** Parallelism, Characteristics of parallelism, Introduction to multithreading, Multiprocessor and shared memory microprocessor.	15 Hours	1

Suggested Readings:

1. M. Morris Mano "Digital Logic and Computer Design", 2nd Edition, PHI.
2. P. Raja, "Switching Theory", Fourth Edition, Umesh Publication.
3. M. Morris Mano, "Computer System Architecture", PHI
4. William Stalling, "Computer Organization & Architecture", Pearson Education Asia
5. R. S. Goankar, "Microprocessor architecture, Programming and application with 8085", Pen Ram International

MCA4103: Discrete Mathematics

Course Objective:

1. Students should be able to distinguish between the notion of discrete and continuous mathematical structures.
2. Students should be able to understand the basic concepts of set theory.
3. Students should be able to apply fundamental counting algorithms to solve applied problems in the area of computer science.
4. Students should be able to prove mathematical statements by means of inductive reasoning.
5. Students should be able to understand the principle of recursion and apply it to the study of sequences and sets.

Learning Outcomes: On completion of this course students will be able to:

1. Verify the correctness of an argument using propositional and predicate logic and truth tables.
2. Demonstrate the ability to solve problems using counting techniques and combinatory.
3. Solve problems of recurrence relations and generating functions.
4. Use graphs and trees as tools to visualize and simplify network related problems.
5. Perform operations on discrete structures such as sets, functions, relations, and sequences.
6. Construct proofs using direct proof, proof by contraposition, proof by contradiction, proof by cases and mathematical induction.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Set Theory, Relation & Function:** Set Theory: Definition of Sets, Type of Sets, Venn Diagrams, Operation on Sets, Subsets, Power Set, Cartesian Product, Principle of Inclusion and Exclusion, Multisets; Relation: Binary Relations, Inverse Relation, Composition of Relations, Properties of Relations, Equivalence Relations, Partial Order Relations, Ordered Set, Hasse Diagram of Poset; Function: Definition & Type of Functions, One-to-One Function, Onto Function, Inverse Function, Compositions of Functions.	15 Hours	1
II	**Discrete Numeric Function and Recurrence Relation:** Numeric Function, Generating Function, Recurrence Relation, Linear Recurrence , Relation with Constant Coefficients, Homogeneous and Particular Solution, Solution by Method of Generating Function.	15 Hours	1
III	**Fundamentals of Logics:** Fundamentals of Logics: Proposition, First order Logic, Logical Operation, Truth Values, Compound Proposition, Tautologies & Contradiction, Logical Equivalences, De-Morgan's laws. Predicates, Universal and Existential Quantifiers.	15 Hours	1
IV	**Graph Theory:** Graph**:** Graph Terminology, Bipartite, Regular and Planar Graph, Euler Graphs, Directed Graph, Hamiltonian Path and Circuits, Graph Coloring, Chromatic Number; Tree: Spanning Tree, Minimal Spanning Tree, Kruskal's Algorithms, Prim's Algorithms.	15 Hours	1

Suggested Readings:

1. J. P. Tremblay and R. Manohar, “Discrete Mathematical Structure with Application to Computer Science”, TMH, New Delhi, 2000.
2. Kolman, Busby and Ross “Discrete Mathematical Structures” PHI/Pearson., 6th Ed., 2009.
3. Kenneth H. Rosen, “Discrete Mathematics & Applications”, TMH, 6th Ed., 2007.
4. C. L. Liu, “Elements of Discrete Mathematics”, McGraw Hill Book Company, 2nd Ed., 1985.
5. Narsingh Deo, “Graph Theory”, PHI, 24th Indian Print, 2003.

MCA4104: Relational DataBase Management System

Course Objective:

1. To present the fundamental concepts of Database Management.
2. To develop skill of Database Design, Database Languages and Database-System implementation with respect to Relational Database Management System.
3. To develop the concepts of Transaction Processing System, Concurrency control and Recovery procedures in database.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Understand the basic concepts of the database and data models.
2. Design a database using ER diagrams and map ER into Relations and normalize the relations.
3. Develop a simple database applications using normalization.
4. Acquire the knowledge about different special purpose databases and to critique how they differ from traditional database systems.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Database System Concepts, Database Users, and Architecture:** Introduction to Database System with example, Characteristics of the Database Approach: Database Users, Advantages and disadvantages of Using a DBMS, Implication of Database Approach; Data Models, Schemas, and Instances; DBMS Architecture (ANSI/SPARC), Data Independence, Database Languages and Interfaces, Database System Environment; Classification of Database Management Systems.	15 Hours	1
II	**Data Modeling & Relational Database Management System:** Data Modeling Using the Entity-Relationship Model: Entity Types, Entity Sets, Attributes, and Keys, Relationships, Relationship Types, Rules, and Structural, Constraints , Weak Entity Types , ER Diagrams, Naming Conventions, and Design Issues. **Enhanced Entity- Relationship Modeling:** Super Classes, Subclasses, and Inheritance, Specialization and Generalization, Constraints and Characteristics of Specialization and Generalization, Modeling of UNION Types using Categories; The Relational Data Model: Relational Constraints, and the Relational Algebra: Relational Model Concepts, Codd's Rules for relational algebra, Relational Database Schemas. Basic Relational Algebra Operations, Additional Relational Operations, Examples of Queries in Relational Algebra.	15 Hours	1

III	**SQL and Database Design Theory and Methodology** **Structured Query Language- The Relational Database Standard:** Data Definition, Constraints, and Schema Changes in SQL, Types of SQL Commands, SQL Operators and their Procedure, Insert, Delete, and Update Operations and Dealing with Constraint Violations, Queries and Sub Queries, Aggregate Functions, Joins, Unions, Intersection, Minus, Views (Virtual Tables) in SQL, Cursors, Triggers and PL/SQL **Functional Dependencies and Normalization for Relational Databases:** Informal Design Guidelines for Relation Schemas, Functional Dependencies, Armstrong Rules, Closure of Attributes, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form	15 Hours	1
IV	**Transaction Processing, Concurrency Control and Distributed Database:** Transaction Processing Concepts: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Schedule and Recoverability, Serializability of Schedule, **Transaction Support in SQL:** Concurrency Control Techniques, Locking Techniques for Concurrency Control, Concurrency Control Based on Timestamp Ordering, Multiversion Concurrency Control Technique, Granularity of Data Items. **Recovery Concepts:** Recovery Technique Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging, The ARIES Recovery Algorithm, Database Backup and Recovery from Catasrophic Failures, Introduction to Distributed Database.	15 Hours	1

Suggested Readings:

1. Date C. J.—An Introduction to Data Base System, AddisionWesley.
2. Korth, Silbertz, Sudarshan —Data Base Concepts, McGraw-Hill.
3. Elmasri, Navathe —Fundamentals Of Data Base Systems, AddisionWesley.
4. Bipin C. Desai —An introduction to Data Base Systems, Galgotia Publication.
5. Ramakrishnan, Gehrke —Data Base Management System, McGraw-Hill.
6. R. S. Despandey --SQL/PL SQL for Oracle.
7. Ivan Bayross -- SQL, PL/SQL: The Programming Language of Oracle

MCA4105: Data Structures using JAVA Programming

Course Objective:

1. To study Java as an Application Programming Language
2. To study various Applications of Java.
3. To focus on developing interactive Applications.
4. To make the student learn fundamental data structures algorithms.
5. To describes and implements algorithms such as stacks, queues, linked lists, trees, searching techniques, sorting techniques.
6. To comprehend alternative implementations using the differing logical relationships and appreciate the significance of choosing a particular logical relationship for implementation within real-world setting.
7. To demonstrate the ability to plan, design, execute and document sophisticated technical programs to handle various sorts of data structures.
8. Be familiar with the use of data structures as the foundational base for computer solutions to problems.

Learning Outcome: Students who have successfully completed this course will have understanding of the following concepts:

1. Students will be able to learn how and why java came about and what makes it so important.
2. Build complex system from software components
3. Apply advance Java programming techniques such as pointers, dynamic memory allocation, structures to developing solutions for particular problems.
4. Design and implement abstract data types such as linked list, stack, queue and tree by using Java as the programming language using static or dynamic implementations.
5. Design and implement Java programs that apply abstract data types.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction**: Introduction to Object Oriented Programming Concept, Paradigm, Classes, Abstraction, Encapsulation, Inheritance, Polymorphism, **Introduction of Java**: Java History, JDK Directory Structure, Java Features, Structure of Java Program, Compiling and Interpreting Applications. Java Tokens: Java character set, Keywords, Identifiers, Literals. **Data types and Variables:** Primitive Data types Declarations, Literals; Numeric Literals, Character Literals, String Literals, Non-Primitive data types. Operators and Expressions, Implicit Type Conversions, The Cast Operator, Control Flow Statements. Introduction to Object-Oriented Programming, Type Casting, Input and output-Scanner and System class-print(), println(), and printf() methods.	15 Hours	1

II	**Classes & Objects:** Creating Classes and objects, Memory allocation for objects, Constructor, Access Modifiers and Access Control, Default, public private protected, **Inheritance**: Implementation of Inheritance, Simple, Multilevel, and Hierarchical. **Polymorphism:** Implementation of Polymorphism, Method Overloading, Method Overriding **Thread:** Threaded programming. Strings: String, String Methods, String Buffer class. Abstract classes and methods. **Package & Interfaces:** Interfaces, Packages, Packages Concept, Creating user defined packages, Java Built in packages, Java.lang, Java.util. **Exception Handling:** Exception types, Using try catch and Multiple catch, Nested try, throw, throws and finally, Creating User defined Exceptions.	15 Hours	1
III	**Data Structure:** Definition & Classification. **Array:** Single and multidimensional array. **Sorting Algorithm:** Insertion, Bubble and Selection. **Searching Algorithm:** Linear & Binary Search. **Stack:** Operations on Stack, array representation, Applications of Stack. **Queue:** Operations on Queue, Circular Queue, Dqueue	15 Hours	1
IV	**Linked List:** Comparison with Array. **Single Linked List:** Structure & Implementations, Traversing, add new node, delete node. Stack with Single Linked List, Queue as Circular Linked List. **Double Linked List.** **Tree & Binary Tree:** Basic Terminology and Properties, Linked representation of Binary Tree. **Tree Traversal:** in order, pre order and post order.	15 Hours	1

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Suggested Readings:

1. E. Balagurusamy, Programming with Java, Tata McGraw Hill.
2. Patrick Naughton and Herbertz Schildt, “Java 2.0: The Complete Reference”, TMH, 1999.
3. Deitel & Deitel, "Java How to program”, Prentice Hall, 4th Edition, 2000.
4. Gary Cornell and Cay S. Horstmann, "Core Java Vol 1 and Vol 2", TMH.
5. Java 6 Programming black books Kogent solutions published by dreamtech press edition 2007
6. Steve Holzner, “Java black book”, Paraglyph Press; Second Edit ion (July 1, 2002)
7. Duncan A Buell, “Data Structures Using Java”, Jones & Bartlett Learning,January 2012
8. Robert Lafore, “Data Structures and Algorithms in Java”, Second Edition, SAMS, Second Edition, 2003.
9. Goodrich, “Data Structures & Algorithms in Java”, Sixth Edition, (January, 2014)

1.

MCA4106: Principles of Management

Course Objective:

1. Principles of management is a comprehensive introductory course on the management process from a manager's perspective, with particular emphasis on the skills, competencies, techniques and knowledge needed to successfully manage an organization.
2. It focuses on the entire organization from both, short and long-term perspective for forming a strategic vision, setting objectives, crafting a strategy and then implementing it.

Learning Outcome: On completion of this course students will be able to:

1. Understand how managers manage business organizations in the dynamic global environment.
2. Comprehend effective management planning and organizing staff.
3. Understand contemporary management concepts and skills and put these concepts and skills into practice.
4. Get an understanding of the basic principles of staffing and leadership.
5. Investigate how organizations develop and maintain competitive advantage within a changing business environment.
6. Appreciate and use of the range of controlling tools available in the management.
7. Reach a systematic understanding of management-related challenges.
8. Apply conceptual tools and techniques in analyzing, evaluating and addressing management issues.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction:** Concept, nature, process and significance of management. Managerial levels, skills, functions and roles. Management Vs. Administration. Coordination as essence of management. Development of management thought: classical, neo-classical, behavioral, systems and contingency approaches.	15 Hours	1
II	**Planning and Organizing I:** Planning: Nature, scope and objectives of planning, Types of plans, Planning process, Business forecasting. MBO: Concept, types, process and techniques of decision-making, Bounded Rationality. Organizing: Concept, nature, process and significance. Principles of an organization Span of Control, Departmentation, Types of an organization. Authority-Responsibility, Delegation and Decentralization, Formal and Informal Organization.	15 Hours	1
III	**Staffing and Motivation:** Staffing: Concept, Nature and Importance of Staffing; Motivating and Leading: Nature and Importance of motivation, Types of motivation, Theories of motivation: Maslow, Herzberg, X, Y and Z. Leadership: meaning and importance, Traits of a leader, Leadership Styles: Likert's Systems of Management, Tannenbaum and Schmidt Model and Managerial Grid.	15 Hours	1
IV	**Controlling:** Nature and Scope of control, Types of Control, Control process, Control techniques: traditional and modern, Effective Control System.	15 Hours	1

Suggested Readings:

1. Stoner, Freeman and Gilbert Jr., Management, Prentice Hall of India, New Delhi, 2003.
2. Gupta, C.B., Management Concepts and Practices, Sultan Chand and Sons, New Delhi, 2003.
3. Koontz. O Donnel and Weirich, Management, Tata McGraw Hill Publishing Company, New Delhi, 2001.

MCA4151: Relational Data Base Management System Lab

Module	Course Topics	Credits
I	1. Use of DDL for creating objects (Table, Database). 2. Use of DML for performing retrieval operations. 3. Use of DCL for specifying constraints and authorities on table. 4. Use of Aggregate functions. 5. Use of String functions. 6. Grouping and Ordering operations on table. 7. Creating and Performing various operations on Views 8. Performing queries for Union, Intersection, Difference, Cartesian Product and Division. 9. Performing queries on varies joins and nested queries 10. Creating Indexes.	1
II	1. Writing Programs in PL/SQL 2. Understanding and Creating Cursors 3. Writing Triggers Program 4. Creating Forms, Reports. 5.Writing Codes for generating read, Write and Update operations in a transactions using different situations.	1

MCA4152: Data Structures using JAVA Programming Lab

Module	Course Topics	Credits
I	1. Implementation of Fundamental Data Types & Testing and Debugging of Programs 2. Implementation of Basic Control Constructs such as loops etc 3. Implementation of classes & objects 4. Implementation of Methods in Java. 5. Implementation of constructors. 6. Implementation of Inheritance 7. Implementation of Polymorphism. 8. Implementation of String Handling. 9. Implementation of Abstract Class, Interfaces & Packages. 10. Implementation of String Handling. 11. Implementation of Input Output Streams. 12. Implementation of Exception Handling. 13. Implementation of Event Handling	1
II	1. Implementation of Arrays (Single & Double Dimension). 2. Implementation of Searching techniques: Linear Search, Binary Search. 3. Array implementation of Stack, Queue, Circular Queue, Linked List. 4. Implementation of Stack, Queue, Circular Queue, Linked List using dynamic memory allocation. 5. Implementation of Binary tree. 6. Implementation of Tree Traversals (preorder, inorder, postorder). 7. Implementation of B-Tree. 8. Implementation of sorting techniques: Bubble sort, Merge sort, Insertion sort, Selection sort, and Quick sort.	1

II Semester

MCA4201: Design and Analysis of Algorithms

Course Objective:

1. To know the importance of studying the complexity of a given algorithm.
2. To study various algorithmic design techniques.
3. To utilize data structures and/or algorithmic design techniques in solving new problems.
4. To know and understand basic computability concepts and the complexity classes P, NP, and NP-Complete.
5. To study some techniques for solving hard problems.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains.
2. Apply the algorithms and design techniques to solve problems.
3. Analyze the complexities of various problems in different domains.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Basic Concepts of Algorithms:** Definitions; Explanation & Scope, Time and Space Complexity; Asymptotic Notations (Growth of Functions); Pseudo Codes & Time Complexity of Basic Control Structures, Recursive Algorithms Complexity	15 Hours	1
II	**Analysis of Data Structures:** Elementary Data Structure; Dictionaries & Hash Tables; Binary Search Tree; AVL Trees; Red Black tree; B-Trees; Binomial Heaps; Fibonacci Heaps; Data Structures for Disjoint Sets; Augmenting Data Structures	15 Hours	1
III	**Advanced Design & Analysis Techniques** **Dynamic Programming:** Assembly Line Scheduling, Matrix Chain Multiplications, Longest Common Subsequence, Optimal Binary Search Tree, Activity Selection Problem, Knapsack Problem; **Greedy Algorithms:** Knapsack Problem, Huffman Codes, An Activity Selection Problem, Task Scheduling Problem; **Back Tracking:** Hamiltonian Circuit Problem; Subset-Sum Problem: N-Queens Problem; **Branch & Bound:** FIFO Branch-and-Bound Algorithm, Knapsack Problem, Assignment Problem, Traveling Salesman Problem; Amortized Analysis.	15 Hours	1
IV	**Analysis of Graph Algorithms:** BFS & DFS; Minimum Spanning Trees: Kruskal & Prim; Single Source Shortest Path: The Bellman-Ford Algorithm, Dijkstra's Algorithm; All Pairs Shortest Path: The Floyd Warshall Algorithm; Maximum Flow: Ford-Fulkerson Method; **NP Completeness:** Polynomial Time, NP-completeness, NP- complete problems; String Matching; Approximation Algorithms; Randomized Algorithms.	15 Hours	1

Suggested Readings:

1. Thomas H. Coremen, “Introduction to Algorithms”, PHI.
2. Horowitz & Sahani, “Fundamental of Algorithms”, Galgotia.
3. Aho, “Design & Analysis of Computer Algorithms”, Pearson.
4. Johnsonbaugh, “Algorithms”, Pearson.
5. Bressard “Fundamental of Algorithm”, PHI.
6. Jon Kleinberg and Eva Tardos “Algorithm Design”, Pearson Education, 2006.

MCA4202: Data Communication and Networks

Course Objective:

1. To study the different aspects of data communication service integrated over the IP networks**,** focusing on protocol design, implementation and performance issues.
2. To debate the current trends and leading research in the **computer networking** area.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Understand concepts data communication and signal transmission.
2. Different networking elements and protocols in each layer of references models gain the knowledge of network deployment.
3. Select the transport protocol appropriate for a given application.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Data Communication and Network Models:** Data and Signals: Analog and Digital, Transmission Digital Signals, Noisy and Noiseless channel, Bandwidth and Throughput, Attenuation and Noise; Digital and Analog Transmission: Transmission modes, PCM, DM, AM, FM, PM; Multiplexing and Spread Spectrum; Guided and Unguided Media; Switching; Modem; ISDN and PSTN; Introduction to Computer Network: Introduction, Application of Network, Types of Network, Network Protocols and Standards, Switched and Broadcast Network; Topology; References Models: OSI Model, TCP/IP Protocol Suite, Example of Networks	15 Hours	1
II	**Data Link Layer and Multiple Access:** Basic Function of Data Link Layer: Fixed and variable size Framing, Flow and Error control, Redundancy, Block Coding, Noisy and Noiseless Channel, HDLC; Multiple Access: ALOHA, CSMA/CD, CSMA/CA, Polling, FDMA, TDMA, CDMA; Wired and Wireless LAN's: IEEE Standards, Standard-Ethernet, Gigabit Ethernet, IEEE 802.11; Intermediary Network Devices; Frame Relay and ATM; Categories of Satellites, SONET/SDH	15 Hours	1

III	**Network Layer:** Basic Function of Network Layer; Logical Addressing: IPv4, IPv6; Address Mapping: ARP, RARP, BOOTP, DHCP; Routing Protocols: Delivery, Forwarding Techniques, Routing Table, Distance Vector Routing, Link State Routing, Path Vector Routing, Multicast Routing, Flooding, Hierarchical Routing; Internetworking: Tunneling, Fragmentation, OSPF, BGP, Mobile IP; Congestion Control: Data Traffic, Network Performance, Congestion Control Mechanism	15 Hours	1
IV	**Transport Layer and User Defined Layer:** Basic Function of Transport Layer; Process-to-Process Delivery: TCP, UDP; QoS; Basic Function of Presentation and Session Layer; Application Layer: Namespace, Domain Namespace, Distribution of Namespace, Resolution, DDNS, TELNET, E-Mail, SMTP, SNMP, POP, IMAP, FTP, WWW and HTTP; Basic Terminology of Cryptography; Security in Internet: IPSec, PGP Algorithms, Packet-filter and Proxy Firewall	15 Hours	1

Suggested Readings:

1. Andrew S Tanenbaum, David. J. Wetherall, “Computer Networks”, Pearson Education, 5th Edition,
2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, Fourth Edition
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, Mc Graw Hill Publisher, 2011
4. Dayanand Ambawade, Dr. Deven shah, Prof. Mahendra Mehra, “Advance Computer Network”, Wiley India.
5. Todd Lammle, “CCNA Intro – Study Guide”, Sybex.

MCA4203: Programming in PYTHON

Course Objectives:

1. Appreciate the basic and advanced features of core language built-ins.
2. Handle and control system/OS level features.
3. Communicate using sockets, write client and server side scripts.
4. Design and implement basic applications with database connectivity.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Acquire programming skills in core Python.
2. Acquire Object Oriented Skills in Python.
3. Develop the skill of designing Graphical user Interfaces in Python
4. Develop the ability to write database applications in Python

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction to Python:** Introduction to python ,History of python, Installing python, Executing python programs, Comments in python, Internal working of python, Python Implementations, Difference between Python2 and Python3, Indentation Python character set, Tokens, **Core Data Types:** Integer, Floating Point Number, Complex Number, Boolean Type, String Type; print(), Assigning values to a variable, Multiple Assignments, input(), eval(), Formatting Number & String, Python inbuilt mathematical function, ord and chr Functions; **Python Operators & Expression:** Types of operators; Operator Precedence & Associativity; **Decision Statement:** if, if-else, nested if, multiway if-elif-else statement, conditional expression; **Loop Control Statement**: while Loop, for loop, range(), Nested Loops, break, continue, pass.	15 Hours	1
II	**Functions:** Syntax, use of function, return statement, parameters & arguments: Required argument, Default argument, Keyword Arguments, Variable length argument; Scope of a variable, Recursive function, Lambda function, Python Modules, Built-in Modules in Python: math, random, time & date module; **String:** str class, index[] operator, Traversing: for & while loop, Immutable strings, string operators: slicing, +, *; String operations: comparison, format(), split(), Built-in method: Testing string, search a substring, convert string from one to another, stripping string, Formatting string;	15 Hours	1

III	**Array:** Creation, array(data_type, value), Adding elements, Accessing elements, Removing elements, Slicing, Searching element, Updating Array; **List:** Creation, list(), Accessing Elements in List, Negative List Indices , List Slicing[start:end], Built-in list class Methods, List operators, List Comprehension, List & Strings, Passing list to a function and returning from a function, Difference between list & array; **List/Array Processing:** Searching: Linear, Binary; Sorting: Selection, Bubble, Insertion, Merge, Quick; **Tuple:** Creation, tuple(), Built-in tuple class methods, Indexing & slicing, Operations on tuple, Variable length tuple to functions, List & Tuple, Sort, Traverse, zip(), Inverse zip(*); **Set**: Creation, set(), set operator, Built-in set class methods, Set operations: union(), intersection(), difference(), symmetric_difference(); **Dictionary**: Creation, dict(), Adding values, Replacing values, Retrieving Values, Formatting, Deleting items, Comparing, Built-in dict class methods, Traversing, Nested Dictionary, Traversing Nested Dictionary, polynomial Dictionary.	15 Hours	1
IV	**File Handling:** Need, Text Files: Open, Read, Write, Append, Close, modes, seek(); Binary Files: Reading, Built-in Functions to to access files and directories; **Object Oriented Programming:** Defining Classes: Adding Attributes, Assigning values to an attribute; Self parameters and adding methods to a class, Displaying class attributes and methods, special class attributes, Accessibility, _init_()(Constructor), _del_()(Destructor), Passing object as a parameter to a method, Class Membership Test, Method overloading, Operator Overloading: Special Methods: Arithmetic Operations, comparing types; Reference Equality and Object Equality, Inbuilt Overloading Methods; Inheritance: Introduction, Types of Inheritance, Object Class, Using super(); Method Overriding.	15 Hours	1

Suggested Readings:

1. Ashok N. Kamthane & Amit A. Kamthane, “Programming and Problem Solving with Python”, McGraw Hill Educations
2. Kenneth A. Lambert, “The Fundamentals of Python: First Programs”, Cengage Learning, ISBN: 978- 1111822705.
3. Jake VanderPlas “Python Data Science Handbook” O’Reilly Publications
4. David Beazley, “Python Essential Reference (4th Edition) “ Addison Wesley

5. Vernon L. Ceder,” The Quick Python Book, Second Edition”, Manning Publications

MCA4204: Web Technologies and Application Development

Course Objective:

1. To focus on the process of Web Development.
2. To build sound concepts of several languages used in Web Technology.
3. To create a dynamic, interactive website quickly, confidently and successfully.

Learning Outcome: Students who have successfully completed this course will have understanding of the following concepts:

1. Gradually build a static website using HTML, DHTML and CSS.
2. Move this skill upward by creating some degree of user interactivity using Javascript,AJAX, Django.
3. Server side data processing by creating PHP scripts and JSP technologies.

Course Contents:

Module	Course Topics	Hours	Credits
I	**HTML, DHTML:** Introduction to HTML5, Introduction to Text Formatting tags; Various types of Lists: Ordered, Unordered, Definition lists; Table tags: Methods to Create Tables ,Attributes of table tag, Col span and Rowspan; block level and inline elements, classes, entities , QR Generator and Validator, Frame tags and its Attributes; Form tag: Creation of Forms, Textbox, Radio Button, Hidden etc; Introduction to DHTML; Document Object Model Style sheets: Need of CSS, Types of Style sheet: Inline, Internal and External.	15 Hours	1
II	**JAVA SCRIPT:** Introduction to JavaScript: Advantages of JavaScript; Basic Programming Techniques: Data Types and Literal, Creating Variables and JavaScript Array; Operators and Expressions in JavaScript; JavaScript Programming Constructs: Conditional Checking, Loops; Functions in JavaScript: Built in Functions and User Defined Functions; Dialog Boxes; JavaScript Document Object Model (DOM): Object hierarchy in DOM, Event Handling; Form Object: Form Object's Methods and Properties, Text Element, Button Element, etc; Other Built in Objects in JavaScript: String, Math and Date Object; Writing Client Side Validations from HTML Form Elements	15 Hours	1

III	**PHP:** Introduction to PHP: Features of PHP, Basics of PHP, Data Types, Variables, Constants, Operators,Arrays; Conditional Statements and Iterations; Functions: User Defined and Built in Functions; Working with String Functions; Working with Forms : Adding elements to a form, Uploading files to the web server using PHP; Debugging and Errors: Types of Errors and Error handling in PHP; Database Connectivity with MySQL	15 Hours	1
IV	**JSP, AJAX:** JSP: JSP Features, Architecture, Life Cycle; JSP Tags; Implicit objects in JSP: Request, Response, Out, Session etc; Using HTML forms with JSP, Accessing form data using JDBC; AJAX: Introduction to AJAX; AJAX Advantages and Disadvantages; Ajax Technologies & Frameworks: HTML, JAVA SCRIPT, DOM, XMLHttpRequest, SOAP, SOA, WSDL.	15 Hours	1

Suggested Readings:

1. Burdman Jessica, "Collaborative Web Development", Addison Wesley. 2002.
2. Bayross Ivan,"HTML, DHTML. JavaScript, and PHP", BPB Publications, 4th Edition,2001.
3. Xavier, C,"Web Technology and Design", New Age International, 2000.
4. Teodoru Gugoiu,"HTML, XHTML, CSS and XML by EXAMPLE" Firewall Media,2009.
5. Achyut S Godbole and Atul Kahate, "Web Technologies", Tata McGraw Hill.
6. James L Mohler and Jon Duff, "Designing interactive web sites", Delmar ThomsonLearning.
7. Nicholas C. Zakas, Jeremy McPeak, Joe Fawcett, "Professional Ajax, 2nd Edition",Wrox.
8. Lynn Beighley & Michael Morrison, "Head First PHP & MySQL, First Edition", O'Reilly.

MCA4205: Software Project Management

Course Objective:

1. To presents a comprehensive introduction to the system analysis and design skill in information management.
2. To provide the students with the skills to identify business problems which may be solved by technology based solutions and develop design which form the basis for implementing systems as well as a strong foundation in systems analysis and design concepts, methodologies, techniques and tools.
3. The Process, presents a variety of different views of software process, considering all important process models and addressing the debate between prescriptive and agile process philosophies
4. Presents analysis and design methods with an emphasis on object-oriented techniques and UML modeling
5. Presents topics that are relevant to those who plan, manage, and control a software development project and consider software process improvement and software engineering trends.

Learning Outcomes On completion of this course students will be able to:

1. Describe the different phases of systems development life cycle.
2. Describe the different fact-finding techniques in system analysis and design.
3. Explain different methodologies of analysis and design of information systems.
4. Manage implementation and maintenance of information systems.
5. Understand and adhere to professional ethical standards in the system development and modification process, especially by accepting responsibility for the consequences of design decisions and design implementations.
6. Have demand for knowledgeable experts in software engineering is steadily increasing, which makes students very competitive nationally as well as internationally, both in industry and in academic research.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Overview of Systems Concepts and System Analysis:** Introduction to System Concept, Characteristics and Elements of the System, Types of Systems and different Levels of Management, Software Development Life Cycle (SDLC); Role and Attributes of System Analyst; Fact Finding Techniques.	15 Hours	1
II	**System Design, Testing and its Implementation:** Systems Design Tools, Functional Decomposition Diagram (FDDs), Context Diagram, Feasibility Study, Conversion, System Testing and different types of testing, Quality Assurance and different levels of Quality Assurance, Criteria for Computer Hardware And Software Selection, Software Maintenance	15 Hours	1

III	**Software Engineering and Modeling Design concepts:** Software Engineering, Software Process, Different types of Process Models, Requirement Engineering, Developing USE CASE, UML models, Requirement Modeling for Web Apps, Object Oriented Design concepts; Design Models: Component Level Design, User Interface Design, Software Reliability, SQA plan, Software Testing Strategies for Object Oriented Software and Web Apps.	15 Hours	1
IV	**Managing Software Projects and Process Improvement:** Object and USE CASE Oriented Metrics, web–apps project metrics, Estimation for Object Oriented Projects, specialized Estimation Techniques, Risk Management; CASE tools, Reengineering, Reverse Engineering, Forward Engineering, The Capability Maturity Model (CMM), Software Engineering trends: Software Trends and Tools related trends.	15 Hours	1

Suggested Readings:

1. Whitten, L. Bentley and K. Dittman, ―Systems Analysis & Design Methods, Fifth Edition, TMH Publications.
2. Elias M. Awad ― Systems Analysis and Design, Galgotia Publications.
3. V. Raja Raman ―Analysis & Design of Information System, PHI Publications.
4. Hussain & Hussain― Information Systems Analysis, Design and Implementation, McGraw Hill Publications
5. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", McGraw Hill Publications.
6. Ian Sommerville, "Software Engineering", Pearson Education Publications.
7. Shari LawrencePfleeger, "Software Engineering Theory and Practices".

MCA4211: Theory of Computation

Course Objective:

1. The primary objective of a Theory of Computation (TOC) is to introduce the fundamental mathematical and computational principles that are the foundation of computer science.
2. A secondary objective is to address students' misconceptions about computer science theory: that it is irrelevant for today's problems.
3. Objective of the course is to prepare students to be either well-rounded practitioners or potential candidates for computer science.

Learning Outcomes: Upon successful completion of this course students should be able to:

1. Understand basic properties of formal languages and formal grammars.
2. Understand basic properties of deterministic and nondeterministic finite automata.
3. Understand the relation between types of languages and types of finite automata.
4. Understand basic properties of Turing machines and computing with Turing machines.
5. Understand the concepts of tractability and decidability.
6. Understand the challenges for Theoretical Computer Science and its contribution to other sciences.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction to Languages & Finite Automata:** Introduction to Alphabets; Strings and Language; Finite Automata: Transition Graph, DFA, NFA, Method of Conversion from NFA to DFA, FA with € -moves, Method of Conversion from NFA with € -moves to NFA, Equivalence of NFA with € -moves to DFA, Minimization of Automata.	15 Hours	1
II	**Regular Expressions & Languages:** Introduction to Regular Expressions; Kleene Closures; Construction of DFA from Regular Expression; Construction of Regular Expression from DFA; Finite Automata with output: Mealy Automation, Moore Automation, Equivalence of Mealy and Moore Automations; Pumping Lemma for Regular Languages; Properties of Regular Languages; Decision Problem of Regular Languages.	15 Hours	1
III	**Non Regular Grammars:** Definition of Grammar; Chomsky's Hierarchy; Sentential Forms; CFG & CFL; CSG; Derivation Tree; Ambiguous Grammar; CNF& GNF; Pumping Lemma for CFL; Properties of CFL; Decision Problem of CFL; Undecided Problems of CFL.	15 Hours	1
IV	**Push Down Automata (PDA) & Turing Machines:** Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, Two stack PDA; Turing Machines: Introduction, Basic Features of Turing Machine, Languages of Turing	15 Hours	1

	Machine, Turing Machine as Acceptor, Computing Devices, Universal Turing Machine, Undecidable problems about Turing Machines; Rice's Theorem.		

Suggested Readings:

1. John E. Hopcroft & Jeffery D. Ullman, "Introduction to Automata Theory, Languages & Computation", Pearson.
2. K L P Mishra & N. Chandra Shekhran, "Theory of Computer Science", PHI 2010.
3. Kamala Krithivasan Rama R., "Introduction to Formal Languages, Automata theory & Computation", Pearson 2010.
4. E.V. Krishnamurthi,"Introductory Theory of Computer Science", East West Press.
5. ZVI Kohavi, "Switching & Finite Automata Theory", TMH.

MCA4212: Data Science with Machine Learning

Course Objective:

1. Learn about the basics of data Science and to understand the various supervised and unsupervised learning techniques.
2. Learn about Classification and clustering process and Data Visualization Techniques.
3. Ability to do regression, correlation and knowledge discovery of the data.
4. Bring together several key technologies used for manipulating, storing, and analyzing big data from advanced analytics perspectives.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Explore the fundamental concepts of data science
2. Understand data analysis techniques for applications handling large data
3. Make data-driven predictions through statistical inference.
4. Basic and advanced analytic methods and an introduction to big data analytics technology and tools.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction To Data Science:** Definition, Concepts Of Data, Data Problems And Solutions, Data Acquisition, Pre-Processing. **Data Visualization:** Design Of Data Collection Formats With Illustration, Principles Of Data Visualization , Visualization Types **Descriptive Statistics:** Qualitative And Quantitative Data, Measure Of Central Tendency, Measure Of Dispersion **Sampling Distribution:** Sample Versus Population, Sample Techniques, Sampling Distributions, Parameter Estimation **Inferential Statistics:** Inferential Statistics Through Hypothesis Tests, Null Hypothesis And Alternative Hypothesis, Sample T-Tests, Z-Test And F-Test	15 Hours	1
II	**Machine Learning in Data Science**: Role of Machine Learning in Data Science, Different Types of Machine Learning Techniques and its Scope in Data Science: Supervised, Unsupervised, Reinforcement and Deep Learning, Importance of Machine Learning in Today's Business, Difference Between Machine Learning Classification and Prediction. **Neural network:** Perceptron, multilayer network, back propagation, introduction to deep neural network	15 Hours	1
III	**Classification:** Naïve Bayes Classifier, SVM for classification, Bagging & Boosting Ensemble Methods and its Impact on Bias and Variance. **Model Development:** Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot,	15 Hours	1

	Polynomial Regression and Pipelines, Measures for In-sample Evaluation – Prediction and Decision Making.		
IV	**Model Evaluation**: Generalization Error, Out-of-Sample Evaluation Metrics, Cross Validation, Overfitting, Under Fitting and Model Selection, Prediction by using Ridge Regression, Testing Multiple Parameters by using Grid Search. Introduction to Big data Analytics.	15 Hours	1

Suggested Readings:

1. David Dietrich, Barry Heller and Beibei Yang, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, EMC Education Services, Reprint 2015, Wiley, ISBN: 9788126556533.
2. Tom White, "Hadoop: The Definitive Guide", 4th Edition, 2015, O'Reilly, ISBN: 9789352130672.
3. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Taylor& Francis Group, Second Edition, 2015, Chapman & Hall / CRC Press, ISBN:9781466583283.

MCA4213: Cloud Computing

Course Objectives:

1. Current cloud computing technologies, including technologies for different cloud services.
2. Large data processing in the cloud
3. Resource management in the cloud
4. Analyze the components of cloud computing showing how business agility in an organization can be created

Learning Outcome

1. Understand the concepts of IAAS, SASS, PAAS
2. Understand the fundamental principles and importance of Virtualization in Distributed Computing
3. Understand the business models that underlie Cloud Computing.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction to Cloud Computing & Principles of Parallel and Distributed Computing:** The vision of Cloud Computing; Cloud Computing Reference Model; Characteristics and benefits; Challenges ahead; Historical developments: Distributed Systems, Virtualization; Building Cloud Computing Environments: Application Development, Infrastructure and System Development; Computing Platforms and Technologies; Parallel vs. Distributed computing: Elements of Parallel Computing, Hardware architectures for Parallel Processing, Approaches to Parallel Programming, Laws of caution.	15 Hours	1
II	**Cloud Computing Architecture & Virtualization:** Introduction: The Cloud Reference Model; Types of Clouds; Economics of the Cloud; Virtualization: Characteristics of Virtualized environments, Taxonomy of Virtualization Techniques; Virtualization and Cloud Computing; Pros and Cons of Virtualization; Technology example: VMware: full Virtualization, Microsoft Hyper-V.	15 Hours	1
III	**Cloud platforms, Technologies and Data in the Cloud:** Cloud Computing Economics: **C**loud Infrastructure; Economics of private clouds, Software productivity in the Cloud, Economies of scale: public vs. private clouds; Multi-software: Multi-entity support, Multi-schema approach, Multi-tenancy using cloud data stores, Data access control for enterprise applications; Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase, Cloud data stores: Datastore and SimpleDB.	15 Hours	1

IV	**Cloud Platforms in Industry & Cloud Applications:** Amazon web services: Compute services, Storage services - Communication services, Additional services; Google AppEngine: Architecture and Core Concepts, Application life cycle, Cost model, Observations; Microsoft Azure: Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance; Cloud Applications: Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Gene Expression Data Analysis for Cancer Diagnosis, Geoscience: Satellite Image Processing.	15 Hours	1

Suggested Readings:

1. Rajkumar Buyya, Christian Vecchiola and S. Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill Education Publication (TMH Publication)
2. Gautam Shroff, "Enterprise Cloud Computing: Technology, Architecture, Applications", Cambridge University Press, 2010.
3. Anthony T.Velte, Toby J.Velte, Robert Elsenpeter "Cloud Computing, A Practical Approach", Tata McGraw Hill Education Publication (TMH Publication), 2009
4. Michael J.Kavis, "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", John Wiley & Sons Inc., Jan 2014.

MCA4251: Programming in PYTHON Lab

Module	Course Topics	Credits
I	1. Installing and configuring Anaconda on windows, linux or mac. 2. Introduction to Jupyter lab, Variables, keywords , basics operation in python, Taking input in jupyter , console Taking multiple inputs from user in Python operators implementation 3. Python Input Methods for Competitive Programming, Python Output using print() function Python end parameter in print(), if, else, if elif ladder implementation 4. Special keyword - in and is, for loop, range function, and examples use of enumerate, zip function in loops else with for. 5. Using strings in python, single quoted/double quoted/triple quoted Strings, string functions - split, trim, join, format, replace, count, find, index, rjust, ljust, center, upper, lower 6. Practical implementation of Array, creation and traversal, adding, removing, accessing, updating elements 7. Practical implementation of list, creation and traversal, list functions: append, insert, extend, remove, pop, clear, sort, count, index, copy	1
II	1. Practical implementation of tuples, creation and traversal, Practical implementation of Set, creation and traversal, set functions - add, update, remove, clear, pop, union, intersection, difference, disjoint, subset, superset 2. Practical implementation of Dict, creation and traversal, dictionary function - get, update, keys, items, values. 3. creating functions in jupyter calling function, argument based functions, different type of style for passing parameter in python 4. Making module for functions, and importing them different types of imports in python, random and math module OS module for file and folder operation, file handing in python 5. Creating classes, Creating objects, implementing function calls, constructor, and self-keyword implementation, super method 6. Practical implementation on Inbuilt overloading Methods. 7. Practical implementation of inheritance and Method Overriding	1

MCA4252: Web Technology and Application Development Lab

Module	Course Topics	Credits
I	1. Implementation of List Tags in HTML. 2. Implementation of Table Tag in HTML. 3. Implementation of Frameset Tag in HTML. 4. Implementation of different Form Tags in HTML. 5. Implementation of Cascading Style Sheet in Web Pages. 6. Implementation of control structure in Java Script. 7. Implementation of Looping structure in Java Script 8. Implementation of form validate in Java Script.	1
II	1. Implementation of Request Object in JSP. 2. Implementation of mathematical functions in JSP. 3. Implementation of arrays in JSP. 4. Implementation of Session Object in JSP. 5. Implementation of Database Connectivity in JSP. 6. Implementation of looping structure in PHP 7. Implementation of functions in PHP 8. Implementation of string functions in PHP 9. Implementation of database connectivity using MySql. 10. Using LAMP Stack for web applications 11. Using Tomcat Server for Servlets and JSPs 12. Writing simple applications with Technologies like HTML, Javascript, AJAX, PHP, Servlets and JSPs	1

III Semester

MCA4301: .NET Framework & C#

Course Objective:

1. To present the fundamental concepts of Windows Desktop and Website development through Microsoft Technologies.
2. To impart solid foundation and develop the skill of Web Development through C# Programming.
3. To develop the concepts of static and dynamic Web Pages and make the students familiar with Client Server Technology, Distributed Applications and Web Services.

Learning Outcome: Students who have successfully completed this course will have full understanding of the following concepts:

1. Develop the understanding of .Net technology.
2. Develop the skills in ASP.NET with C# Programming.
3. Understand the Microsoft Database Connectivity.
4. Will be able to understand the Static and Dynamic web pages.
5. Will be able to understand about Distributed applications.
6. Will be able to develop a light to medium weight website.

Course Contents:

Module	Course Topics	Hours	Credits
I	**.Net Framework:** Introduction and Origin of .Net technology; Framework Components, Common Language Runtime(CLR) and FCL; Managed and Unmanaged Code; Common Type System(CTS) & Common Language Specification (CLS);Microsoft Intermediate Language (MSIL) and Metadata; Just-In-Time Compilation (JIT); Garbage Collection; Base Classes and Ms.Net Namespaces. **C# Basics:** Introduction and Evolution of C#; Types, Identifiers, Variables, Constants, Literals; Type Conversion and Casting; Operators; Checked, Unchecked Block and Overflow Checks; Data Structures in C#: Enum, Arrays, Array List, Strings; Control Statements and Looping: If Statement, Switch Statement, For Loop, While Loop, Do While Loop, For each Loop.	15 Hours	1
II	**Object and Classes:** Properties (Read, Write), Indexers, Inheritance (Multilevel and Hierarchical), Polymorphism (Operational and Inclusion), Operator Overloading, Interfaces, Delegates and Events, Boxing and Unboxing. **C# Libraries and Assemblies:** Input output (Streams Classes); Multithreading; Networking and Sockets; Managing Console I/O Operations; .NET Assemblies: Type of Assemblies, GAC (Global Assembly Cache), Concept of Strong Names, Global ASAX Files; Caching Concepts: Page Output Caching, Page	15 Hours	1

	Fragment Caching; State management: Session Object, Hidden Fields, View State, Cookies, Cross page posting; Introduction to Generics; Web Configuration and Machine Configuration Files.		
III	**Windows and Website Development:** Windows Forms (A Skeletal Form Based Windows Program, Handling Messages, Adding a Menu and introduction and usage of various Windows Form Controls); Remoting (Server Activated Object, Client Activated Object; Marshalling: Marshal by value, Marshal by reference);Debugging, Exceptions and Error Handling; ASP.NET Web Form Controls: User controls and Server Controls; Web Services: UDDI, DISCO, WSDL; ADO.NET: Architecture, Difference between Dataset and Data Reader, Connection and Command Object; Distributed applications; Reflection; Globalization and Localization; Authentication and Authorizations; XML in .NET .	15 Hours	1
IV	**Advanced Concepts:** Windows Presentation Foundation: Introduction, create WPF application, Windows Client .NET, WPF programming model features (XAML, Layout, Dependency Properties, Styling and Templating), WPF Features (Controls, Data Binding, Input, Graphics and Multimedia, Security) **Windows Communication Foundation**: Framework, WCF Address, WCF Binding,WSHttp Binding, Basic Http Binding, WCF Using NetTcpBinding, MSMQ In WCF, Contracts in WCF Service (Service contracts,Data Contracts,Message contracts,Fault Contract,Operation Contract), WCF - Hosting WCF Service, Broadcasting in WCF, WCF Messaging Layer, WCF Data Services, WCF Test Client Tool, WCF Configuration editor tool, WCF svcutil tool; WF: Introduction, Choosing right WF Tool, WF4, Binding first WF; Ajax Controls: AJAX and need for AJAX, Implement with JavaScript, ASP.NET AJAX – Update Panel, Update Progress etc., ASP.NET Ajax Control toolkit, Client side Template Rendering – Data View control.	15 Hours	1

Suggested Readings:

1. Balagurusamy ―Programming .with c# ―, Tata McGraw Hill Publication.
2. ASP.NET 3.0 Black Book II, Dreamtech Press.
3. Beginning ASP.NET3.0 II, WROX Publication.
4. Stephen C. Perry, Atul Kahae, Stephen Walther, Joseph Mayo, ―Essential of .NET and Related Technologies with a focus on C#, XML, ASP.net and ADO.net‖, Pearson, 2nd Edition, 2009.

MCA4302: Mobile Application Development and OSS

Course Objective:

1. To provide a basic idea of Open source technology, their software development process so as to understand the role and future of open source software in the industry along with the impact of legal, economic and social issues for such software.
2. Become familiar with and become adapt using the tools of open source development, for example: distributed revision control; documentation tools; automated build and test systems; debuggers; source code utilities; tracking systems; on-line resources.
3. To introduce the capabilities and limitations of mobile platforms that affect application development and deployment also to familiarize with the technology and business trends that mobile application development
4. The techniques for deploying and testing mobile applications, and for enhancing their performance and scalability

Learning Outcome: Students who have successfully completed this course will have understanding of the following concepts:

1. Students will understand concepts, and methodologies related to open source software development.
2. Understand the business, economy, societal and intellectual property issues of open source software. Be familiar with open source software products and development tools currently available on the market and able to utilize open source software for developing a variety of software applications, particularly Web applications.
3. Students will be able to Model and manage mobile application development using a range of methods.
4. Designing and develop mobile applications using a chosen application development framework also able to develop enterprise-level mobile solutions.

Course Content:

Module	Course Topics	Hours	Credits
I	**Introduction to Open Source System :** Introduction to Open sources, Open Source vs. Commercial Software, Open Source Principles, Free Software Vs Open Source Software, Understand the need, advantages and disadvantages of Open Source software, and Applications of Open Source system, Examples of Open source Softwares **Introduction to IOT:** Understanding IoT fundamentals, Components of IoT, IoT Functional Blocks, Physical design of IoT, Logical design of IoT. IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views; Various Platforms for IoT , Real time Examples of IoT , IoT Communication Technologies	15 Hours	1

	, IoT Issues , Challenges in IOT implementation.IOT Applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. **Open Source Operating Systems:** Examples of Open source Softwares. **Open Source Database:** MySQL: Introduction, Setting up Account, Starting, Terminating and Writing your own SQL Programs, Record Selection Technology, Working with Strings, Date and Time, SortingQuery Results, Generating Summary, Working with Metadata, Using Sequences, MySQL and Web.		
II	**Open Source Programming Languages:** PHP: Introduction, Programming in Web Environment, Variables, Constants, Data Types, Operators, Statements, Functions, Arrays, OOP, String Manipulation and Regular Expression, File Handling and Data Storage, PHP and SQL Data Base, PHP and LDAP, PHP Connectivity, Sending and Receiving E-mails, Debugging and Error Handling, Security, Templates. **Open Source Tools & Technologies:** Web Server: Apache Web server, working with Web Server, Configuring and Using apache web services, WAMP(Windows, Apache, MySQL, PHP) Server, Model Driven Architecture(MDA): Introduction to MDA, Genesis of MDA, Meta Object Facility, UML, UML Profiles, and MDA Applications.	15 Hours	1
III	**Introduction to Android:** The Android Platform, Android SDK, Eclipse Installation, Android Installation, Android version: Platform version: Android 10.0, 5.0 Lollipop, 4.4 Kit-Kat, Android platform tools, adb (android debug bridge), Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file. Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions. **Android User Interface Design Essentials:** User Interface Screen elements, Designing User Interfaces with Layouts Manager: Relative layout, Linear layout, Android Menu: Option Menu, Context Menu,	15 Hours	1

	Popup Menu; Adaptor: Array, Array list, Base adaptor; Views: Grid view, Web view, Scroll view, Search view, Table view, Dynamic view, Drawing and Working with Animation.		
IV	**Operations on Android Applications:** Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources. **Using Common Android APIs:** Using Android Data and Storage APIs, Managing data using Sqlite, Android service: API, Android started service, Android bound service, **Sharing Data between Applications with Content Providers:** Understanding content URI, Content Resolver, Sharing Information from custom content provider, Contact content provider, Other built-in content Provider, Creating custom content provider, Understanding content URI, Content Resolver, Sharing Information from custom content provider; Data Storage: Shared preferences, Internal storage, External storage; Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Packaging and Deploying Android Application to the World, Security and .	15 Hours	1

Suggested Readings:

1. Pradeep Kothari, "Android Application Development (With KitKat support)" Black Book, Dreamtech Press
2. Barry Burd, "Android Application Development (All-In-One for Dummies)", Second Edition, John Wiley & Sons
3. James Lee, Brent Ware, "Open Source Web Development with LAMP", Pearson Education.
4. Fadi P. Deek, James A. M. McHugh, "Open Source, Technology and Policy", Cambridge University Press.
5. Kailash Vadera, Bhavyesh Gandhi, "Open Source Technology", University Science Press.
6. Karl Fogel, "Producing Open Source Software".
7. Remy Card, Eric Dumas and Frank Mevel, "The Linux Kernel Book", Wiley Publications, 2003.
8. Steve Suchring, "MySQL Bible", John Wiley, 2002. 7. Rasmus Lerdorf and Levin Tatroe, "Programming PHP", O'Reilly, 2002.
9. Wesley J. Chun, "Core Python Programming", Prentice Hall, 2001.
10. Peter Wainwright, "Professional Apache", Wrox Press, 2002.

11. Stephen J. Mellor, Marc Balces, “Executable UMS: A foundation for MDA”, Addison Wesley, 2002

MCA4303: Data Security and Cryptography

Course Objective:

1. To have a fundamental understanding of the objectives of cryptography and network security.
2. To become familiar with the cryptographic techniques that provides information and network security.
3. To impart knowledge on Encryption techniques, Design Principles and Modes of operation.
4. To analyze a given system with respect to security of the system.
5. To create an understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions works.
6. To examine the issues and structure of Authentication Service and Electronic Mail Security.
7. To provide familiarity in Intrusion detection and Firewall Design Principles.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Describe computer and network security fundamental concepts and principles.
2. Identify and assess different types of threats, malware, spyware, viruses, vulnerabilities, and today's attacks.
3. Describe the inner-workings of today's remote exploitation and penetration techniques.
4. Describe the inner-workings of popular encryption algorithms, digital signatures, certificates, anti-cracking techniques, and copy-right protections.
5. Demonstrate the ability to select among available network security technology and protocols such as IDS, IPS, firewalls, SSL, SSH, IPSec, TLS, VPNs, etc.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction:** Introduction to security attacks, Security Services, Symmetric **Cipher model**: Cryptography, Cryptanalysis, Plain Text, Cipher Text, Encryption, Decryption, Secret Key; **Substitution Techniques**: Caesar Cipher, Monoalphabetic Cipher, Playfair, Hill Cipher, Polyalphabetic Cipher, One Time Paid; Transposition Technique; Steganography	15 Hours	1
II	**Block Ciphers:** Theory of block cipher design: Feistel Cipher Network Structures, DES; Multiple Encryption and Triple DES: Double DES, Triple DES; Bloc k Cipher Modes of Operation: ECB, CBC, OFB, CFB; **Modern Symmetric Encryption Algorithms**: IDEA Public Key Cryptosystem; Principles of Public Key Cryptosystem; Applications for Public- key Cryptosystem; Requirements for Public- key Cryptosystem; Public- key Cryptanalysis; The RSA Algorithm; Security of RSA.	15 Hours	1

III	**Key management**: Diffie-Hellman Key Exchange Algorithms; Hashes and Message Digests; Message Authentication: MD5, SHA-01; Digital Signatures; User Authentication; Digital Signature Standard (DSS and DSA); Digital Certificates: Public key Infrastructure, Private Key Management; Authentication of Systems: Kerberos V4, X.509	15 Hours	1
IV	**Network Security:** Email Security: PGP (Pretty Good Privacy), S/MIME, IP; Web Security, IPSec; Virtual Private Networks; Secure Sockets and Transport Layer (SSL and TLS); Firewalls; Trusted Systems; Electronic Commerce Security: Secure Electronic Transaction (SET), Electronic Money Security.	15 Hours	1

Suggested Readings:

1. William Stallings, "Cryptography and Network Security- Principles and Practices", Prentice Hall of India, Third Edition, 2003
2. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.
3. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.
4. Charles B. Pfleeger, Shari L. Pfleeger, "Security in Computing", Third Edition, Pearson Education, 2003.
5. Christos Douligeris, Dimitrios N. Serpanos, "Network Security : Current Status and Future Directions", Wiley –IEEE Press, 2007
6. Charles P. Pfleeger, Shari Lawrence Pfleger, "Security in Computing", Prentice Hall, 3rd Edition, 2003.

MCA4304: Data Mining and BigData

Course Objective:

1. To introduce the basic concepts and functionalists of data mining
2. Learn various classification and clustering techniques
3. To provide an overview of an exciting growing field of big data and also study the basic technologies that forms the foundations of big data.
4. To understand the specialized aspects of big data
5. Learning how to gather and analyze large sets of data to gain useful business understanding.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Understand the fundamental concepts of data mining and big data
2. Understand techniques for handling large data
3. Identify business applications of data mining and big data
4. Understand the key issues in big data management and its associated applications in strategic decision making

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction to Data Mining :** Overview of data mining, Related technologies - Machine learning, DBMS, OLAP, Statistics, Data mining goals, data mining functionalities **Data Preprocessing:** Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies **Data Mining Knowledge Representation:** Task relevant data, Background knowledge, Interestingness measures, Representing input data and output knowledge, Visualization techniques **Introduction of Data Warehouse**: Overview, Data warehousing components, Building a data warehouse, Architecture	15 Hours	1
II	**Classification Techniques:** classification of Decision Tree Induction, Naive bayes method, Rule-based classification, Nearest neighbor classification, Neural network classification **Clustering Techniques:** Types of data in cluster analysis, Methods: Partitioning methods (k-Means and k-Medoids), Hierarchical Methods (Agglomerative and Divisive Hierarchical clustering, BIRCH, ROCK, Chameleon), Density-Based methods (DBSCAN, OPTICS, DENCLUE), Grid-based methods (STING, Wave Cluster), Model-based clustering methods (Expectation-Maximization, Conceptual clustering, Neural Network approach)	15 Hours	1
III	**Introduction To Big Data**: Evolution of big data, Best practices for big data analytics, Big data characteristics, characteristics of big data applications, Basic overview of big	15 Hours	1

	data storage and Querying/Analysis: Apache Hadoop, Microsoft HDInsight, NoSQL, Hive, Sqoop, PolyBase, Big data in EXCEL, Presto		
IV	**Hadoop**: Analyzing data with Hadoop, Scaling out, Hadoop streaming, Hadoop pipes, concept of Hadoop distributed file system (HDFS), Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Hadoop Processing: MapReduce Framework, Hadoop YARN, Hadoop Common	15 Hours	1

Suggested Readings:

1. Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques” Second Edition
2. Margaret H. Dunham, S. Sridhar,”Data Mining: Introductory and Advanced Topics” Pearson Education
3. Pieter Adriaans, Dolf Zantinge, “Data-Mining”, Pearson Education
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013
5. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.

MCA4305: Computer Based Numerical and Statistical Techniques

Course Objective:

1. To implement computational problems on machine.
2. To offer sound knowledge on statistical tools.
3. To compute the relevant statistical measures for different types of data.
4. To analyze the statistical data based on experiments.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. To apply statistical distributions for real life problems.
2. To draw valid inferences based on the analysis of statistical data.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Errors and Floating Point Numbers:** Errors in numerical computation: Sources of Errors, Types of Errors, Representation of Floating point numbers: Arithmetic operations on Floating Point numbers, Normalization of Floating Point numbers, Pitfalls of Floating Point Representation. **Solution of Non Linear equations:** Zero's of Single transcendental equations and zero's of polynomial: Bisection Method, Iteration or Successive Approximation Method, Regula-Falsi or False Position Method, Newton Rapson Method, Secant Method, Rate of Convergence of iterative Methods.	15 Hours	1
II	**Solutions of Simultaneous Linear equations:** Solution of System of Linear equation using Direct Method and pivoting: Gauss Elimination Method, Gauss Jordan Method, Matrix Invasion Method, ILL Conditioned System of Equations; Solution of System of Linear equation using Iterative Method: Gauss Jacobi iterative method, Gauss Seidel iterative method. **Interpolation and Approximations:** Finite Difference; Difference Tables; Polynomial Interpolation for equal intervals: Newton's Forward and Backward, Central Difference Formulas: Gauss Forward and Backward Formulas, Stir ling's and Bessel's Formula	15 Hours	1
III	**Interpolation and Approximations:** Polynomial Interpolation for Unequal intervals: Lagrange's Interpolation Formula, Newton divided difference Formula. **Numerical Differentiation and Integration:** Numerical Differentiation of Polynomial Interpolation: Newton's Formulae, Central Difference Formulae; Numerical Integration: Trapezoidal Rule, Simpson's Rule, Boole's and Weddle's Rule.	15 Hours	1
IV	**Solution of Ordinary Differential Equation:** Introduction and Methods of Ordinary Differential Equation**:** Picard's Method,	15 Hours	1

	Euler's Method, Runge-kutta Method, Predictor Corrector Method. **Curve Fitting:** Curve Fitting Method of Least Squares: Fitting of Straight Line, Fitting of Polynomial, Fitting of Exponential Curves; Cubic spline and approximations. **Time Series and Forecasting:** Introduction of Time Series; Methods of Measurement: Semi Averages, Moving Averages, Least Square Method; Models of Components of Time Series. **Statistical Quality Control Methods:** Types of Control Charts: X-Bar Chart, R Chart, C-Chart; Advantages and Limitations of SQC		

Suggested Readings:

1. Shastri S.S., "Numerical Analysis", PHI.
2. Balaguruswami E, "Numerical Methods", TMH Publications.
3. Gupta S.P., "Statistical Methods", Sultan and Sons.
4. Rajaraman V., "Computer Oriented Numerical Methods", PHI.
5. Francis Scheld, "Numerical Analysis", TMH.
6. Kandasamy P. "Numerical Methods", S. Chand Publications.
7. Curtis F. Gerald and Patrick O. Wheatley "Applied Numerical Analysis", Prentice Hall.
8. D. Kincaid and W. Cheney "Numerical Analysis", Thomson/Brooks-Cole, 2002

MCA4311: Pattern Recognition

Course Objective:

1. To understand basic, as well as advanced techniques of pattern classification
2. Statistical, nonparametric and neural network techniques for pattern recognition have been discussed.
3. Finding and understanding **patterns** is crucial to mathematical thinking and problem-solving.

Learning Outcome: On completion of this course students will be able to:

1. Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.
2. Apply pattern recognition techniques to real-world problems such as document analysis and recognition.
3. Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.

Course Contents:

Module	Course Topics	Hours	Credits
I	Introduction: Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches. **Probability:** independence of events, conditional and joint probability, Bayes theorem. **Linear Algebra**: Inner product, outer product, inverses, Eigen values, Eigen vectors, singular values, singular vectors. **Bayes Decision Theory**: Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Normal density and discriminant functions. Discrete features.	15 Hours	1
II	**Parameter Estimation Methods**: Maximum - Likelihood Estimation: Gaussian case. Maximum a posteriori estimation. Bayesian estimation: Gaussian case. Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models, Expectation-Maximization method for parameter estimation. Maximum entropy estimation. Sequential Pattern Recognition. Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs. Nonparametric techniques for density estimation, Parzen - window method. K-Nearest neighbor method.	15 Hours	1
III	**Dimensionality reduction**: Principal component analysis, Fisher discriminant analysis. Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Dictionary learning method - Total variability space and Non negative matrix factorization. **Linear Discriminant Functions**: Gradient descent procedures, Perceptron, Support vector machines - a brief introduction.	15 Hours	1

IV	A**rtificial neural networks**: Multilayer Perceptron – Feed Forward neural network. A brief introduction to deep neural networks, Convolution neural networks, recurrent neural networks. **Non-metric methods for pattern classification**: Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART).	15 Hours	1

Suggested Readings:

1. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", 2nd Edition, John Wiley, 2006.
2. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2009.
3. S. Theodoridis and K. Koutroumbas, "Pattern Recognition", 4th Edition, Academic Press, 2009.

MCA4312: Artificial Intelligence

Course Objective:

1. To introduce the fundamental concepts of artificial intelligence.
2. To equip students with the knowledge and skills in logic programming using Prolog.
3. To explore the different paradigms in knowledge representation and reasoning.
4. To understand the contemporary techniques in machine learning.
5. To evaluate the effectiveness of hybridization of different artificial intelligence techniques.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Understand the history, development and various applications of artificial intelligence.
2. Familiarize with propositional and predicate logic and their roles in logic programming.
3. Learn the knowledge representation and reasoning techniques in rule-based systems, case- based systems, and model-based systems.
4. Appreciate how uncertainty is being tackled in the knowledge representation and Reasoning, process, in particular, techniques based on probability theory and possibility theory (fuzzy logic).
5. Master the skills and techniques in machine learning, such as decision tree induction, artificial neural networks, and genetic algorithm.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Scope of AI:** Games, Theorem Proving, Natural Language Processing, Vision And Speech Processing, Robotics, Expert Systems; General Issues and Overview of AI; AI Techniques; AI Problems; **Intelligent Agents:** Definitions of a Rational Agent, Reflex, Model-Based, Goal-Based and Utility-Based Agents, The Environment In Which A Particular Agent Operates; **Problem Solving**: State Space Search, Production Systems, Search Space Control; **Uninformed Search:** Depth-First, Breadth-first search.	15 Hours	1
II	**Informed /Heuristic Search:** Hill Climbing, Best-First Search, A*, AO* Search, Branch And Bound; Problem Reduction; Constraint Satisfaction End; Means-End Analysis; **Knowledge Representation**: Predicate Logic, Unification, Modus Ponens, Backward Chaining, Declarative And Procedural Representation, Rule Based Systems	15 Hours	1
III	**Structured Knowledge Representation:** Semantic Nets, Slots, Exceptions And Default Frames, Conceptual Dependency, Scripts; **Game Playing:** Game Tree, Mini Max Algorithm, Alpha Beta Cutoff, Modified Mini Max Algorithm; Natural	15 Hours	1

	Languages and NLP: Syntactic Processing, Parsing Techniques, Semantic Analysis, Case Grammar, Augmented Transition; **Handling Inconsistent And Incomplete Knowledge:** Truth Maintenance Systems, Reasoning Techniques, Concept of Uncertainty, Bayes' Theorem, Certainty Factors And Rule- Based Systems, Bayesian Networks, Dempster - Shafter Theory, Fuzzy Logic.		
IV	**Learning**: Concept of Learning, Learning Automation, Rote Learning; Genetic Algorithm; Learning by Inductions; Artificial Neural Nets; Expert Systems: Need and Justification for Expert Systems, Knowledge Acquisition; AI: Present and Future; Case Studies: Mycin, Black Board System.	15 Hours	1

Suggested Readings:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach" (2nd ed.), Pearson Education, 2005.
2. Elaine Rich and Kelvin Knight, "Artificial Intelligence", Tata McGraw Hill, 2002.
3. Eugene Charniak and Drew McDermott, "Introduction to Artificial Intelligence", Pearson Education, 2009.
4. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Prentice Hall of India, 2006.
5. George F. Luger, "Artificial Intelligence-Structures and Strategies For Complex Problem Solving", Pearson Education, 5th Edition, 2010.

MCA4313: Mobile Communication System

Course Objective:

1. To explain and extend the concepts of networking and communication through wireless mode.
2. To develop an understanding of the various wireless communication systems for mobility.
3. To develop an understanding of various functional and design issues involved in Cellular Mobile Communication System

Learning Outcome: Students after successfully completing this course shall be able to:

1. Appreciate the distinctions of Wireless Communication from their wired counterparts.
2. Understand the working of various Wireless Mobile Communication Systems and the associated protocols and standards.
3. Theoretically design the Wireless Communication Networks for LANs, Voice & Data Services using Cellular as well as Satellite Communication Systems.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Introduction to Wireless Communication:** Introduction to Wireless Communication, Introduction Radio Frequency spectrum. Wireless Signal propagation and Propagation Modes, Wireless Antennas, Line-of-Sight Transmission, Characteristics and Impairments. Trend in cellular Radio and Personal Communication.	15 Hours	1
II	**Introduction to Cellular concept:** Evolution of Mobile Communication system, its Generations. Introduction and Cellular concept- System Design and Fundamental. Frequency Reuse, Channel Assignment, Handoff strategies, Interference and system capacity. Improving the Coverage and Capacity.	15 Hours	1
III	**Multiple Access Techniques for Wireless Communication:** Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum Multiple Access, WCDMA and LTE. Introduction to 4G, its evolution and History, 4G Application & Advantages, 4G Technologies: Mobile WiMax (IEEE 802.16e).	15 Hours	1
IV	**Wireless Standards:** AMPS and ETACS, IS-54 and IS-136, GSM, CDMA (IS-95) DECT, PACS. Principal Working Concepts; Fifth Generation of Cellular Mobile Communication System (5G): Next Generation Mobile Network Alliance, Projected Specifications of 5G, State-of-art of 5G developments	15 Hours	1

Suggested Readings:

1. Theodore S. Rappaport, “Wireless Communication Principles and Practice” Second Edition, Person.
2. Gottapu Sasibhushana Rao, “Mobile Cellular Communications”, Pearson Education, I Edition, 2009
3. William Stallings, “Wireless Communication and Networks”, Pearson Education, I Edition, 2009
4. Jochen Schiller, “Mobile Communications”, Pearson Education, 2003
5. William C. Y. Lee, “Mobile Cellular Telecommunications”, Tata Mc.Graw Hill, II Edition

MCA4314: Distributed Systems

Course Objective:

1. To explain fundamental principles and models underlying the Distributed Systems.
2. To develop an understanding of the various practical-system like problems e.g. Global
   State and Time, Mutual Exclusion, Deadlock Detection, Failure Recovery, Authentication etc.
3. To expose the students to the emerging topics like Distributed System Security, Peer to-Peer Computing etc.

Learning Outcome: Students after successfully completing this course shall be able to

1. Identify various design and operational issues of Distributed Systems like Concept of Distributed Object, Indirect Inter-process Communication in Distributed System; Logical Clocks, Global State and Message Ordering, Coordination and Agreement; Distributed Deadlock, Transaction & Concurrency Control, Replication; System Services like Security, Distributed File System, Naming Services & Directory Services etc.
2. Understand the working of various Algorithms required in modeling various functional aspects and designing the distributed systems.
3. Use the acquired skill to understand as well as design and develop distributed system application at the level of concept.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Characterization of Distributed Systems:** Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. **Theoretical Foundation for Distributed System:** Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks. **Concepts in Message Passing Systems:** causal order, total order, total causal order, Techniques for Message Ordering, Causal ordering of messages, global state, and termination detection.	15 Hours	1

II	**Distributed Mutual Exclusion:** Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non-token based algorithms, performance metric for distributed mutual exclusion algorithms. **Distributed Deadlock Detection:** system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms.	15 Hours	1
III	**Agreement Protocols**: Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system. **Distributed Resource Management:** Issues in distributed File Systems, Mechanism for building distributed file systems, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory.	15 Hours	1
IV	**Failure Recovery in Distributed Systems:** Concepts in Backward and Forward recovery, Recovery in Concurrent systems, Obtaining consistent Checkpoints, Recovery in Distributed Database Systems. Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols. **Transactions and Concurrency Control:** Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, comparison of methods for concurrency control. **Distributed Transactions:** Flat and nested distributed transactions, Atomic commit protocols, concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault – tolerant services, highly available services, Transactions with replicated data.	15 Hours	1

Suggested Readings:

1. Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill
2. Ramakrishna, Gehrke," Database Management Systems", McGraw Hill
3. Vijay K. Garg Elements of Distributed Computing , Wiley

4. Coulouris, Dollimore, Kindberg, “Distributed System: Concepts and Design”, Pearson Education
5. Tenanuanbaum, Steen,” Distributed Systems”, PHI

MCA4351:.NET Framework & C# Lab

Module	Course Topics	Credits
I	1. Implementation of Decision Making and Branching Statements. 2. Implementation Iterative Statements on Console Applications. 3. Implementation of Enum and Structures on console Applications. 4. Implementation of Arrays and ArrayList on Console Applications. 5. Implementation of Boxing and UnBoxing on Console Applications. 6. Implementation of Strings on Console Applications. 7. Implementation of Inheritance and Polymorphism. 8. Implementation of Interfaces on Console Applications. 9. Implementation of Events on Console Applications. 10. Implementation of Properties and Indexers on Console Applications. 11. Construct the C# application to implement the Operator Overloading. 12. Implementation of Delegates on Console Applications. 13. Implementation of Multithreading in C# 14. Implementation of private assemblies in .NET Applications. 15. Implementation of shared assemblies in .NET Applications. 16. Implementation of Server Side Controls in asp.net. 17. Implementation of Database Connectivity in asp.Net 18. Implementation of various Data Rendering Controls in asp.Net.	1
II	1. Write a program for Arithmetic Calculator using Windows Application. 2. Implement Windows Form based application using controls like menus, dialog and tool tip, dropdown, radio and selection button etc. 3. Implement Overloading and Overriding, constructor and Destructor. 4. Write a program for events and Delegates. 5. Implement concepts of Inheritance in c#. 6. Implementation of Web Services in asp.Net Application. 7. Implementation of Remoting in asp.Net Application. 8. Implementing connected and disconnected Architecture of ADO.NET with Windows application. 9. Implementing connected and disconnected Architecture of ADO.NET with Web Application. 10. Implementation of validation controls in Web Application. 11. Implement web application using ASP.NET with Web Controls. 12. Implement the concept of state management in a Web Application. 13. Implementation of web services in ASP.NET. 14. Create the simple application to demonstrate the WPF concept. 15. Create the simple application to demonstrate the WCF concept. 16. Create the simple application to demonstrate the WF concept. 17. Create the simple to demonstrate the AJAX concept using AJAX toolkit.	1

MCA4352: Mobile Application Development and OSS Lab

Module	Course Topics	Credits
I	1. Creating a Database Using MySql 2. Working on String using MySql. 3. Working on Date & Time using MySql. 4. Creating Sequence in MySql. 5. Implementation of looping structure in PHP 6. Implementation of functions in PHP 7. Implementation of Arrays in PHP 8. Implementation of string functions in PHP 9. Implementation of Regular Expressions in PHP 10. Implementation of database connectivity using MySql. 11. Working on Error handling & Debugging in PHP	
Ii	1. Develop an application that uses GUI components, Font and Colours 2. Develop an application that uses Layout Managers and event listeners. 3. Develop a native calculator application. 4. Develop a mobile application that creates alarm clock. 5. Develop an application that draws basic graphical primitives on the screen. 6. Develop an application that makes use of databases. 7. Develop an application that makes use of Notification Manager 8. Develop an application that uses Multi-threading 9. Develop a native application that uses GPS location information 10. Develop an application that creates an alert upon receiving a message 11. Develop a Mobile application for simple needs (Mini Project)	1

IV Semester

MCA4401: Internet of Things

Course Objective

1. Understand the basics of Embedded System, IoT and the development model.
2. Understand the architecture, Instruction set and work on an 8-bit microcontroller using simulation and real-time.
3. Ability to select appropriate hardware and microcontrollers based on need of application
4. Understand the Internet of Things Standards, Frameworks and techniques.
5. Apply the tools, techniques and skills acquired towards development of Projects.

Learning Outcome: Upon successful completion of the course the student will be able to:

1. Assess the vision and introduction of IoT.
2. Understand IoT Market perspective.
3. Implement Data and Knowledge Management and use of Devices in IoT Technology.
4. Classify Real World IoT Design Constraints, Industrial Automation in IoT.

Course Contents:

Module	Course Topics	Hours	Credits
I	**Internet of Things (IoT), Design Principles for Connected Devices:** Introduction to IoT, Basics of Networking, Communication Protocols, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, Sensor Networks, Machine-to-Machine Communications, IoT Examples, IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation. **Technologies Standard and Hardware:** Introduction, Sensors, digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology, Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.	15 Hours	1
II	**Network & Communication Aspects in IoT, Case Studies, Cloud Computing:** Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring. Introduction of Cloud Computing. **Challenges in IoT Design Challenges, IoT Applications:** Development challenges, Security challenges, Other	15 Hours	1

	challenges, Smart metering, e-health, Smart city, automotive applications, home automation, smart cards, Communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city.		

Suggested Readings:

1. Embedded Real Time Systems: Concepts, Design and Programming by Dr.K.V.K.K.Prasad, DreamTech Publication, 2003.
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C 2/e by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay, Pearson Education, 2011.
3. Designing the Internet of Things‖ by Adrian McEwen, Hakim Cassimally, Wiley Publications, 2012
4. The Internet of Things: Key applications and Protocols‖ Wiley Publications 2nd Edition