Department of Computer Applications
National Institute of Technology

New Proposed Syllabi
(Session: 2016-19)

SCHEME AND SYLLABI

MASTER OF COMPUTER APPLICATIONS

NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA

Proposed (2016-2019)

SEMESTER – I

SUBJECT CODE	COURSE TITLE	Lecture Hours	LAB Hours	CREDITS
MCA-101	Computer Programming using C	4	0	4
MCA-103	Computer Organization and Architecture	4	0	4
MCA-105	Discrete Mathematical Structure	4	0	4
MCA-107	Microprocessors	4	0	4
MCA-109	Fundamentals of Management	4	0	4
MCA-111	Computer Programming using C Lab	0	2	1
MCA-113	Microprocessors Lab	0	2	1
MCA-115	Free and Open Source Software Systems Lab	0	2	1
			Total Credits	23

SEMESTER – I

MCA-101: Computer Programming using C

L	T	P	Total	Credits – 4
4	0	0	4	Duration of Exam- 3 Hours

Course Objective: *To understand structured programming approach, implementing the solutions of the problems using C language.*

Introduction: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation, Techniques of Problem Solving (Flowcharting, algorithms, pseudo code, decision table), Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.

Overview and Elements of C language: History of C, Importance of C, Structure of a C Program, C character set, identifiers and keywords, Data types, their Storage classes, scope and life time, Constants and Variables, Assignment statement, Symbolic constant, Unformatted & formatted I/O function, Input functions, operators, athematic expression, type casting and conversion, operator's precedence & associativity. Decision making structures, case control structures, looping structures, break and continue.

Arrays and user defined data types: Definition, types, initialization, processing an array, Dynamic Memory Allocation, Structures and Unions, Bit Fields, Array of Structures, Array within Structures, Structures within Structures, Enumerations

Functions and pointers: Functions definition, prototype, passing parameters, recursion, pointers, pointers and arrays, pointers and Functions, Pre-processor Directives, creating your own header files.

String and File handling: String, built in functions, string and functions, command line arguments, File handling in C.

Text Books:-

1. Gottfried, Byron S., *"Programming with C"*, Tata McGraw Hill
2. Balagurusamy, E., *"ANSI C"*, Tata McGraw-Hill
3. Yashwant Kanetker, *"Let us C"*, BPB

Reference:-

1. Kernighan B.W., Ritchie D.M., "The C Programming Language", PHI.
2. Jeri R. Hanly & Elliot P. Koffman, *"Problem Solving and Program Design in C"*, Addison Wesley.
3. Rajaraman, V., *"Computer Programming in C"*, PHI

SEMESTER – I

MCA-103: Computer Organization and Architecture

L	T	P	Total	Credits – 4
4	0	0	4	Duration of Exam- 3 Hours

Course Objective: *This course is designed to have a thorough understanding of the basic structure of a digital computer. It discusses the operation of the control unit with I/O devices and memories.*

Introduction: Number Systems and Conversions. Boolean algebra, Basic Logic Gates and Universal Logic Gates. Binary Data Representation and Binary Codes.

Combinational and Sequential Logic Circuits: Binary Adder-Subtractor, Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers and De multiplexers, Latches, Flip Flops, Registers and Counters.

Digital computer generations: Computer types and classifications, functional units and their interconnections, buses, bus architecture, types of buses and bus arbitration. Register, bus and memory transfer.

Central Processing Unit: Addition and subtraction of signed numbers, look ahead carry adders. Signed operand multiplication, Booths algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation Processor organization, general register organization, stack organization and addressing modes.

Control Unit: Instruction types, formats, instruction cycles and sub cycles (fetch and execute), micro-operations, execution of a complete instruction.

Hardwire and microprogrammed control: micro program sequencing, wide branch addressing, micro instruction with next address field, pre-fetching microinstructions, concept of horizontal and vertical microprogramming.

Memory: Basic concept and hierarchy, semiconductor RAM memories, 2D & 2 1/2D 8 memory organization. ROM memories, Cache memories - concept and design issues, performance, address mapping and replacement), Auxiliary memories- magnetic disk, magnetic tape and optical disks, Virtual memory- concept implementation.

Input / Output Devices: Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Data Transfer modes- Programmed I/O, interrupt initiated I/O and Direct Memory Access., I/O channels and processors.

Advanced Computer Architecture: RISC & CISC Processors, Multiprocessing and Multiprocessors and Parallel Processors.

Text Books:-

1. R P Jain, *"Modern Digital Electronics",* 3E, TMH.
2. Moris Mano, *"Computer System Architecture"*, 3E, Prentice Hall.
3. John P. Hayes, *"Computer architecture and Organization"*, 3E, TMH.

References:-

1. Kai Hwang, *"Advanced Computer Architecture"*, TMH.

SEMESTER – I

MCA-105: Discrete Mathematical Structures

L	T	P	Total	Credits – 4
4	0	0	4	Duration of Exam- 3 Hours

Course Objective: *Understanding discrete mathematical structures that are widely used in various computer science subjects.*

Introduction: Logics, various proving techniques (Direct proof, contrapositive, contradiction, Pigeon hole, Diagonalizable Principle, Principle of mathematical induction), fundamental structures, Well Ordering Principle

Sets Theory: Sets, Types of sets, set operations, identities in sets, Principle of Inclusion and Exclusion

Relations and Functions: Types and representation of relation, Properties of Binary Relations, Equivalence Relations and Partitions, Partial Ordering Relations, paths in relations, Functions, Types of functions, inverse of function, Composition of functions

Algebraic System: Elementary properties of algebraic structures, Semigroups, monoids, Groups, Abelian groups, subgroups, normal subgroups, cyclic groups, permutation groups, Homomorphism and Isomorphism of Groups, Rings, its characteristics and types, Integral Domain, Ring isomorphism, Field, its characteristics and subfield.

Graphs theory: Graphs, directed graphs, graph terminologies, paths, cycles, Eulerian and Hamiltonian graphs, Planar Graphs, graph traversals, shortest path algorithm, Tree terminologies, types of trees, tree traversals, binary search tree.

Counting Principles: Basic counting techniques, the rules of Sum and Product, Permutations, Combinations, Generation of Permutations and Combinations.

Recurrence Relations: Recurrence Relations, Linear recurrence relations with constant coefficients (homogeneous and non-homogeneous cases) and their solving techniques

Text Books:-

1. S. Kaushik, *"Logic and Prolog Programing"*, New Age International, 2012.
2. C.L. Liu, D.P Mohapatra, "Elements of discrete mathematics: A Computer oriented Approach", 3E, TMH, 2008.
3. Mott, Kandel, Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", PHI Learning.
4. Kenneth H. Rosen, "Discrete Mathematics", TMH, 2005

References:-

1. J.P Trembley, *"Discrete mathematical Structures with Applications to Computer Science"*, TMH, New York, 1977.
2. Seymour Lopshutz, M. Lipson, *"Discrete Mathematics"*, TMH, 2005.
3. Richard Hammack, *"Book of Proofs"*, VCU Mathematics textbook series.

SEMESTER – I

MCA-107: Microprocessors

L T P Total **Credits – 4**

4 0 0 4 **Duration of Exam- 3 Hours**

Couse Objective: *Understanding the core functioning of computer, 8085 microprocessor architecture and interfacing peripheral devices.*

Introduction: Microprocessor, Microcontroller, Review of popular 8 bit microprocessors, 8085 microprocessor: Architecture, PIN configuration, Timing and Control unit, Machine cycles.

Programming the 8085: Introduction to 8085 Assembly Language Programming, Instruction Classification, Instruction Format, Addressing Modes, Instruction Set: Data Transfer Operations, Arithmetic Operations, Logic Operations, Branch Operations, Writing Assembly Language Programs for multi byte addition/subtraction, multiplication, division, block transfer, counter and time delays, BCD athematic.

Programming Techniques with Additional Instructions: Programming Techniques Looping, Counting and Indexing, Additional Data Transfer and Multi Byte Arithmetic Instructions, Arithmetic Operations Related to Memory, Logic Operations, Stack, Subroutine, Conditional Call and Return Instructions.

Interrupts and DMA: The 8085 Interrupts, Different types of interrupts, 8085 Vectored interrupts, Multiple Interrupts, interrupts priority, Interrupts service routines, Enabling and disabling interrupts, 8259 Programmable interrupt controller, Data transfer schemes, Introduction to DMA process, 8237 DMA controller.

General –Purpose Programmable Peripheral Devices: The 8255A Programmable Peripheral Interface, Details of interfacing devices 8253, Block Diagram and pin description of 8254 Programmable Interval Timer, serial communication, Programmable communications interface 8251, interfacing with A/D and D/A converters

INTEL 8086 Microprocessor: Pin Functions, Architecture, Characteristics and Basic Features of Family, INTEL 8086 System Configuration, Description of Instructions. Addressing Modes and basic operations.

Brief Introduction to 32 and 64 bit microprocessor chips.

Text Books:-

1. Ramesh S Gaonkar, *"Microprocessor Architecture, Programming & Applications with 8085"*, Wiley Eastern Ltd.
2. B. Ram, *"Advanced Microprocessors and Interfacing",* TMH.

References:-

1. Brey, *"The Intel Microprocessors 8086- Pentium processor"*, PHI.
2. Hall, *"Microprocessors and interfacing"*; TMH.

SEMESTER – I

MCA-109: Fundamentals of Management

L	T	P	Total	
4	0	0	4	Credits – 4
				Duration of Exam- 3 Hours

Course Objective: *This course enables the students to develop understanding about management in an organization. The course focuses on importance of management functions such as planning, organizing, leading and controlling as useful managerial activities.*

Introduction: Concept, definition, nature and significance of Management; Management as an art, a science, a profession; Managerial skills and organizational hierarchy.

Functions of Management: Operative functions – production, marketing, finance, personnel, Managerial functions – planning, Organizing, Staffing, Directing and Controlling.

Financial Management: Introduction of financial Management, Objectives of financial decisions, status and duties of financial Executives. Financial Planning tools of financial planning, Management of working capital, Factors affecting requirements of working capital, Capital structure decision, Features of appropriate capital structure, Sources of finance.

Personnel Management: Meaning. Nature and importance. Functions of personnel Management (Managerial Functions and Operative functions), Job analysis meaning and importance. Process of Job analysis, job Description and job specification. Human Resource Development – Meaning and Concept.

Production Management: Objectives, Plant Location: Ideal Plant Location, Factors affecting plant Location. Plant Layout: Ideal Plant Layout, Factors affecting plant layout Work Measurement: Meaning, Objectives and Essentials of work Measurement Production Control: Meaning and importance of production control and steps involved in production control.

Marketing Management: Nature, Scope and importance of marketing management Modern marketing concepts, Role of marketing in economic development. Marketing information system, Meaning nature and scope of international Marketing.

Text Books:-

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", TMH.
2. Stephen Robbins & Mary Coulter, "Management", Prentice Hall.
3. L.M. Prasad, "Principles and practices of Management", Sultan Chand & Sons.

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References:-

1. Peter Drucker, "The Practice of Management".
2. S.K.Mandal, "Principles and practices of Management", Jaico.

SEMESTER – I

MCA-111: Computer Programming Using C - Laboratory

L	T	P	Total	Credits – 1
0	0	2	2	

Lab Objective: *To practice and demonstrate programs on each and every concept learned in C program*

List of Experiments:

1. Implementing pre-defined functions and control statements.
2. Implementing all string operations.
3. Implementing enumerations.
4. Implementing Dynamic memory allocation, De-allocation using malloc, calloc, free.
5. Use of preprocessors.
6. Implementing arrays.
7. Implementing functions and header files.
8. Implementing Structures and unions.
9. Implementing Files to read and write data to disk.
10. Implementing and differentiating storage classes.

SEMESTER – I

MCA-113: Microprocessors - Laboratory

L	T	P	Total	Credits – 1
0	0	2	2	

Lab Objective: *To practice and demonstrate programs on each and every assembly codes in microprocessor*

List of Experiments:

1. Implementing 1's Complement of 8 bit and 16 bit numbers
2. Implementing 2's Complement of 8 bit and 16 bit numbers
3. Implementing addition of two 8 bit numbers and 16 bit numbers (with or without carry).
4. Implementing addition of two 8 bit numbers and 16 bit numbers (with or without carry).
5. Implementing addition of a series of 8 bit numbers and 16 bit numbers (with or without carry).
6. Implementing subtraction of two 8 bit numbers and 16 bit numbers (with or without carry).
7. Implementing subtraction of a series of 8 bit numbers and 16 bit numbers (with or without carry).
8. Implementing multiplication of two 8 bit numbers and 16 bit numbers (with or without carry).
9. Implementing division of two 8 bit numbers and 16 bit numbers (with or without carry).
10. Implementing Left and right shift of 8 bit and 16 bit numbers.
11. Finding Largest and smallest among two 8 bit numbers.
12. Finding Largest and smallest from an array of 8 bit numbers.
13. Implementing sorting of an array of 8 bit numbers.
14. Implementing square root and cube root of an 8 bit number.
15. Implementing factorial of an 8 bit number.

SEMESTER – I

MCA- 115: Free and Open source software systems – Laboratory

L	T	P	Total	Credits – 1
0	0	2	2	

Lab Objective: *To practice and demonstrate free open source software*

List of Experiments:

1. Implementing Common Commands, File handling, Control Structure etc. in Terminal.
2. Working with vi editor
3. Basics of shell Programming
4. Taking source code from git hub/ code repositories
5. Connecting to open source development community
6. Learning one programming language (python/ruby) (Handling common data-structures such as lists etc., exception handling)
7. Learning one web programming language (php/perl) (Handling common data-structures such as lists etc., exception handling)
8. Working with one database (MySQL)
9. Working with IDEs like eclipse.

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MASTER OF COMPUTER APPLICATIONS

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Proposed (2016-2019)

SEMESTER – II

SUBJECT CODE	COURSE TITLE	Lecture Hours	LAB Hours	CREDITS
MCA- 102	Data Structures	4	0	4
MCA- 104	Object Oriented Programming using Java	4	0	4
MCA- 106	Design & Analysis of Algorithms	4	0	4
MCA- 108	Operating Systems	4	0	4
MCA- 110	Organizational Behavior	4	0	4
MCA- 112	Data Structures Lab	0	2	1
MCA- 114	Object Oriented Programming using Java Lab	0	2	1
			Total Credits	22

SEMESTER – II

MCA-102: Data Structures

L	T	P	Total		
4	0	0	4	**Credits – 4**	**Duration of Exam- 3 Hours**

Course Objective: *To study the data structures available and choose the appropriate data structure for a specified application. Solve problems using data structures such as arrays, linear lists, stacks, queues, hash tables, binary trees, heaps, tournament trees, binary search trees, and graphs and writing programs for these solutions.*

Introduction: Review of data types: Scalar types – Primitive types, Enumerated types, Subranges Structures types – Character strings, arrays, records, sets, files. Data abstraction.

Complexity of algorithms: Complexity types, Asymptotic notations Time and space complexity of algorithms using "big oh" notation.

Linear data structures: arrays, arrays implementation, linked list, Linked list implementation using pointers. Stacks, queues, stack and queue implementation using array and linked lists

Non-linear Structures: Graphs, trees, sets, Graph and tree implementation using array linked list. Set implementation using bit string, linked list.

Searching: Sequential Search – Searching arrays and linked lists. Binary Search – Searching arrays and binary search trees. Hashing – Introduction to simple hash functions, resolution of collisions.

Sorting: n^2 Sorts – Bubble sort, insertion Sort, selection sort; nlogn sorts – quick sort, heap sort, merge sort, External sort – merge files.

Text Books:-

1. Narasimha Karumanchi, *"Data Structures and Algorithms Made Easy: Second Edition: Data Structure and Algorithmic"* , Career Monk Publications
2. Seymour Lipschutz, *"Data Structures with C"*, Schaum's Outline Series, TMH

References:-

1. Thomas H.Cormen, Charles E. Leiserson and Ronald L. Rivest, *"Introduction to Algorithms",* PHI.
2. E. Horowitz, S. Sahni & S. Rajsekaran, *"Computer Algorithms"*, Galgotia Publications (P) Ltd.

SEMESTER – II

MCA-104: Object Oriented Programming using JAVA

L	T	P	Total	Credits – 4
4	0	0	4	Duration of Exam- 3 Hours

Course Objective: *Understanding fundamentals of object-oriented programming in Java, attaining the ability to write a computer program to solve specified problems and be able to use the Java SDK environment to create, debug and run simple Java programs.*

Introduction: Object Oriented Programming approach, Difference from Structured Paradigm, Class and Object, Abstraction, Encapsulation, Information hiding, Signature, Polymorphism, Inheritance, Coupling and Cohesion in object oriented software

Java Programming Language: History of Java, features of Java, how java is different form C++, data types & expressions, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion and casting, constructors, access control, this pointer, garbage collection, overloading methods and constructors, parameter passing, recursion, nested and inner classes, String handling, exploring java.util, UML (Unified Modeling Language): introduction to UML, UML Notations, Test case generation using UML diagrams.

Inheritance: Concepts of inheritance, benefits of inheritance, subclass, forms of inheritance-specialization, specification, construction, extension, limitation. Member access rules, super, final, method overriding, abstract classes, Dynamic Method Dispatch, the Object class.

Packages and Interfaces: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces. Exploring java.io - java I/O classes and interfaces, stream classes, the byte stream, I/O stream, Filtered Byte Stream, Buffered Byte Stream, printStream, the character Streams

Networking: Networking basics: Socket Overview, Client/server basics, Reserved Sockets, proxy servers, networking Classes and interfaces, TCP/IP Client Sockets, URL, Datagrams.

Exception handling & Multithreading: Concepts of exception handling, benefits of exception handling, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes. Multithreading - Thread life cycle, creating threads, thread priorities, synchronizing threads, inter thread communication, thread groups.

Event Handling & AWT: Basic concept of Event Handling, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes.

The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, check box, check box groups, choices, lists panels – scrollpane, dialogs, menubar, graphics, layout managers

Applets, Swing & JDBC: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating applets, passing parameters to applets, Swing, Limitations of AWT, MVC architecture, components, containers, exploring swing- JApplet, JFrame and JComponent, Icons and Labels, text fields, buttons, Check boxes, Radio buttons, Combo boxes, Tabbed Panes, Scroll Panes, Trees, and Tables, Java database connectivity.

Text Books:-

1. Herbert schildt, *"Java; The Complete Reference",* 7E, TMH.
2. Steven Holzner, *"Java programming"*, Coriolis Black book.
3. Kathy Sierra, Bert Bates, *"Head First Java"*, 2E, O'Reilly.
4. Joshua Bloch, *"Effective Java"*, 2E, Addison Wesley.

References:-

1. Ivor Hortron, "Beginning Java 2", JDK 5 Edition, Wiley-India
2. B. Eckel, "Thinking in Java", Pearson Education,
3. J.Nino and F.A. Hosch, "An Introduction to programming and OO design using Java", John wiley & sons.
4. T. Budd, *"An Introduction to OOP",* 3E, Pearson education.
5. Y. Daniel Liang, *"Introduction to Java programming"*, Pearson education.
6. R.A. Johnson, *"An introduction to Java programming and object oriented application development"*, Thomson.
7. Deitel & Deitel, *"How to Program Java"*, Pearson Education,

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SEMESTER – II

MCA-106: Design and Analysis of Algorithms

L	T	P	Total	Credits – 4
4	0	0	4	Duration of Exam- 3 Hours

Course Objective: *Analyzing the asymptotic performance of algorithms, Apply important algorithmic design paradigms and Synthesizing efficient algorithms in common engineering design situations.*

Introduction: Review of basic data structures, metrics for algorithmic performance

Complexity of Algorithms: Complexity and its types, asymptotic notations, complexity analysis, notions of optimality, recurrence equations and their solutions (substitution method, recursion tree method, Master's Theorem), space complexity.

Design Techniques and applications: Divide and Conquer, Greedy method, Dynamic Programming, branch-and-bound, backtracking.

Conventional Problems: Fractional and 0-1 knapsack problems, sorting techniques; Integer, matrix (Strassen's) and polynomial multiplication.

Advanced Data Structures: Variants of Trees and heaps, Disjoint sets.

Graphs and Algorithms: graphs, Representations of graphs, graph traversals, single source and all pairs shortest path algorithms (with or without negative edge weight), Maximum Flow Control, Spanning Tree, Minimal Spanning trees.

Computational Geometry: Line-segment properties, Intersection properties, Convex Hull, Closest pairs of points.

Computational Complexity: Introduction to NP completeness, The classes P and NP, Polynomial Reduction, NP Hard and NP Complete Problems, Polynomial time verification.

Other Algorithms: String Matching Algorithms **(**Knave, Rabin-Karp, String matching with finite automata, KMP), Number theoretic algorithms, approximation algorithms, randomized algorithms, fractals.

Text Books:-

1. Thomas H.Cormen, Charles E. Leiserson and Ronald L. Rivest, *"Introduction to Algorithms",* PHI.
2. E. Horowitz, S. Sahni & S. Rajsekaran, *"Computer Algorithms"*, Galgotia Publications (P) Ltd.
3. Nitin Upadhyay, *"The Design and Analysis of Algorithms"*, Katson Books.

References:-

1. Bassard Bratley, *"Fundamentals of Algorithms"*, PHI.
2. Alfred V. Aho, John E. Hopcroft and J.D. Ullman, *"The Design and Analysis of Computer Algorithms"*, Addison Wesley Publishing Company.
3. Niklaus Wirth, *"Algorithms and Data Structures"*, Prentice Hall.
4. Prof. Hari Mohan Pandey, *"Design Analysis and Algorithms"*, Laxmi Publications.

SEMESTER – II

MCA-108: Operating Systems

L T P Total **Credits – 4**
4 0 0 4 **Duration of Exam- 3 Hours**

Course Objectives: *To make the students understand the structure of operating system, to explain process management, concurrent processes and threads, memory management, virtual memory concepts and deadlock and to provide a practical knowledge with the help of case studies.*

Introduction: Fundamental Roles of Operating System, Layered Architecture, operating system structures models (monolithic, layered, modular, microkernel models), Historical evolution of operating system, Methodologies for implementation of OS Service, system calls, spooling, interrupt mechanisms.

Process management: Process, PCB, Dispatching and context switching, Schedulers, CPU scheduling, Scheduling Algorithms, performance analysis (turnaround time, waiting time, throughput), multiple processors scheduling, Threads, Inter-process communication, shared memory communication, message passing mechanism.

Deadlocks and Concurrency Control: Deadlock, Deadlock characterization, Deadlock prevention and avoidance, Banker's Algorithm, Deadlock detection and recovery.

Concurrent Processes: Critical section problem, Semaphores, Classical synchronizations (producer-consumer,

Readers-writer, dining-philosophers, barber's shop problems and their solutions) monitors, synchronization hardware's (test and set), Mutex Implementation.

Memory Management: Logical v/s physical address space, Address binding, Swapping, Overlays, Memory management policies, Fragmentation and its types, Partitioned memory managements, Paging, Multilevel Paging, TLB, Segmentation, combination of Paging and Segmentation, Virtual memory concepts, Need of Virtual memories, Demand Paging, Page replacement Algorithms, Concept of Thrashing, Locality of reference and working model set.

Device Management: I/O system and secondary storage structure – Disk Structure, Disk Scheduling, Disk Management, Spooling, RAID Structure

File Management: File System Architecture, File access and allocation methods, Layered File - system mounting, sharing, protection, Directory Systems - Structured Organizations, directory protection mechanisms, implementation issues, recovery.

Protection & Security: Goals & principles of protection, domains of protection, access matrix, access control list, User based classification.

Security - Security problem, threats, security tools, classification.

Case Studies: Study of LINUX / UNIX and Windows OS.

Text Books:

1. Silbersachatz and Galvin, *"Operating System Concepts"*, Pearson, 8E, 2008.
2. Dr. R. C. Joshi, *"Operating Systems"*, Wiley Dreamtech, 2005.
3. Dietel & Dietel, *"Operating Systems"*, 3E, Pearson Education.

References:

1. Tannenbaum, *"Operating Systems"*, PHI, 4E, 2006.
2. E. Madnick, J. Donovan, *"Operating Systems"*, TMH, 2001.
3. NIIT, *"An Introduction to Operating System"*, PHI Pvt Ltd.
4. Allen B. Downey "*A little book on Semaphores*", Green Tea Press

SEMESTER – II

MCA-110: Organizational Behavior

L	T	P	Total	Credits – 4
4	0	0	4	Duration of Exam- 3 Hours

Course Objective: *This course is designed to enhance understanding of human behavior in organization and increase the effectiveness as a professional and leader.*

Introduction: Organization as a Social Unit, Concept of Learning Organization, Field of OB, Individual, Groups & System as building blocks, contributing disciplines, Challenges & opportunities of OB, Historical background of OB, Hawthorne Studies.

Individual behavior: Foundations of individual behavior, Personality: Meaning, "Big - Five" Personality traits, Perception: Meaning, Judging Others.
Learning: Meaning, Theories: Classical conditioning, Methods to shape behavior (reinforcement, punishment, & extinction)

Individual behavior in Organization- Attitudes: Components, functions, changing attitudes, work attitudes (Job satisfaction, Organizational Commitment & Employee Engagement)

Motivation: Concept of motivation, theories of motivation – Maslow's, Herezberg's and McGregor's theories.

Groups in Organization: Types, their development stages, concept of role, status, norms size and cohesiveness. Group decision making techniques, Transactional analysis; Four Life positions.

Stress and Conflict: Meaning and causes of stress, types of conflicts (intra, individual and interactive), coping strategies for stress & conflict; negotiation skills. Communication: Process, types, barriers; Grapevine.

Leadership: Concept, Trait, Behavioral and Contingency theories; leadership styles.

Organizational Culture and Change: Concept, Characteristics, Elements of Culture, Implications of Organization culture, Organizational change concept, resistance to and managing change.

Text Books:-

1. Stephen P Robbins, *"Organizational Behavior: Concepts, Controversies & Applications",* Prentice Hall of India.
2. Keith Davis*, "Organizational Behavior",* TMH.
3. Prasad .L. M, *"Organizational Behavior",* Sulton Chand & Sons

References:-

1. Fred Luthans, *"Organizational Behavior"*, Prentice Hall of India.
2. Agarwal, R.D., *"Organization and Management"*, Tata Mc Graw Hill.

SEMESTER – II

MCA-112: Data Structures - Laboratory

L T P Total **Credits – 1**
0 0 2 2

Lab Objective: *To practice and demonstrate programs on each and every concept learned in data structures course.*

List of Experiments:

1. Implement arrays and perform all the operations.
2. Implement all string operations.
3. Implement sparse matrices.
4. Implement linked list and perform all the operations.
5. Implement circular linked list and perform all the operations.
6. Implement header linked list and perform all the operations.
7. Implement doubly linked list and perform all the operations.
8. Implement stacks using array and linked list.
9. Implement queues using array and linked list.
10. Implement priority queues using array and linked list.
11. Implement trees and perform all the operations.
12. Implement graphs and perform all the operations.
13. Implement Heap.
14. Implement all Searching techniques.
15. Implement all Sorting techniques.
16. Implement all Hashing techniques.

SEMESTER-II

MCA-114: Object Oriented Programming using Java- Laboratory

L T P Total **Credits – 1**
0 0 2 2

Lab Objective: *To practice and demonstrate programs on each and every concept learned in object oriented programming using java course.*

List of Experiments:

1. Implementing control statements.
2. Implementing string operations.
3. Implementing classes and objects
4. Implementing programs to demonstrate inheritance and interfaces.
5. Create your own package and use it in your program when needed.
6. Implementing I/O stream to read and write content of disc file.
7. Implementing simple chat application using TCP/IP.
8. Implementing multithreading & Inter-thread communication.
9. Implementing AWT and different Layouts in Java.
10. Implementing Java Applets and swings.
11. Implementing a java project using AWT, swings and JDBC.

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SEMESTER – III

SUBJECT CODE	COURSE TITLE	Lecture Hours	LAB Hours	CREDITS
MCA-201	Database Management Systems	4	0	4
MCA-203	Software Engineering & Project Management	4	0	4
MCA-205	Computer Networks	4	0	4
MCA-207	Formal Languages and Automata Theory	4	0	4
MCA-209	Elective-I	3	0	3
MCA-211	Database Management System Lab	0	2	1
MCA-213	OS and Network Lab	0	2	1
MCA-215	Innovative Project Design	0	4	2
			Total Credits	23

List of Electives: (One from block of electives)

Elective- I

3.1.4. E-Governance
3.1.5. Network Programming and Security
3.1.6. Modeling and Simulation

SEMESTER – III

MCA-201: Database Management Systems

L T P Total **Credits – 4**
4 0 0 4 **Duration of Exam- 3 Hours**

Course Objective: *Understand basic database concepts, relational data model, E-R diagrams and database normalization, usage of Database query language like (SQL), database transactions, concurrency control, data recovery and advanced database topics, such as distributed database systems.*

Introduction: Concept, characteristics, advantages and limitations of database system, data base management system, data base administrator and users, Data Models (Relational Models, Networks data model, Hierarchical Model, semantic data model and object oriented data model), Schema and instances, three Schema architecture, data independence, mappings, classifications of DBMS

Relational and E-R models: Domain, attributes, tuples, entity, entity set, entity types, concept of keys, Integrity rules, relations, relationships types, E-R diagram, specification and generalization, relational algebra and relational calculus.

SQL: Data definition, manipulation and control language, triggers, views.

Functional dependencies and Normalization: Functional dependencies, dealing with constraint violations, normal forms.

Transaction management, Concurrency Control and recovery techniques: Transaction processing, characterizing schedules based on recoverability, serializability, **Concurrency Control,** locking techniques, timestamp ordering, granularity of data items and multiple granularity locking, concept of recovery, recovery techniques based on deferred and immediate update, shadow paging.

Advanced databases: Distributed database concepts, data fragmentation, replication, and allocation techniques, query processing. Enhanced data models (active database, temporal database, spatial, multimedia databases, deductive databases, and mobile databases). Graph Database, RDBMS Vs Graph Database, Popular Graph Databases like Neo4j, Oracle NoSQL Database, OrientDB.

Text Books:-

1. S. B. Navathe, R. Elmasri, *"Fundamentals of Database"*, Pearson
2. A Silberschatz, H.F. Korth & S. Sudarshan, *"Data Base System Concepts"*, TMH, Latest edition.
3. Evan Byross, *"SQL, PL/SQL the Programming Language of Oracle"*, BPB Publications, Latest edition

References:-

1. C.J. Date, *"An Introduction to Database systems*", Ed. Addison Wesley, Latest edition
2. Schaum Outlines, *"Fundamentals of relational databases"*, Tata McGrew Hills.

SEMESTER – III

MCA-203: Software Engineering& Project Management

L T P Total **Credits – 4**
4 0 0 4 **Duration of Exam- 3 Hours**

Course Objective: *This course will enable students to work in a team and experience the complete life cycle of a software development project including all the phases & components of software engineering such as context diagrams, DFDs, E-R Diagrams, SRS document etc.*

Introduction: Software, software engineering, software myths, program and software, characteristics, types and applications of software, various life cycle models- Build & Fix model, waterfall, prototyping, spiral, RAD model & incremental process model.

Requirement Specification: Problem Definition, requirement engineering phases- requirement elicitation, requirement analysis, requirement documentation & requirement review; SRS document, characteristics of a good SRS, Types of requirements, use case diagrams

Software Design: Introduction, Modularity, Cohesion & Coupling with types, Data Flow diagram, data dictionaries, E-R Diagrams & Object diagrams, Function and object oriented design, design approaches.

Software Reliability: Hardware reliability, software reliability, reliability models- basic execution time model, logarithmic Poisson execution time model, calendar time component model & Jelinski-moranda model

Software Project Management: product metrics, size metrics, lines of code, Function point metric, data structure metric, Halstead metric, concept of live variables & variable span, information flow metric, COCOMO& COCOMO II Model, Risk Management.

Software Testing: Introduction, Functional testing- boundary value analysis, equivalence class testing, Decision table based testing, cause effect based testing, structural testing- cyclomatic complexity, basis path testing, mutation testing, graph matrix; acceptance testing, alpha and beta testing, verification & validation, debugging

Software maintenance: Introduction, types of maintenance, maintenance models, reverse engineering, re-engineering, CMM Model, CASE Tools.

Text Books:

1. K.K.Aggarwal, Yogesh Singh, *"Software Engineering"*, New Age International Ltd, 2001.
2. R.S. Pressman, *"Software Engineering – A Practitioner's Approach"*, 5th Ed, TMH, 2000.
3. Pankaj Jalote, *"An Integrated Approach to Software Engineering"*, Springer; 3rd ed. 2005 edition (28 November 2005).

References:

1. Rajib Mall, *"Fundamentals of Software Engineering"*, P.H.I.
2. Ian Sommerville, *"Software Engineering"*, 4th Ed., Addison Wesley.

SEMESTER – III

MCA-205: Computer Networks

L T P Total **Credits – 4**

4 0 0 4 **Duration of Exam- 3 Hours**

Course Objective: *Introduce students to intranet and benefits of intranets, various protocols in different layers of network model, Wireless and Mobile Networking,*

Introduction: Definition, Goals, Applications, Classification, Protocols and Standards, Network Topology, Transmission Media, Layered Network Architecture, Review of ISO-OSI Model, TCP/IP Model, Design Issues of Layers, Multiplexing, switching methods

Data Link Layer: Stop and Wait Protocols, Sliding Window Protocols, ARQ, HDLC and ATM, Error Detection and Correction

Medium Access Control: Concept of Random Access, Pure ALOHA, Slotted ALOHA, CSMA, LAN: IEEE 802.3, 802.4 and 802.5

Network Layer: Internetworking using Bridge, Routers and Gateways, Connection-oriented, Connection-less services, Routing Algorithms, flow and congestion control, Addressing, Classful addressing, Classless Addressing, Subnetting, Supernetting, IP Packet

Transport Layer: Design issues, Quality of Services, Primitives Connection Management: Addressing, Connection Establishment and Releases, Transmission Control Protocol, Flow control and Buffering, TCP Window management

Application Layer: Introduction to the various protocols at application layer

Wireless and Mobile Networking: IEEE 802.11, IEEE 802.16, Bluetooth and IEEE 802.15, Ad-hoc networks, Cellular networks – GSM, CDMA

Text Books:

1. Forouzan., *"Data Communication and Networking"*, 4th Edition, McGrawhill,
2. A.Tanenbaum, *"Computer Networks"*, 4th Ed., Pearson Education Asia (LPE), 2003.
3. Douglas E.Comer, *"Computer Networks and Internet"*, 4th Ed., Pearson Education.

References:

1. L.L. Peterson and B.S. Davie, *"Computer Networks: A Systems Approach"*, 2nd Ed., Morgan Kaufman, Harcourt Asia, 2000.
2. W. Stallings, *"Data and Computer Communications"*, 6th Ed., Pearson Education Asia (LPE), 2000.

3. J.F. Kurose and K.W. Ross, *"Computer Networking: A Top-Down Approach Featuring the Internet"*, Pearson Education Asia (LPE), 2001.
4. Bertsekas and R. Gallagar, *"Data Networks"*, 2nd Ed., PHI (EEE), 1988.

SEMESTER – III

MCA-207: Formal Languages and Automata Theory

L T P Total **Credits – 4**
4 0 0 4 **Duration of Exam- 3 Hours**

Course Objective: *The objective is to introduce students to fundamentals of mathematical models of computing machines, languages and language constructs such as grammar with advanced concepts of Formal languages in detail.*

Introduction: Introduction to language theory, tokens, alphabets, production rules, sentences, sentential forms, derivations.

Finite Automata: Definition, Deterministic, Non-Deterministic FA and their equivalence, Moore and Mealy machines and their transformations, Minimization of Finite Automata, Use of Epsilon Transitions

Regular Languages: Definition, identities, Pumping Lemma of regular sets, Equivalence of regular expressions and FA, Arden's theorem, Equivalence of FAs, Equivalence of Regular expressions, closure properties.

Grammar: Definition, Chomsky hierarchy of languages, Relations between classes of languages, operations on languages, removing ambiguity from grammars

Context Free Language: Definition, Derivation trees, ambiguity, simplification, Normal forms, applications.

Pushdown Automata: Definition, Language of a PDA, construction and acceptance of PDA for simple CFLs, Deterministic and Non- Deterministic PDA, Linear bounded automata, PDAs and CFGs

Turning machines: Definition, Introduction to computability, Language of a Turing Machine, Universal Turing Machines, Types of Turing Machines, Design of Turing Machines, Un-decidability and Halting problem.

Complexity: Time complexity of deterministic and nondeterministic Turing machines, P and NP classes, NP- completeness and NP – Complete problems.

Text Books:-

1. K.L.P Mishra and N. Chandrasekheran, *"Formal Languages and Automata Theory",* PHI.
2. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, *"Introduction to Automata Theory, Languages, and Computation"*, Pearson Education Asia.
3. R.B Patel, Prem Nath, *"Theory of Automata and Formal Languages"*, Umesh Publications.

References:-

1. C. Papadimitrou and C. L. Lewis, *"Elements of Theory of Computation"*, PHI, 1981.
2. John Martin, "Introduction to Languages and the Theory of Computation", TMH.

SEMESTER – III

MCA-209 (Elective 3.1.1): E-Governance

L	T	P	Total		
3	0	0	3		

Credits – 3

Duration of Exam- 3 Hours

Course Objective: *To understand the foundations of governance, structure and processes and role of Information Technology in improving governance. Governance is key to development. With the increasing role and focus of governments and society on technology in daily discourse and long term strategy, it becomes imperative for academicians to prepare the youth for positive and effectual contribution to governance through technology.*

The present course will introduce the students with structure of government, foundations of governance in the country, the issues faced in governance, the role of technology in improving governance (through case studies and live projects).

Introduction: Foundations of India democracy, Historical context- governments in Ancient times, Governance in Medieval times; Britishers and the their response to governance challenges; Freedom struggle and independence; Constitution formation

Introduction to Governance In India: Indian constitution: basic elements; Rights, Duties; Executive, Judiciary and legislature; Division of power; The Governance system at National level; Governance Systems at States and at Local level; small study from native/nearby area.

Governance Issues and challenges: Diversity; Social challenges, Economic Challenges, Political challenges, Demographic challenges

E-Governance and its role in development: System analysis, design and implementation;

Case studies in e-governance: Presentation from students on the Mission mode projects under National e-Governance Plan, Study of good projects in various other domains) (negp.gov.in,http://deity.gov.in/content/national-e-governance-plan,http://www.nisg.org/,

Text Books:-

1. S.C. Kashyap, *"Our Political System"*, National Book Trust
2. A. Tiwari, *"Polity, Constitution and governance in India"*, 2E, Unique
3. CSR Prabhu, *"E-Governance: Concepts and Case Studies"*, Prentice Hall of India, 2004

References:

1. Eric Schmidt, *"The New Digital Age: Reshaping the Future of People, Nations and Business"*, Brilliance Corp; MP3 Una edition (8 April 2014)
2. T.S.R. Subramanian, *"Journey through Babudam and Netaland: Governance in India",* Rupa Publications (February 1, 2004)

3. P Sainath, *"Everybody Loves a good drought",* Penguin India; 1st Edition (14 October 2000)
4. S.K. DAS, *Oxford India Short Introductions, "Civil Services in India",* Oxford Univ Press.
5. https://en.wikipedia.org/wiki/E-Governance
6. http://nceg.gov.in/
7. http://deity.gov.in with special reference to policies and national e-governance-plan
8. http://www.nisg.org with special reference to knowledge and projects

SEMESTER – III

MCA-209 (Elective 3.1.2): Network Programming & Security

L	T	P	Total	Credits – 3
3	0	0	3	Duration of Exam- 3 Hours

Course Objective: *Understand various security principles and types of threats affecting security, basic concepts of cryptography, encryption & decryption, various hash algorithms, various Network security & web security related terms.*

Introduction: Attackers and Types of threats, challenges for information security.

Basic Encryption and Decryption: Encryption Techniques, Classical Cryptographic Algorithms-Mono alphabetic Substitutions, Cryptanalysis of Mono alphabetic ciphers, Polyalphabetic Ciphers, Vernam Cipher, Stream and Block Cipher

Number Theory: Prime Numbers, Greatest Common Divisor, Euclidean algorithm, Modular Arithmetic, Properties of Modular Arithmetic, Computing the inverse, Fermat's Theorem, Random number generations

Secret key Systems: The Data Encryption Standard (DES), Analysing and Strengthening of DES, Introduction to Advance Encryption Standard (AES)

Key Management Protocols: Solving Key Distribution Problem, Diffie-Hellman Algorithm, Key Exchange with Public Key Cryptography

Public Key Encryption Systems: Public key Encryption, Rivets- Shamir- Adlman (RSA) Cryptosystem, Rabin, ElGamal, Goldwasses- Micali , Blum-Goldwasser cryptosystem, The Digital Signature Standard (DSA), Security handshake pitfalls, Strong password protocols.

Hash Algorithms: Hash concept, description of Hash algorithms, Message Digest Algorithms such as MD4 and MD5, Secure Hash Algorithms such as SH1 and SHA2

Public Key Infrastructure (PKI): Concept of digital Certificate, Certificate Authorities and its roles, X.509 Structure of Digital Certificate, Types of public key infrastructures

Introduction to Network Security: Network security Issues- Message Confidentiality, Message Integrity, Code Integrity, Denial of Service, Securing Switches and Routers, Firewalls, DMZs, Virtual Private Networks, Network Monitoring and Diagnostic Devices, Virtual LANs, IPSec Secure Communication Mechanism

Introduction to Web Security: Secure socket Layer protocol, Secure Electronic Transaction Protocol, Safe Guarding Web Servers, Secure Electronic Mail, Enhanced Email, Pretty Good Privacy, Public Key Cryptography Standards, Secure, SMIME

Network Programming: Introduction to Computer Networking and TCP/IP, Introduction to Socket Programming, TCP Sockets and Concurrent Servers, Threads, I/O Multiplexing and Socket Options, UDP Sockets and Name and Address Conversions, Daemon Processeses and Inetd Superserver, Advanced I/O and Timeouts, Non-blocking Sockets, Unix Domain Sockets, Broadcasting, Multicasting, Advanced UDP Sockets.

Text Books:-

1. William Stallimgs, *"Principles of Cryptography"*, Pearson Education.
2. Atul Kahate, "*Cryptography & Network Security"*, TMH.
3. Behrouz A. Forouzan, *"Cryptography and Network Security"*, TMH.

References:-

1. S. Davis, *"Unix Network Programming"*, PHI
2. W.Richard Stevens, *"Unix Network Programming"*, Volume 1 & Volume 2, PHI, 2005

SEMESTER – III

MCA-209 (Elective 3.1.3): Modeling and Simulation

L	T	P	Total	
3	0	0	3	

Credits – 3

Duration of Exam- 3 Hours

Course Objectives: - *The objective is to introduce students to fundamentals of modelling & simulation, random number generation methods and all important simulation experiments.*

Introduction: Modeling & Simulation Fundamentals, Models, Types of simulations, Steps in Modeling, When to Use Simulation?, Limitations of Simulation, Validation and Simulation Languages, Continuous vs. Discrete System Simulation, Numerical Integration vs. Continuous Simulation, Analog vs. Digital Simulation, Simulation vs. Monte- Carlo Simulation.

Random Numbers: Generation of Pseudo Random Numbers, Mid-Square Method, Object Oriented Approach, Rule Based Approaches, Simple examples of Animation object oriented approach in simulation, Generating Random Variates from Continuous and Discrete Probability Distributions, Probability distributions (Gaussian, Normalization, Inequalities, Bounds).

Simulation Experiments: Run length of Static and Dynamic Stochastic Simulation Experiments, Queuing models, M/M systems and their steady state analysis, Single server and multi-server queues, open and closed queuing networks Design of Application Simulators for Multi-server Queuing System, PERT, Optimizing Inventory Policy and Cost in Business environment.

Text Books:

1. G. Gordon, *"System Simulation"*, PHI, New Delhi.
2. Nar Singh Deo, *"System Simulation with Digital computer"*, PHI, New Delhi.
3. James A. Payne, *"Introduction to Simulation: Programming Techniques and Methods of Analysis"*, McGraw Hill International Editions, Computer Science services, New York.

References:

1. Seila, *"Simulation Modeling"*, Cengage Learning
2. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, *"Discrete-Event System Simulation"*, 4th Edition, 2007, Pearson Education.

SEMESTER-III

MCA-211: Database Management System Lab

L	T	P	Total	Credits – 1
0	0	2	2	

Lab Objective: *To understand, appreciate and effectively explain the underlying concepts of database technologies, to design and implement a database scheme for a given problem-domain and also to populate and query a database using SQL DML/DDL commands.*

List of Experiments:

1. Creation and manipulation of relations using basic SQL Commands.
2. Define various integrity constraints including primary key, check, default, unique & not null the schema.
3. Implementation of reference constraint using foreign key.
4. Queries related to inbuilt functions in database.
5. Use of logical operator, range searching and pattern matching in query processing.
6. Queries related to group data, join and date manipulation.
7. Formation of sub queries.
8. Use of Index, view and sequences.
9. Granting and revoking permissions.
10. Database triggers.

SEMESTER-III

MCA-213: OS and Network Lab

L T P Total **Credits – 1**
0 0 2 2

Lab Objective: : *To study and make programs regarding four core features of operating system those are process management, memory management, file management and I/O management and to implement all fundamentals networks topologies and network commands.*

List of Experiments:

1. Study of hardware and software requirements of different operating systems (UNIX, LINUX, WINDOWS XP, WINDOWS 7/8/10).
2. Execute various UNIX system calls for Process management, File management and Input/ Output Device Management.
3. Implement CPU scheduling schemes: FCFS, SJF, SRTF, Priority, Round Robin, Multi-Level Queue and find out avg. turn-around time, avg. waiting time, response time, throughput.
4. Implement file storage allocation techniques: Contiguous (using array), Linked–list allocation (using linked list) and indirect allocation (indexing).
5. Implement File Directories: Single Level, Two Level, Tree Level, Acyclic Graph Directory.
6. Implement Disk Scheduling: FCFS, SSTF, SCAN, Circular SCAN, Look and Circular Look.
7. Implement of different Network Topologies. Locating different interfaces, routers and switches. Studying different pools of IP addresses.
8. Learn and observe the usage of different networking commands e.g. PING, TRACEROUTE. Learning remote login using telnet session. Measuring typical average delays between different locations of the network.
9. Familiarize with the network packet sniffer, ethereal. Analyzing HTTP request and response messages. Working with methods like GET, HEAD, POST etc. Establishing FTP connection with the server and downloading different data files.
10. Working with client/server scenario. Observing the difference between UDP and TCP servers.
11. Compare the working of 1750, 2620 and 2621 series of routers on the basis of bandwidth, reliability, txload, rxload, queuing strategy, queue drops, input errors and output errors.
12. Client Server program using TCP Socket
13. Decentralized application like a Peer to Peer system.
14. Open source firewall/proxy packages like iptables, ufw, squid etc.
15. Experiments with Emulator like Netkit, Emulab etc.
16. Experiments with Simulator like NS2, NCTU NS etc.

SEMESTER-III

MCA-215: Innovative Project Design

L T P Total **Credits – 2**

0 0 4 4

Guidelines

1. Students have to finalize the following by 1st week of 3rd sem.
   a) Project Group (2-3 students per group).
   b) Broad Area of study.
   c) Supervisor.
2. Co-Supervisor will be provided by the Department.
3. Topics should be finalized with guidance and approval from concerned supervisors. Topic of the Project should be innovative and research oriented. Please make sure that the Topics of the Project should be in same field that you would prefer to extend in 4th semester & 5th Semester.
4. All Groups have to present a brief overview/Background details and scope for the Topic selected to the respective Supervisors in 4th week of August.
5. It is mandatory for all students to attend the Seminar of the Project, weekly attendance will be recorded for all Project presentation sessions.
6. Detailed Schedule for the Final Seminar Presentation of Project will be displayed by 5th week.
7. Each group would be given 10-15 minutes to present their respective topics.
8. **Marks Distribution**:- **100 Marks**

Queries	PPT skills	PPT	Report	Attendance	Total
20	20	20	30	10	100

The Seminars of the Project will start from 6th week of the Semester.

REPORT: - Guidelines

- Report Submission to be done by last week of November. Exact date will be announced during the semester.
- Soft copy of the Report to be mailed at **mcanitkuruproject@gmail.com** and the hard copy to be submitted to the Project Coordinator for that semester.
- Project Presentation slides and the Report should be written to a CD and submitted to Project Coordinator.
- The Project Report should be IEEE two-column format (4-6 pages). It may be organized as mentioned below:

I. Title
II. Acknowledgement
III. Table of contents
IV. List of figures, symbols
V. Abstract
VI. Introduction
VII. Literature survey
VIII. Theoretical concept, model or Algorithm
IX. Conclusion and future scope

X. References

Evaluation of Report (30 Marks):-*How thorough you have done your Literature Survey*

Quality of Literature survey (Latest, Relevant)	Formatting	Total
20	10	30

SCHEME AND SYLLABI
MASTER OF COMPUTER APPLICATIONS
NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA

Proposed (2016-2019)

SEMESTER – IV

SUBJECT CODE	COURSE TITLE	Lecture Hours	LAB Hours	CREDITS
MCA-202	Artificial Intelligence	4	0	4
MCA-204	Interoperable Web Technologies	4	0	4
MCA-206	Data Analytics	4	0	4
MCA-208	Elective-I	3	0	3
MCA-210	Elective-II	3	0	3
MCA-212	Artificial Intelligence Lab	0	2	1
MCA-214	Web Technology Lab	0	2	1
MCA-216	Innovative Project Development	0	8	4
			Total Credits	24

List of Electives (One from each block of electives)

Elective- I

4.1.1. Numerical Analysis & Optimizations Techniques

4.1.2. Digital Image Processing

4.1.3. Unix and Shell Programming

Elective- II

4.2.1. E-Commerce

4.2.4. Principles of Compiler Design

4.2.5. Graph Theory

SEMESTER – IV

MCA-202: Artificial Intelligence

L	T	P	Total	
4	0	0	4	**Credits – 4**
				Duration of Exam- 3 Hours

Course Objective: *Understanding the role of knowledge representation, problem solving, and learning in intelligent-system engineering. Small introduction about AI programming languages*

Introduction: Historical Perspective, Turing test, Scope of AI, Problems and Approaches to AI, Types of Intelligent Agents and their environments.

Search Strategies: State space search, Uninformed Search, Depth-first Search, Breadth-First Search, Iterative Deepening; Informed Search: Best First Search, Heuristic Search, Hill climbing, Simulated Annealing; Evaluate search algorithms on Complexity (Time and Space), Completeness and Optimality

Game Playing: Minimax, Game trees, Alpha-Beta Pruning, Constraint Satisfaction Problems (Backtrack, 8-queens, coloring problem)

Logic, Inference and Predicate Calculus: Propositional Logic, Predicate calculus, First Order Logic, Inference in First Order Logic, Unification, Resolution, Conversion to Normal Form,

Knowledge Representation and Reasoning: Rule-based Systems, Semantic Networks, Frame Systems, Ontologies, Knowledge Representation for the web - Semantic Web

Handling uncertainty: Non-monotonic reasoning, Certainty factors, Probabilistic Methods for Uncertain Reasoning, Overview of fuzzy logic

Additional Topics: Learning, Overview of different forms of learning, Overview of Neural Network, Overview of Expert Systems, Process Planning and Robotics, Overview of Natural Language Processing

AI Programming Languages: Introduction to LISP, Syntax and Numeric Function; List manipulation functions; Iteration and Recursion; Property list and Arrays, Introduction to PROLOG.

Text Books:-

1. Saroj Kaushik, *"Artificial Intelligence"*, Cengage Learning India, 2012.
2. Stuart Russell and Peter Norvig, *"Artificial Intelligence: A Modern Approach"*, 3E, PHI, 2009.
3. Elaine Rich and Kevin Knight, *"Artificial Intelligence"*, TMH.

References:-

1. Dan W. Patterson, *"Introduction to Artificial Intelligence and Expert Systems"*, PHI.
2. Nils J.Nilsson, *"Principles of Artificial Intelligence",* Narosa Publishing house.
3. Patrick Henry Winston, *"Artificial Intelligence"*, Addison-Wesley, 1992.
4. Jankiraman, V.S Sarukesi, K., and Gopalakrishnan, P., "*Artificial Intelligence and Expert Systems",* Macmillan, New Delhi, 1993

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SEMESTER – IV

MCA-204: Interoperable Web Technologies

L	T	P	Total	Credits – 4
4	0	0	4	Duration of Exam- 3 Hours

Course Objective: *To introduce students about web technologies that relate to the interface between web servers and their clients. It includes markup languages; programming interfaces and standards for document identification and display.*

Introduction: History of Internet & WWW, W3C client/server model, Internet Principles, DNS, Web Servers, URL.

HTML: HTML elements, core attributes, lists, colors, tables, anchors, client side and server side Image mapping, semantic linking, Frames, audio video support in browsers, HTML form controls, HTML Canvas, SVG, HTML Plug-ins.

JavaScript: Use of JavaScript as web technology, JavaScript objects, functions, events, JavaScript Regular Expressions, JavaScript Debugging, validations, JavaScript HTML DOM.

CSS: Introduction, syntax, types of Style Sheet, CSS3 Modules, 2D/ 3D transformation with CSS3, transitions, animations, flex Box, media query with CSS3.

XML & Web Services: DTD, XML validations, Schemas, DOM, XML Parsing, XSLT, XSL, ActiveX Control, Web Services- WSDL, SOAP, AJAX, JQuery.

PHP: Introduction and basic syntax of PHP, decision and looping with examples, PHP Arrays, Functions, strings, decision controls, PHP form handling.
PHP Cookies, Sessions, MySQL Database with PHP (creation, connection, queries to database).

Servlets and JSP: Servlets life cycle, Handling Servlets, JSP Scripting Elements, JSP Expressions, Scriplets, Declarations, Including Files & Applets in JSP documents, Database Connectivity, Creating Beans for web Applications.

Text Books:-

1. Deitel, Deitel and Nieto, *"Internet and Worldwide Web -How to Program"*, 5th Edition, PHI, 2011.
2. Ivan Bayross, *"Web Enabled Commercial Application Development Using HTML, DHTML, JavaScript, Perl, CGI"*, BPB Publications.
3. Jeffrey C Jackson, *"Web Technology – A computer Science perspective"*, Pearson Education, 2007.

References:-

1. Chris Bates, *"Web Programming –Building Internet Applications"*, Wiley India, 2006.
2. Thomas A Powell, *"HTML The Complete Reference"*, TMH.
3. http://www.w3schools.com
4. http://www.tizag.com/

SEMESTER – IV

MCA-206: Data Analytics

L	T	P	Total	Credits – 4
4	0	0	4	Duration of Exam- 3 Hours

Course Objective: *The course is meant to give background for understanding the concepts behind machine learning methods and give some hands-on experience on machine learning methods.*

Introduction: Linear Algebra and Matrix operations- Vector spaces, Column Space, Row Space, Solving system of linear equations, homogeneous equation, kernel-null space, affine space, Eigenvector, Eigenvalues, Characteristic equation, roots, Principal Component Analysis, Singular Value Decomposition, Linear Transformations, Matrix Addition, Multiplication, inverting, transposing, Matrix factorization, LU, QR, SVD, Ordinary least squares for regression, Linear Discriminant Analysis

Probability: Probability axioms, sample space, events, random variable, mutually exclusive events, independent events, joint, marginal, conditional probability, Bayes rule, chain rule, discrete probability, mass function, continuous probability, distribution function, uniform distribution, expectation, variance. Important distributions: Bernoulli, Poisson, Gaussian. Log trick, normalization, inequalities and bounds

Information theory: introduction, information measure, entropy, inference, data compression, source coding theorem, symbol codes, stream codes, noisy channel coding, dependent random variables, communication over noisy channel, noisy channel coding theorem, error correcting codes and real channels. Concentration of measure, Curse of dimensionality

Machine learning Tools: maximum likelihood, Support vector machine, Markov model, ID3 algorithm

Text Books:-

1. Foster Provost, Tom Fawcett, *"Data Science for Business"*, O'Reilly, 2013
2. Wes McKinney, *"Python for Data Analysis"*, O'Reilly; 1 edition (26 October 2012
3. Christopher M. Bishop, *"Pattern Recognition and machine learning"*, Springer; 1st ed. 2006. Corr. 2nd printing 2011 edition (15 February 2010)

References:-

1. http://www.cin.ufpe.br/~embat/Python%20for%20Data%20Analysis.pdf
2. http://machinelearningmastery.com/linear-algebra-machine-learning/
3. https://see.stanford.edu/materials/aimlcs229/cs229-prob.pdf
4. http://www.princeton.edu/~eabbe/publications/tuto_slides_part1.pdf
5. http://www.inference.phy.cam.ac.uk/itprnn/book.pdf
6. http://it-ebooks.info/book/2883/

SEMESTER – IV

MCA-208 (Elective 4.1.1): Numerical Analysis and Optimization Techniques

L	T	P	Total	Credits – 3
3	0	0	3	Duration of Exam- 3 Hours

Course Objective: *Study about numerical methods and solution of polynomial and transcendental equations, Numerical differentiation and Integration, Polynomial interpolation, Solution of ordinary differential equations. Optimization methods, LPP and their solutions, PERT and CPM and Some statistical Methods.*

Introduction: Errors in numerical calculations, sources of errors, significant digits, numerical solution of polynomial and transcendental equations.

Iterative Methods: Bisection method, Regula-falsi method, Newton-Raphson method, fixed point method of iteration, rates of convergence of these methods.

Solution of system of algebraic equations: Exact methods, Crout's triangularization method, Gauss - Seidel and relaxation method.

Polynomial interpolation: Lagrange interpolation polynomial, divided differences, Newton's divided difference interpolation polynomial, finite differences, operators Δ,∇,e,δ, Gregory, Newton forward and backward difference interpolation polynomials, central differences, Stirlings interpolation formulae.

Numerical differentiation and Integration: Differentiation formulae in the case of equally spaced points, Trapezoidal and Simpson's rules, compounded rules, errors of interpolation and integration formulae numerical.

Solution of ordinary differential equations: Single stepmethods, Taylor series method, Euler's method, modified Euler's method, Picard's iteration method, Runge - Kutta methods (2^{nd}, 3^{rd} and 4^{th} order formulae- derivations not required), multistep methods, Milne's predictor and corrector formulae.

Optimization methods: Mathematical formulation of linear programming problem, simplex method, artificial variables, two phase technique, Dual simplex method, duality in linear programming, Transportation problem, Assignment models.

PERT and CPM: Basic steps in PERT/CPM, Techniques, Network Diagram Representation, Forward and Backward Pass-computation, Representation in Tabular form, Determination of Critical path, Critical activity, Difference between CPM and PERT, Floats and Slack Times.

Statistical methods: Sample distributions, Test of Significance: Chi-Square Test, T and F test.

Text Books:-

1. B.S Grewal, *"Numerical Methods in Engineering and Science with Programs in C & C++"*, Khanna Publications.
2. Manish Goyal, "*Numerical Methods and Statistical Techniques Using 'C'",* Laxmi Publications, 2009
3. S.D Sharma, *"Operations Research"* Kedar Nath Ram.

Reference:-

1. Sastry S. S., *"Numerical Analysis"*, Prentice-Hall India.
2. S. S. Rao, *"Optimization Techniques"*, New Age Int., New Delhi
3. Gupta S.P. and Kapoor, V.K., *"Fundamentals of Mathematical Statistics"*, Sultan Chand and Sons
4. William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, *"Numerical Recipes in C"*, 2E, Cambridge University Press.

SEMESTER – IV

MCA-208 (Elective 4.1.2): Digital Image Processing

L T P Total **Credits – 3**
3 0 0 3 **Duration of Exam- 3 Hours**

Course Objective: *Study of* fundamentals of concepts of image processing, Image restoration and reconstruction techniques, Color image processing, Image enhancement, Image Segmentation and Morphology

Introduction: The origins of Digital Image Processing, Applications of Digital Image Processing.

Digital Image Fundamentals: Elements of visual Perception, Basic Steps in Image Processing, Elements of Digital Image Processing Systems, Image Sampling and Quantization, Gamma-Ray Imaging, X-Ray Imaging, Imaging in the Ultraviolet Band, Some basic relationships (Neighbors, Connectivity, Distance Measures between pixels, Linear and Non Linear Operations).

Image Enhancement in the Spatial and Frequency Domain: Some basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Edge enhancement filters, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering, Low Pass filters, High Pass filters, sharpening filters, and Comparative study of all filters.

Color Image Processing: Color Fundamentals, Color Models, Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation. Morphological Image Processing Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening, Hit or miss transformations.

Image Restoration: A model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations.

Image Compression: Coding, Inter pixel and Psychovisual Redundancy, Image Compression models, Elements of Information Theory, Error free comparison, Lossy compression, Image compression standards.

Image Segmentation: Detection of Discontinuities, Edge linking and boundary detection, Thresholding, Region Oriented Segmentation, Motion based segmentation.

Representation and Description: Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Introduction to Morphology,

Object Recognition: Patterns and Pattern Classes, Decision-Theoretic Methods, Structural Methods. Advanced applications of DIP (biomedical image processing, digital watermarking)

Text Books:-

1. Rafael C. Gonzalez & Richard E. Woods, *"Digital Image Processing",* 2nd edition, Pearson Education, 2004.
2. A.K. Jain, *"Fundamental of Digital Image Processing"*, PHI, 2003.

References:-

1. Rosefield Kak, *"Digital Picture Processing"*, 1999.
2. W.K. Pratt, *"Digital Image Processing",* 2000.
3. Milan Sonka vaclan Halavac Roger Boyle,"*Image processing, Analysis, and Machine vision"*, Vikas Publishing House.

SEMESTER – IV

MCA-208 (Elective 4.1.3): UNIX and Shell Programming

L	T	P	Total	Credits – 3
3	0	0	3	Duration of Exam- 3 Hours

Course Objectives: *Stating the major components of UNIX, describing the architecture of the UNIX operating system, organizing and manipulating files and directories, use of the vi text editor to create and modify files and using UNIX utilities to create simple tools for the information processing*

Introduction to UNIX: Architecture of UNIX, Features of UNIX, internal & External commands, login, logout.

Unix Commands: at, banner, batch, bc, cal, cat, cd, cmp, comm, chmod, chown, chgrp, cp, cron, cut, date, dd, diff, echo, finger, find, ftp, head, kill, lock, ln, ls, lp, lpstat, man, mesg, mkdir, more, mv, nl, nice, passwd, pr, paste, ping, ps, pwd, rcp, rlogin, rmdir, rm, rsh, split, sort, tail, talk, tar, telnet, touch, tput, tr, tty, uname, uniq, wc, who, write

File Systems: File names, File Types –Regular Files, Directories, File System Implementation - Operations Unique to directories and regular files, Security and File Permission

Shell Programming: Study of different types of shells, shell environment, Pattern matching - wild cards, Escaping, quoting, File I/O, Redirection, Pipes, Command substitution, shell variables, Aliases, Command history, interactive shell scripting using if, if-else, case, for, while, until statements

Editors: Modes, Structure, case study of vi, sed, gedit and word star, commands.

Filters: Regular expressions, syntax, character class, introduction to grep, egrep, pr, head, tail, cut, paste, sort, uniq, tr.

Processes in Linux: Processes, Process control, process creation, process termination, user id of a process, Job control e.g. at, batch, corn, time, signals and signal handlers, Linux I/O system,

Introduction to Utilities: Lex, Yacc utilities, Introduction to awk, perl and python programming.

Text Books:-

1. SumitabhaDas, *"UNIX Concepts and Applications"*, TMH, 8E, 2008.
2. Kernighan and Pike, *"Unix Programming Environment"*, PHI.
3. Kanetkar, *"Unix Shell Programming"*, BPB Publication.

References:-

1. Behrouz A. Forouzan, Richard F. Gilberg, *"UNIX and Shell Programming"*, 9E, Cengage Learning, 2009
2. M G Venkateshmurthy, *"UNIX and Shell Programming"*, Pearson Education, 2005
3. Maurice J. Bach, *"The Design of the Unix Operating System"*, Indian Edition, PHI Learning Private Limited, 2011

SEMESTER – IV

MCA-210 (Elective 4.2.1): E-Commerce

L	T	P	Total	Credits – 3
3	0	0	3	Duration of Exam- 3 Hours

Course Objective: *The purpose of this course is to introduce e-commerce, its impacts on business processes and key issues in the development of web based business information systems and applications.*

Introduction: Electronic commerce concepts, Electronic commerce environment, Electronic marketplace technologies, Web based tools for e-commerce, E-commerce softwares, Hosting services and packages, Managing the e-Enterprise, Business Models of E-Commerce, E-Business Models based on the Relationship of Transaction.

Ecommerce Security: Ecommerce Security issues, Threats to e-commerce, Approaches to safe e-commerce, Secure transactions and protocols, Intruder approaches, Security strategies and tools, Risk of Insecure systems, Risk Management Paradigms, Encryption, Security Teams, Protecting e-commerce assets : protecting client machines, servers and channels, Transaction integrity.

Ecommerce Payment: Electronic payment systems, Types of e-payment, Internet monetary payment and security requirements, Payment and purchase order process, Electronic cash, Electronic wallets, Smart cards, Credit and charge cards, Third Party Payment processing.

Ecommerce Marketing: Strategies for marketing, Creating web presence, Identifying and reaching customers, Web branding, Sales on the web, Strategies for purchasing and support activities, EDI, EDI Models and Protocols. Supply chain management, Softwares for purchasing, Strategies for web auctions, Virtual communities and web portals, International, Legal, Ethical and tax issues, Planning and managing e-commerce projects, Internet Marketing Techniques.

Text Books:-

1. P.T. Joseph, *"E-commerce: A Managerial Perspective"*, PHI, 2002.
2. Dave Chaffey, *"E-business and E-Commerce Management"*, 3E, 2009, Pearson education Inc., New Delhi.

References:-

1. Ellen Monk, Bret Wagner, *"Concepts in Enterprise Resource Planning"*, 2E, Cengage Learning India Pvt. Ltd., New Delhi.
2. K. K. Bajaj, D.Nag, *"E-Commerce"*, 2E, TMH, New Delhi.
3. https://quizlet.com/26989473/
4. www.tutorialspoint.com/e_commerce/e_commerce.pdf.
5. www.html-5-tutorial.com.
6. www.w3schools.com/html/.

SEMESTER – IV

MCA-210 (Elective 4.2.2): Principles of Compiler Design

L	T	P	Total	Credits – 3
3	0	0	3	Duration of Exam- 3 Hours

Course Objective: *Introducing students to the concepts and principles of compiler design, providing basic understanding of grammars and language, Introducing to the various phases of designing a compiler and various programming techniques and structures used in compiler construction, Providing students with practical programming skills necessary for constructing a compiler.*

Introduction: Compilers and its phases, Compiler structure, analysis-synthesis model of translation, compiler construction tools, Cross compilers: Bootstrapping.

Lexical and Syntax Analysis: Process of lexical analysis, specification of tokens, recognition of tokens, input buffering, automatic tools, finite state automata, DFA and NFA, recognition of regular expressions, LEX, Process of syntax analysis, types of grammar, top-down and bottom-up parsing techniques, parser generator, YACC, LR parsers, Canonical LR parser

Syntax-Directed Translation: Syntax directed translation schemes; implementation of syntax directed translation, postfix notation parse trees and syntax trees, postfix translation with top down parser.
Semantic analysis: declaration processing, type checking, symbol tables, Data structure for symbols tables, representing scope information, error recovery;
Run-Time Administration: Implementation of simple stack allocation scheme, storage allocation in block structured language. Error Detection & Recovery: Lexical Phase errors, syntactic phase errors semantic errors.

Intermediate Code Generation: Intermediate languages, generating intermediate code for declarative statement, assignment statement, Boolean expression, and case statement, three address code, quadruples and triples, translation of assignment statements,

Code Optimization: Introduction to code optimization, potential cases of code optimization, optimization of basic blocks, loops in flow graphs, code improving transformation.

Code Generation: The target machine, dynamic storage management, translating basic blocks, a simple code generator, peephole optimization, directed acyclic graphs and basic blocks, code generation from directed acyclic graphs.

A Complete Compiler: The grammar specification; scanner; parser; code generation; Building and running the compiler; The Assembler and the virtual machine.

Text Books:-

1) Aho, Ullman, &Sethi, *"Compilers: Principles, Techniques & Tools"*, 2E, Addison Wesley.
2) Aho& Ullman, *"Principles of Compiler Design"*, Narosa Publications.

References:-

1. HenkAlblas et al., *"Practice & Principles of Compiler Building with C"*, PHI.
2. Trembley& Sorenson, *"Principles of Compiler Design",* TMH.
3. Jean Paul Tremblay and Sorenson, *"The Theory and Practice of Compiler Writing"*, TMH.
4. Barret, Couch, *"Compiler Construction Theory and Practice"*, Computer Science series, Asian Student Edition.

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SEMESTER – IV

MCA-210 (Elective 4.2.3): Graph Theory

L	T	P	Total	
3	0	0	3	Credits – 3
				Duration of Exam- 3 Hours

Course Objective: - *To study graph theory, fundamentals, trails, circuits, trees, matrices, directed graphs, graph colouring, matching, covering, spanning trees, graphs applications and cycles etc.*

Introduction: Graphs and their applications, Graph terminologies, Directed graph, handshaking lemma, isomorphism, Euler's graphs, Hamiltonian graphs and their Applications in Computer Science, operations on graphs, distance between two nodes, diameter of a graph, eccentricity of a node, centre and median of graph.

Special classes of graphs: Complete graphs, bipartite graphs, planar graphs, line graphs, chordal graphs, dual graph, genus of a graph.

Tress and Spanning trees: Tree terminologies, types of trees, number of trees, spanning trees and its applications, minimal spanning tree and its algorithms

Cut Sets, cut Vertices and Fundamental circuits: Cut sets and their properties, Connectivity and separatibility. Network flows, Fundamental circuit, Min-cut theorem. Maximum flows algorithms.

Graph traversal: Tarry's traversal algorithm, BFS & DFS algorithms and applications, spanning trees construction using flooding and DFS

Graph colouring: Problem and model, greedy and random colouring algorithms, edge colouring, colouring trees, colouring planar and arbitrary graph, Chromatic number, Chromatic partitioning.

Independent sets, coverings, matchings and Vertex cover: concepts, Unweighted and weighted matching algorithms, matchings in bipartite graphs, matching from edge colouring, perfect matchings, Unweighted and weighted vertex cover algorithms

Algorithms in Routing: Shortest path algorithms, Dijkstra, Bellman-Ford, Floyd-Warshall,

Text Books:

1. NarsinghDeo, *"Graph theory and applications to Engineering and Computer Science"*, PHI, 1986.
2. K. Thulasirama, M. N. S. Swamy, *"Graphs theory and algorithm"*, John Wiley and Sons Inc.

References:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *"Introduction to Algorithms"*, PHI.
2. Douglas B. West, *"Introduction to Graph Theory"*, PHI.
3. Thomas Koshy, *"Discrete Mathematics with Applications"*, Elsevier, 2006.

SEMESTER-IV

MCA-212: Artificial Intelligence Lab

L	T	P	Total	Credits – 1
0	0	2	2	

Lab Objective: *Experimenting and implementing various algorithms covered in the AI course and also introduce some AI programming languages*

List of Experiments:

1. Problem solving by searching.
2. Find path between two nodes.
3. 8 puzzle problem with different heuristics
4. Shortest Path.
5. Sorting.
6. Traveling Salesman problem. The heuristic function used, number of nodes generated, depth of the search at each stages should be listed.
7. Implement Alpha – beta search procedures. Use it to play the game tic-tac-toe.
8. Write an Eliza like program to converse in some domain.
9. Develop a knowledge base system consisting of facts and rules about some specialized knowledge domain of your choice; Implement Unification Algorithms. Input data sets may be any Well Formed Formulas;
10. List manipulation Programs, union and intersection of two given sets represented as lists.
11. Given a knowledge base, the student should be able to it into wff's, clausal form and deduce something.
12. Water Jug problem.
13. Monkey Banana problem.
14. The classical Blocks World Problem.
15. Perform backward and forward reasoning.

SEMESTER-IV

MCA-214: Web Technology Lab

L T P Total **Credits – 1**
0 0 2 2

Lab Objective: *This Lab will enable students to experiment and visualize various network protocols, simulators. It also enhance understanding of web technologies that relate to the interface between web servers and clients.*

List of Experiments:

1. Implement html program for stylesheet consisting the use of external, internal and inline stylesheet, overriding sequences among them and use of id and class.
2. Implement HTML program for nested frame structure in TLB fashion consisting of targeting between frames and audio, video features and image mapping.
3. Implement HTML program for form consisting of controls (single line text field with size, value, maxlength; Dropdown list and scrolled list; Checkbox and radio controls; Text area with different wrapping options.
4. Apply validations (not null, min, max, multiple of n, read only and disabled, Pattern length, domain ,Overriding submit, formnovallidate) on form controls:
5. Embed XML into HTML document.
6. Implement a program to display XML data using XSL.
7. Implement a program to apply all the validation controls on XML data.
8. Implement JavaScript Regular Expressions, JavaScript Debugging.
9. Creating and reading cookies using java script/ASP/JSP
10. Implement PHP form handling.
11. Implement MySQL Database with PHP (creation, connection, queries to database).
12. Implement Web Services- WSDL, SOAP, AJAX, JQuery.
13. Implement JSP Scripting Elements, JSP Expressions.
14. Including Files & Applets in JSP documents, Database Connectivity.
15. Creating Beans for web Applications.

SEMESTER-IV

MCA-216: Innovative Project Development

L T P Total **Credits – 4**
0 0 8 8

Guidelines

1. Complete analysis of the research topic will be done in this semester with partial implementation as part of 4th sem and rest of the implementation as part of 5th sem.
2. The students should make a note that this Project Development is an extension of the Project Design done in Semester III.
3. Any changes / enhancements / updations in the Project topic should be reported to the Supervisors and the Project Coordinator of this semester by second week of the start of the semester.
4. After their Review of the Topic, the student has to report regular to his/her concerned supervisor.
5. Students have to submit the progress details of the project work to their supervisor weekly.
6. Students have to complete the project till last week of March.
7. Students have to prepare one Research paper for the Project.
8. Students will be rewarded with extra marks if their research paper is accepted for conference / journal depending on the impact of conference / journal.
9. Each group would be given 10-15 minutes to present their respective topics.
10. Students should focus on the Technical details (Implementation, Execution) supporting the research paper as part of proect work.
    The Presentation includes:-
    - Experimental Results
    - Discussion & Proofs to justify the efficacy of their work
    - Graphs (Result oriented) should be displayed.

11. **Marks Distribution**:

Queries	PPT skills	Report	Demo Project (Running) 50 Marks			Attendance	Total
10	10	20	Theoretical Modeling (10)	Coding (30)	Execution (10)	10	100

SCHEME AND SYLLABI
MASTER OF COMPUTER APPLICATIONS
NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA

Proposed (2016-2019)

SEMESTER – V

SUBJECT CODE	COURSE TITLE	Lecture Hours	LAB Hours	CREDITS
MCA-301	Cloud Computing Architecture	4	0	4
MCA-303	Cyber Security	4	0	4
MCA-305	Elective- I	3	0	3
MCA-307	Elective – II	3	0	3
MCA-309	Elective- III	3	0	3
MCA-311	Cyber Security Lab	0	2	1
MCA-313	Innovative Project Dissertation	0	12	6
			Total Credits	24

List of Electives (One from each block of electives)

Elective- I
5.1.6. Natural Language Processing
5.1.7. Distributed Computing System
5.1.8. Business Intelligence
5.1.9. Data Mining & data Warehouse
5.1.10. Social Networking

Elective- III
5.3.1. Computer Vision
5.3.2. Machine Learning
5.3.3. Bio. Informatics
5.3.4. Computer Graphics & Multimedia
5.3.5. Content Creation and Authoring Tools

Elective- II
5.2.6. Server management
5.2.7. Human Computer Interaction
5.2.8. Neural Network & Fuzzy Systems
5.2.9. System Programming
5.2.10. Enterprise Application Integration

SEMESTER – V

MCA-301: Cloud Computing Architecture

L	T	P	Total	Credits – 4
4	0	0	4	Duration of Exam- 3 Hours

Course Objectives: *To provide end-to-end coverage of fundamental cloud computing topics as they pertain to both technology and business considerations and to motivate students to do programming and experiment with the various cloud computing environments.*

Introduction: History of Centralized and Distributed Computing, Overview of parallel and Distributed Computing, Cluster computing, Grid computing. Technologies for Network based systems- System models for Distributed and cloud computing- Software environments for distributed systems and clouds.

Cloud issues and challenges: Properties, Service models, Deployment models. Cloud resources: Network and API - Virtual and Physical computational resources - Data-storage. Virtualization concepts - Types of Virtualization, Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs .

Performance measures on Cloud: Load balancing techniques for stateful and stateless applications. Performance metrics for evaluating Cloud applications with demonstration. Consistency, Availability and Partitioning (CAP) theorem and case studies.

Cloud based Data Storage: Introduction to Map Reduce for Simplified data processing on Large clusters, Design of data applications based on Map Reduce in Apache Hadoop, Task Partitioning, Data partitioning, Data Synchronization, Distributed File system, Data Replication , Shared access management- authentication, authorization and accounting - Cloud Provenance and meta-data - Cloud Reliability and fault-tolerance - Cloud Security, privacy, policy and compliance- Cloud federation, interoperability and standards.

Cloud Programming: Software Environments - Installing cloud platforms and performance evaluation Features and functions of cloud platforms: Xen Cloud Platform, Eucalyptus, OpenNebula, Nimbus, TPlatform, Apache Virtual Computing Lab (VCL), Enomaly Elastic Computing Platform, Windows Azure, Aneka, A Comparison of Cloud Computing Platforms, NoSQL Cloud storage for information storage and retrieval. Design and implement Cloud applications that can scale up on a VM and out across multiple VMs.

Text Books:-

1. Anthony Velte, Toby Velte and Robert Elsenpeter, *"Cloud Computing: A practical Approach"*, Tata McGrawHill (2009).
2. Barrie Sosinsky, *"Cloud Computing Bible"*, John Wiley & Sons (2010)
3. Danc.Marinercus, *"Cloud Computing Theory And Practice"*, Elsevier (2013).

4. Dinakar Sitaram, *"Moving to The Cloud"*, Elsevier (2014).
5. Dario Bruneo, Salvatore Distefano, *"Quantitative Assessments of Distributed Systems: Methodologies and Techniques"* Wiley-Scrivener (2015)
6. Gautam Shroff, *"Enterprise Cloud Computing"*, Cambridge (2010).
7. Gerard Blokdijk, Ivanka Menken, *"The Complete Cornerstone Guide to Cloud Computing Best Practices",* Second Edition, by Emereo Pty Ltd (2009)

References:-

1. Kai Hwang, Jack Dongarra and Geoffrey Fox, Morgan Kaufmann, *"Distributed and Cloud Computing: From Parallel Processing to the Internet of Things",* Tata Book House (2011)
2. Maozhen Li, Mark Baker, *"The Grid Core Technologies"*, John Wiley & Sons, (2005).
3. Pete Warden, *"An Introduction to Map Reduce with Pete Warden"*, O'Reilly Media, (2011).
4. Tim Mather, Subra Kumaraswamy, and Shahed Latif, *"Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance",* O'Reilly (2009)

SEMESTER – V

MCA-303: Cyber Security

L	T	P	Total	Credits – 4
4	0	0	4	Duration of Exam- 3 Hours

Course Objectives: *Introducing students to various cyber threats, tools for detection and recovery of cyber crimes.*

Introduction to Computer Security: State the basic concepts in information security, including Security Goals, security policies, security models, and security mechanisms. Introduction to techniques for defending against hostile adversaries in modern computer systems and computer networks. Viruses and related threats, Anatomy of Virus. Virus Counter Measures - Software Flaws: Buffer Overflow, Incomplete Mediation, Race Conditions, Malware: Brain, Morris Worm, Code Red, Malware Analysis, Malware Detection -Firewalls, Design principles, Types of Firewalls, Firewall Architectures, Trusted Systems.

Ethics and Law of Cyber Security: Introduction to the Legal Perspectives of Cybercrimes and Cyber security, Cybercrime and the Legal Landscape around the World, Why Do We Need Cyber laws, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario.

Ethical hacking: Introduction: Understanding the importance of security, Concept of ethical hacking and essential Terminologies-Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking, Foot printing, Scanning, System Hacking, Session Hijacking. Buffer Overflows attack, SQL Injection attack.

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Phishing and Identity Theft, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer overflows.

Web Application Security: Core Defense Mechanisms. Handling User Access, Authentication, Session Management, Access Control. Web Application Technologies: HTTP Protocol, Requests, Responses and Methods. Encoding schemes. Server side functionality technologies (Java, ASP, PHP).

Text Books:

1. Michael Goodrich, Roberto Tamassia, *"Introduction to Computer Security"*, Pearson (2013).
2. Dieter Gollmann, *"Computer Security"*, John Wiley & Sons, 2011.
3. Nina Godhole, Sunit Belapure, "*Cyber Security*", Wiley India.
4. James Graham, Ryan Olson, Rick Howard, "*Cyber Security Essentials*", CRC Press, Taylor & Francis Group.

References:

1. Bernard Menezes, "*Network Security and Cryptography*", Cengage Learning India.
2. William Stalling and Lawrie Brown, "*Computer Security: Principles and Practice*", Pearson Education (2010).
3. SunitBelapure Nina Godbole, "*Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*", Wiley India Pvt Ltd (2011).
4. Mark F Grady, FransescoParisi, "*The Law and Economics of Cyber Security*", Cambridge University Press (2006).
5. Jonathan Rosenoer, "*Cyber Law: The law of the Internet*", Springer-Verlag (1997).
6. Patrick Engebretson, "*The Basics of Hacking and Penetration Testing*", Elsevier (2013).
7. RajatKhare ,Luniver, "*Network Security and Ethical Hacking*", Press (30-Nov-2006).
8. Ankit Fadia, Manu Zacharia, Thomson, "*Network intrusion alert: an ethical hacking guide to intrusion detection*", Course Technology PTR (12-Jun-2007).

SEMESTER – V

MCA-305 (Elective 5.1.1): Natural Language Processing

L	T	P	Total		
3	0	0	3	**Credits – 3**	**Duration of Exam- 3 Hours**

Course Objective: *The Introduction to various recent statistical methods in natural language processing. Developing familiarity to linguistics and their application to part-of-speech tagging, background to various tools, aspects of NLP like syntax and semantic analysis, parsing, machine translation, information retrieval and statistical discourse processing.*

Introduction: Need for Processing Natural languages, Issues in NLP and Complexity of Processing NLP, Brief history of NLP application development.

Language Modeling: Various types of Languages and its modeling, Grammar based language models, Government and Binding, Lexical Functional Grammar and Paninian Grammar for handling natural languages, Statistical modeling.

Word Level Analysis: Regular expressions, Finite State Automata, Morphological parsing, Spelling Error Detection and Correction, Words and word classes (Hindi and English), Part of speech tagging : Rule-based tagger, Stochastic tagger, Hybrid tagger, Unknown words

Syntactic Analysis: Context Free Grammar, Phrase and sentence level Constructions,
Parsing: Top-down Parsing, Bottom-up parsing, A Basic Top-down Parser, The Earley Parser, The CYK Parser, Probabilistic Parsing : Estimating Rule Probabilities, Parsing PCFGs, Problems with PCFG

Semantic Analysis: Meaning Representation, Characteristics of Meaning Representation Languages, Meaning structure of languages, Syntax-driven semantic analysis, Semantic Grammars, Lexical Semantics, Relationships, Internal structure of words, Ambiguity, Word Sense Disambiguation, Selectional Restriction in Word sense Disambiguation, Context-based Word Sense Disambiguation Approaches, Knowledge sources in WSD, Applications of WSD, WSD Evaluation

Discourse Context and World Knowledge: Local discourse Context and Anaphora Resolution, World Knowledge, Discourse Structure, Discourse Analysis

Language Generation: Architecture of language generators, Template-based, Phrase-based and Feature-based Natural language generation, Knowledge-based Approaches

Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches: Direct Machine Translation, Rule-based
Machine Translation: Transfer-based and Interlingua based Machine Translation, Corpus-based Machine Translation: Statistical and Example-based Machine Translation, Semantic or Knowledge-based MT systems

Text Book:-

1. James Allen, "*Natural Language Understanding",* 2/e, Pearson Education, 2003.

References:

1. T. Siddiqui and U. S. Tiwary, *"Natural language Processing and Information Retrieval"*, Oxford Univ. Press
2. E. Charniac, *"Statistical Language Learning"*, MIT Press
3. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, *"NLP: A Paninian, Perspective*", Prentice Hall, New Delhi
4. Daniel M. Bikel, Imed Zitouni, *"Multilingual natural language processing Applications",* Pearson.

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SEMESTER – V

MCA-305 (Elective 5.1.2): Distributed Computing System

L T P Total **Credits – 3**
3 0 0 3 **Duration of Exam- 3 Hours**

Course Objective: *To understand fundamental concepts of distributed computing and to acquire knowledge about development of fault tolerant protocols for middleware design.*

Introduction: Goals, Advantages over centralized systems, Types of Distributed systems, Architecture styles, Architectures Versus Middleware, Self-Management in distributed systems, Processes, Threads, Distributed systems versus Parallel systems.

Communication: Fundamentals, Remote Procedure Call (RPC), Stream oriented communication Message ordering and group communication, Basic algorithms in message-passing systems, Multicast communication, Naming.

Synchronization: Clock Synchronization, Logical clocks, distributed mutual exclusion algorithms, Deadlock detection in distributed systems, Distributed shared memory, distributed transactions, consistency models, Replica management, Consistency protocols.

Fault Tolerance: Introduction, Process resilience, Reliable client server communication, Reliable group communication, Distributed commit, Check pointing and rollback recovery, secure channels, Access control, Security management, Distributed File Systems.

Distributed Operating Systems: Introduction to Distributed Operating Systems**,** Motivations, Management systems, Levels of distribution transparency, Architecture, Introduction to concurrency control.

Text Books:

1. Andrew S. Tanenbaum and Maarten Van Steen, *"Distributed Systems – Principles and Paradigms"*, PHI, Second edition, 2008.
2. Pradeep K Sinha, *"Distributed Operating Systems"*, PHI, New Delhi, 2001.

References:

1. Kshemkalyani, M. Singhal, *"Distributed Computing: Principles, Algorithms, and Systems"*, Cambridge University Press, 2007.
2. George Coulouris and Jean Dollimore, and Tim Kindberg, *"Distributed System Concepts and Design"*, 4th Edition, Addison Wesley, 2005.
3. Vijay K. Garg., *"Elements of Distributed Computing"*, Wiley & Sons, 2002.

SEMESTER – V

MCA-305 (Elective 5.1.3): Business Intelligence

L	T	P	Total	
3	0	0	3	Credits – 3
				Duration of Exam- 3 Hours

Course Objectives: *How to select or develop, and deploy an information system to help a manager in decision making, Introducing Business Intelligence, Make students to use data analysis techniques to make better business decisions and to use of simple tools for solving data mining problems.*

Business Intelligence:

Definition and History of Business Intelligence, Transaction processing versus analytical processing, BI implementation, Major tools and techniques of BI.

Business performance management:

Key performance indicators and operational metrics, balanced scorecard, Six Sigma, Dashboards and scorecards.

Data Warehousing:

Need for Data Warehousing, Paradigm Shift, Operational and Informational Data Stores, Data Warehouse Characteristics, Architecture for a Data Warehouse Data Warehouse Sourcing, Acquisition, Clean-up and Transformation tools, Metadata, Access Tools, Data Marts Building a Data Warehouse: Data Warehouse Schemas. Steps for the Design and Construction of Data Warehouses. Business consideration, Design consideration, Technical consideration, Integrated Solutions.

Data Mining: Introduction- Motivation, Knowledge Discovery Process, Kind of Data, Data Mining Functionalities, Interesting Patterns, Classification of Data Mining Systems, Major issues.Data Preparation: Pre-process, Data Cleaning, Data Integration and Transformation, Data Reduction.

Text and Web mining for Business intelligence:

Text mining Applications, Process and Tools, Web content, structure and usage mining

BI implementation, Integration and emerging trends

Implementing BI, BI Application Life Cycle, Connecting BI to Enterprise systems, On-demand BI, Issues of legality, privacy and Ethics, Emerging topics in BI, Social Networking and BI, RFID and BI

Text Books:-

1. EfraimTurban, Ramesh Sharda, Dursun Delen, and David King *"Business Intelligence: A Managerial Approach"*, Pearson.
2. Simon Miller, William Hutchinson *"Oracle Business Intelligence Applications"*, Oracle Press.
3. A. Berson, S.J. Smith, *"Data Warehousing, Data Mining & OLAP"*, McGraw-Hill.

References:-

1. J Han, M. Kamber and J. Pei, "Data Mining Concepts and Techniques", Elsevier India.
2. Pardeep Hari Pendse *" Business analysis"* ,PHI

SEMESTER – V

MCA-305 (Elective 5.1.4): Data Warehousing and Data Mining

L	T	P	Total	Credits – 3
3	0	0	3	Duration of Exam- 3 Hours

Course Objective: *To identify the scope and necessity of Data Mining & Warehousing for the society, to understand various tools of Data Mining and their techniques to solve the real time problems, to develop ability to design various algorithms based on data mining tools.*

Introduction: Data mining definitions, KDD vs data mining, DBMS vs DM, DM techniques, issues and challenges in Data mining, Applications and trends in DM.

Data Warehousing: Data Warehousing basics - what is DW, Difference between Operational Database and Data warehouse, Data Warehousing a multi-tier architecture, Metadata Repository, Data warehousing Modelling - Data cube, Star, Snowflake, Fact Constellation Schemas, Dimensions and Measures; OLAP operations, OLAP Server Architecture - ROLAP vs MOLAP vs HOLAP, DW Implementation - Efficient computation of DATA Cubes, Efficient Processing of OLAP queries.

Data Preprocessing: Data cleaning, Data Integration and Transformation, Data Reduction, Discretization and concept Hierarchy Generation. Task-relevant data, Presentation and Visualization of Discovered Patterns, Data Mining Query Language.

Data Mining Algorithms: Market Based Analysis, Apriori Algorithm, Improving the efficiency of Apriori. Mining Multidimensional Association rules, Mining Multilevel Association Rules.

Classification and Prediction: Decision Tree Induction, Bayesian Classification, Rule Based classification, back propagation, Support Vector Machines, Regression analysis under Prediction, Metrics for evaluating classifier performance

Cluster Analysis: Need of cluster analysis, Partitioning Methods, Hierarchical Method, Density Based Methods and Grid-based methods, Outlier Analysis and its types.

Web, Temporal and Spatial Data Mining: Web Mining - Need, Web Structure Mining, Web usage mining, Spatial Mining - Spatial mining tasks, spatial clustering, spatial trends, Temporal Mining-Modeling Temporal Events, Times series, Pattern Detection, Sequences.

Text Books:-

1. Jiawei I-lan, & Micheline kamber,*"data mining: Concepts and Techniques"*, Harcourt India Private Limited, First Indian Reprint, 2001
2. Arun K. Pujari, *"Data Mining Techniques"*, University Press (India) Limited, 1E, 2001

References:-

1. Margaret H.Dunham, *"Data Mining: Introductory and Advanced Topics"*, Pearson Education, First Indian Reprint, 2003
2. Paulraj Ponniah, *"Data Warehousing Fundamentals"*, A Wiley - Interscience Publication.

SEMESTER – V

MCA-305 (Elective 5.1.5): Social Networking

L	T	P	Total	Credits – 3
3	0	0	3	Duration of Exam- 3 Hours

Course Objective: *The study of networks, including computer networks, social networks, and biological networks*

Introduction: Networks in real life, telephone network, internet, power grid, transport network, delivery and distribution network, social networks, biological networks, ecological networks

Mathematical modelling and Metrics: General introduction to graphs and trees, types, properties, Laplacian graphs, bipartite graphs, hypergraphs, components, connectivity, strength of the graph, random graphs. Centrality: Degree, Eigenvectors, Katz, Pagerank, Hubs and Authorities, large structure of networks, power laws, scale free networks, distribution of centrality measures.

Computer Algorithms: Efficiency, Data-structure, Graph representations, degrees and their distributions, Shortest path algorithms, maximum and minimum cuts, Matrix algorithms, leading eigenvectors and centrality, network clusters, Graph partitioning, Spectral partitioning, Community detection, Simple and Spectral modularity, random graphs

Processes on Networks: Percolation and network resilience, epidemic modelling, Dynamic Systems and Network Search

Text Books:-

1. Mark Newman, *"Networks: An Introduction"*, Oxford University Press; 1 edition (May 20, 2010).
2. Alain Barrat, Marc Barthélemy, Alessandro Vespignani, *"Dynamical Processes on Complex Networks",* Cambridge University Press; Reprint edition (November 30, 2012).

References:-

1. Matthew O Jackson, *"Social and Economic Networks"*, Princeton University Press (3 December 2010).
2. Maarten van Steen, *"Graph Theory and Complex Networks: An Introduction"*, Maarten van Steen (5 April 2010).

SEMESTER – V

MCA-307 (Elective 5.2.1): Server Management

L	T	P	Total	Credits – 3
3	0	0	3	Duration of Exam- 3 Hours

Course Objective: *This course helps for server installations, server roles, active directory, server performance, server management and server maintenance. It also focuses on network infrastructure.*

Introduction: Installation-device drivers, services, server installation options, Server roles-application servers, Web services, remote access, file and print services, server virtualization, Active Directory-accounts and groups, organizational units and containers, Active Directory infrastructure, group policy, Storage - storage technologies, RAID, disk types, Server performance management- major server hardware components, performance monitoring, logs and alerts Server maintenance- start up process, business continuity, updates, troubleshooting methodology

Network Infrastructure: Internet, intranet and extranet, local area networks (LANs), wide area networks (WANs), wireless networking, network topologies and access methods, Hardware- Switches, routers, media types, Protocols and services (45-50%): Open Systems Interconnection (OSI) model, IPv4, IPv6, names resolution, networking services, TCP/IP
Installation and Configuration:

Servers, local storage, Server Roles & Features: file and share access, print and document services, remote management, Hyper –V- Create and configure virtual machine settings, virtual machine storage, virtual networks, Deploy & Configure Core Network Services: IPv4 and IPv6 addressing, Dynamic Host Configuration Protocol (DHCP) service, DNS service, Install & Administer Active Directory-Install domain controllers, Create and manage Active Directory users and computers, Active Directory groups and organizational units (OUs), Group Policy- Create Group Policy objects (GPOs), Configure security policies, Configure application restriction policies, Configure Firewall

Text Books:-

1. *"Windows Server Administration Fundamentals"* by Microsoft
2. Sander van Vugt, *"Red Hat Enterprise Linux 6 Administration: Real World Skills for Red Hat Administrators"*, Sybex.
3. *"Networking Fundamentals"*, by Microsoft
4. *"Installing and Configuring Windows Server 2012",* by Microsoft

References:-

1. https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/7/pdf/System_Administrators_Guide/Red_Hat_Enterprise_Linux-7-System_Administrators_Guide-en-US.pdf

SEMESTER – V

MCA-307 (Elective 5.2.2): Human Computer Interaction

L	T	P	Total	
3	0	0	3	Credits – 3
				Duration of Exam- 3 Hours

Course Objective: *The main objective is to perform analysis, establish requirements, design and evaluate interactive computer-based systems and products. It will discuss about the human cognition and human perspective by working with computers. Designing interactive computer systems to be efficient, easy, and enjoyable to use is important. The course will cover a broad knowledge regarding the human-friendly interface design.*

Introduction- Cognitive Psychology and Computer Science, Capabilities of Human-Computer Interaction(HCI), Goals of Human, Roles of Human, User Interfaces, Standards Framework of HCI, Architecture of HCI systems,

Design and Usability Engineering -Design goals, Guide lines for interface design, Steps in designing HCI Applications, Categories of Screen Based User Interface, Graphical User interface design, HCI and usability Engineering, Usability Engineering Attributes, Process of Usability.

Interface Evaluation and Testing- Importance of Interface Evaluation Testing, Criteria for Choosing an Evaluation Technique, Heuristic Evaluation Procedure, Cognitive Walkthrough, Interface Evaluation through user Participation, Universal Usability Testing, Testing Goals, Methods for recording Users Actions, Reliability and Validity in Usability Testing.

Interaction Devices: Keyboard and function keys, pointing devices, speech recognition digitization and generation, image and video displays.

Theory and HCI Standards- Theory behind Interface Design, HCI patterns, Design Rules, HCI Standards, User benefits from consistency and Standards, Strengths and limitations of HCI Standards, process-oriented standards, product-oriented standards.

Ambient Intelligence- Context-aware systems, Classifications of Contexts, Life Cycle of Context Aware Systems, Applications of Context Aware System, Recent Advances in Context aware systems, middleware framework, Middleware design considerations, developing middleware infrastructure.

Software tools and future of HCI: Software tools for human computer interaction, HCI related fields like Cognition Theory, Artificial intelligence and Accessibility Issues. Research directions in HCI

Text Books:-

1. K. Meena, R. Sivakumar, *"Human-Computer Interaction"*, PHI Learning, 2015.
2. S.A. Kelkar, " Usability and Human-Computer Interaction, A concise Study", PHI Leaning, 2016
3. Wilbert O Galitz, "*The essential guide to user interface design* ",Wiley

References:-

1. B. Shneiderman, C. Pelaisent, M. Cohen, S. Jacobs "*Designing the User Interface*" , Pearson.
2. Yvonne Rogers, Helen Sharp, Jenny Preece, "*Interaction Design: Beyond Human Computer Interaction*", Wiley
3. Dix A., Finlay J., Abowd G. D. and Beale R. "*Human Computer Interaction*", Pearson Education.

SEMESTER – V

MCA-307 (Elective 5.2.3): Neural Networks and Fuzzy System

L	T	P	Total	Credits – 3
3	0	0	3	Duration of Exam- 3 Hours

Course Objectives: *The objective is to introduce students to fundamentals and essential of neural networks & fuzzy system.*

Introduction: Neural network, single layer and multilayer networks, Training ANNs, Types of learning, Basic Learning laws (Hebb's rule, Delta rule, Competitive learning, Boltzmann learning)

Perceptron: Introduction, perceptron learning, perceptron training algorithms, BPN,CPN, Kohonen and Grossberg layers, Training of these layer, Feed forward counter propagation Neural Networks, Hopfield network, Exclusive OR problem, Linear separability.

Introduction to Fuzzy Logic: Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, a-cuts, fuzzy operations, fuzziness in neural networks, neural trained fuzzy system, Operations on Fuzzy Sets, Fuzzy Arithmetic, Fuzzy Relations: Crisp & Fuzzy Relations, Binary Fuzzy Relations, Binary Relations on single set, Equivalence, Compatibility & Ordering Relations, Fuzzy Relation Equations, Possibility Theory.

Fuzzy system Simulation: Fuzzy relational equations, non- linear simulations using fuzzy system, Bi-directional associative memory (BAM), Fuzzy association memory (FAM)

Text Books:-

1. S. Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall.
2. Timothy J Ross, Fuzzy Logic with Engineering Applications, TMH, 2007.
3. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley Publications.

References:-

1. C.M.Bishop, "Neural Networks for Pattern Recognition", Oxford: Oxford University Press.
2. J. A. Anderson, "An Introduction to Neural Networks", PHI.
3. G.J.Klir & B.Yuan, "Fuzzy sets & Fuzzy logic", PHI.
4. James A. Freeman and David M. Skapura, "Neural Network Algorithms, Application and Programming Techniques", Addison – Wesley publishing company.

SEMESTER – V

MCA-307 (Elective 5.2.4): System Programming

L	T	P	Total		
3	0	0	3		

Credits – 3

Duration of Exam- 3 Hours

Course Objective: *Use of Scripting Languages, The students will learn to write multi-process and multi-threaded programs, Consolidate the programming skills, The System Programming course concentrates on how programs run in user space and how the interact with the OS.*

Introduction: Language Processing-Its activities, Fundamentals of Language Processing Development Tools, System Software and Machine Architecture, Hypothetical Computer.

Assembler and Macro Processors: Basic Assembler functions, Machine-dependent and Machine-independent loader features, Assembler Design options, Implementation Examples, Basic Macro Processor functions- Machine –independent Macro Processor features, Design options and Examples.

Loaders and Linkers: Basic loader functions, Machine-independent Loader features, Design options Linkage editors, dynamic linking and Bootstrap Loaders. Implementation Examples, MS DOS linker, SUN-OS linkers and Cray MPP linker.

Compiler and Software Tools: Compiler Structure, Phases of Compiler, Comparison of compilers and Interpreters, Software Tools, Tools of Programming Development, editors, Debug monitors, Programming Environments, User Interfaces.

Text Books:-

1. Leland L. Beck, *"System Software- An Introduction to Systems Programming"*, Latest Edition, Addison Wesley.
2. D.M Dhamdhare, *" Introduction to Systems Software"*, Tata McGrew Hill, 2000
3. D. M. Dhamdhare, *"Systems Programming and Operating Systems"*, 2nd Ed. 1997. TMH Donovan J.J. *"Systems Programming"*, 1972, McGraw Hill.

References:-

1. Sivarama P. Dandamudi, *"Introduction to Assembly Language Programming"*, Springer 1st Edition, 2003.
2. Rajesh Kumar Maurya, *"System Programming"*, Dreamtech Press.

SEMESTER – V

MCA-307 (Elective 5.2.5): Enterprise Application Integration

L	T	P	Total	
3	0	0	3	

Credits – 3

Duration of Exam- 3 Hours

Course Objectives: *Describing the approaches to enterprise application integration, Understanding the integration middleware and evaluate the integration approaches suitable for a given problem*

Introduction: Requirements for EAI - Challenges in EAI – Integration with legacy systems Integration with partners - Heterogeneous environment – Implementation approaches – Web services, messaging, ETL, direct data integration – Middleware requirements – Approaches to integration – services oriented and messaging.

Integration Patterns: Introduction to integration patterns – Architecture for application integration – Integration patterns – Point to point, broker, message bus, publish/subscribe, Challenges in performance, security, reliability - Case studies

Service Oriented Integration: Business process integration - Composite applications-services – Web services – Service choreography and orchestration - Business process modeling - BPMN, Business process execution - BPEL – Middleware infrastructure - Case studies

Messaging Based Integration: Messaging – Synchronous and asynchronous – Message structure – Message oriented middleware – Reliability mechanisms – challenges – Messaging infrastructure – Java Messaging Services – Case studies

Enterprise Service Bus – routing, scalable connectivity, protocol and message transformations, data enrichment, distribution, correlation, monitoring – Deployment configurations – Global ESB, Directly connected, Federated, brokered ESBs – Application server based – Messaging system based – Hardware based ESBs – Support to SOA, message based and event based integrations - Case studies.

Text Books:-

1. George Mentzas and Andreas Frezen (Eds), *"Semantic Enterprise Application Integration for Business Processes: Service-oriented Frameworks"*, Business Science Reference, 2009
2. Waseem Roshen, *"SOA Based Enterprise Integration"*, Tata McGraw Hill, 2009.
3. G Hohpe and B Woolf, *"Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions"*, Addison Wesley Professional, 2003

References:-

1. D Linthicum, *"Next Generation Application Integration: From Simple Information to Web Services"*, Addison Wesley, 2003.
2. Martin Fowler, *"Patterns of Enterprise Application Architecture"*, Addison- Wesley, 2003
3. Kapil Pant and Matiaz Juric, *"Business Process Driven SOA using BPMN and BPEL: From Business Process Modeling to Orchestration and Service Oriented Architecture"*, Packt Publishing, 2008

SEMESTER – V

MCA-309 (Elective 5.3.1): Computer Vision

L	T	P	Total	Credits – 3
3	0	0	3	Duration of Exam- 3 Hours

Course Objective: *The objective of this course is to introduce the student to computer vision algorithms, methods and concepts, which enable the student to implement computer vision system with emphasis on applications and problem solving.*

Introduction: Geometric Primitives, Transformations, Photometric image formation, Digital Camera, Image Processing: Point operators, linear filtering, more neighbourhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Global optimization

Features detection, Segmentation and Alignment: Points and patches, Edges, Lines, Segmentation: Active contours, Split and merge, Mean shift and mode finding, Normalized cuts, Graph cuts and energy-based methods, Feature-based alignment: 2D and 3D feature-based alignment, Pose, estimation, Geometric intrinsic calibration,

Motion: Structure from motion: Triangulation, Two-frame structure from motion, Factorization, Bundle adjustment, constrained structure and motion, Dense motion estimation: Translational alignment, Parametric motion, Spline-based motion, Optical flow, Layered motion

Usage: Image Stitching: Motion models, Global alignment, Compositing, Computational photography: Photometric calibration, High dynamic range imaging, Super-resolution and blur removal, Image matting and compositing, Texture analysis and synthesis, Stereo correspondence: Epipolar geometry, Sparse correspondence, Dense correspondence, Local methods, Global optimization, Multi-view stereo

Advanced Applications: 3D reconstruction: Shape from X, Active range finding, Surface representations, Point-based representations, Volumetric representations, Model-based reconstruction, Recovering texture maps and albedos, Image-based rendering: View interpolation, Layered depth images, Light fields and Lumigraphs, Environment mattes, Video-based rendering, Recognition: Object detection, Face recognition, Instance recognition, Category recognition, Context and scene understanding, Recognition databases and test sets

Text Books:-

1. Richard Szeliski, *"Computer Vision: Algorithms and Application"*, Springer.
2. Mubarak Shah, *"Fundamentals of Computer Vision"*.

References:-

1. D. A. Forsyth, J. Ponce, *"Computer Vision: A Modern Approach"*, PHI Learning, 2009.
2. Milan Soanka, Vaclav Hlavac and Roger Boyle, *"Digital Image Processing and Computer Vision"*, Cengage Learning, 2014
3. R.C. Gonzalez and R.E. Woods, *"Digital Image Processing"*, Pearson Education, 2007

SEMESTER – V

MCA-309 (Elective 5.3.2): Machine Learning

L	T	P	Total	
3	0	0	3	**Credits – 3**
				Duration of Exam- 3 Hours

Course Objective: *Understanding the concepts of machine learning methods*

Introduction: Polynomial curve fitting, Probability Theory, Probability densities, Expectations and co-variances, Bayesian probabilities, Gaussian distribution, Curve fitting re-visited, Bayesian curve fitting, Model Selection, Curse of Dimensionality, Decision Theory, Minimizing the misclassification rate, expected loss, reject option, Inference and decision, loss function for regression, relative entropy and mutual information.

Binary and Multinomial Variables: The beta distribution, Dirichlet distribution, Conditional Gaussian distributions, Marginal Gaussian distributions, Maximum likelihood and sufficient statistics, Conjugate priors, Non informative priors, Kernel density estimators, Nearest-neighbour methods,

Linear Models for Regression: Linear Basis Function Model, Maximum likelihood and least squares, Geometry of least squares, Sequential learning, Regularized least squares, Bias-Variance Decomposition, Bayesian Linear Regression, Comparison, Evidence Approximation

Linear Models for Classification: Discriminant Function, Probabilistic Generative Model, Probabilistic Discriminative Models, Laplace Approximation, Bayesian Logistic Regression

Neural Networks: Feed-forward Network Functions, Network Training, Backpropagation, Hessian Matrix, Regularization, Bayesian Neural Network,

Kernel Methods: Kernel machines, Sparse Kernel Machines, Maximum margin classifiers, Relevance Vector Machines,

Other methods: Graphical models, mixture models, EM minimization etc.

Text Books:-

1. Christopher M. Bishop, *"Pattern Recognition and machine learning"*, Springer (October 1, 2007).
2. Tom M. Mitchell, *"Machine Learning"*, McGraw Hill Education India Private Limited; First edition (1 May 2013).

Reference:

1. Duda, Hart and Stork, *"Pattern Classification"*, Wiley-Blackwell; 2nd Revised edition (21 November 2000).

SEMESTER – V

MCA-309 (Elective 5.3.3): Bio-informatics

L	T	P	Total		
3	0	0	3		

Credits – 3

Duration of Exam- 3 Hours

Course Objective: *Introduction and historical perspective to the field of bioinformatics, learning of the key methods and tools used in bioinformatics, using, bioinformatics in your own work and learning their tools.*

Introduction- Concept and Historical Overview of Bioinformatics, Bioinformatics Applications, Major Databases in Bioinformatics, Data Management and Analysis, Molecular biology and Bioinformatics, Central Dogma of Molecular Biology.

Information search, Data Retrieval and Data Mining- Electronic Libraries, tools for Web Search, Data Mining, Applications of Data Mining to Bioinformatics Problems, Data Mining of Biological Databases.

Genome Analysis and Gene Mapping- Genome analysis and Mapping, The sequence assembly problems, Physical Maps, cloning the entire genome, application of Generic Maps, Sequence assembly tools, Identifications of Genes in Contigs, Human Genome Projects.

Phylogenetics- Taxonomic Relationships form molecular Properties, Tree Topologies, Gene Trees, Methods of Phylogenetics analysis, distance-based methods, character based methods, Tree Evaluation, Problems in Phylogenetics analysis, Automated Tools for Phylogenetics analysis.

Proteomics and Drug Discovery- Tools and Techniques in Proteomics, Protein-protein Interactions, Methods of Gene Family Identification, Post-translational Modifications, Areas Influencing Drug Recovery, Target Discovery strategy, Target Validations**.**

Text Books:

1. S.C Rastogi, N. Mendiratta, P. Rastogi, "*Bioinformatics Method and Applications"*, PHI Leaning
2. Claverie, J.M. and Notredame C, *"Bioinformatics for Dummies "Wiley* Editor.

References:

1. Jones, Pevzner ,*"An Introduction to Bioinformatics Algorithms"* by MIT Press.
2. Ion Mandoiu, Alexander Zelikovsky, *"Bioinformatics Algorithms - Techniques and Applications"*, John Wiley & Sons ltd.
3. B. Bergeron M.D., *"Bioinformatics Computing"*, Pearson.
4. T.K. Attwood, D.J Parry-Smith, S. Phukan, *"Introduction to Bioinformatics"*, Pearson.

SEMESTER – V

MCA-309 (Elective 5.3.4): Computer Graphics and Multimedia

L T P Total **Credits – 3**
3 0 0 3 **Duration of Exam- 3 Hours**

Course Objective: *This course is designed to provide a comprehensive introduction to computer graphics leading to the ability to understand contemporary terminologies. It focusing on 3D modelling, geometric transformation, image synthesis and rendering.*

Introduction: Survey of Computer Graphics and its applications, Components and working of Interactive Graphics, Display Processors.

Graphic Devices: Raster scan and Random Scan displays, Resolution, Aspect Ratio, Direct View Storage Tube, Refresh CRT, Color CRT monitors, LookUp tables, Plasma Panel and LCD monitors, interlacing, grey shades, Interactive Input Devices- keyboard, mouse, trackball, spaceball, joystick, light pen, digitizers, image scanners, voice system; Hard Copy Devices- printers, plotters.

Graphic Primitives: Introduction, Display devices, Primitive Operations, Normalized Device Coordinates, Display file - Interpreter, Structure, Algorithms, Display Control, Text, Line style primitive.

Line Drawing: Geometry and line generation, Vector Generation, DDA Algorithm, Bresenham's algorithms for line and Circle, Anti Aliasing, Character generation.

Polygons: Representation, Interfacing Algorithms, Filling.

2D Transformations: Scaling, Rotation, Translation, Homogenous coordinates, Coordinate Transformations, Rotation about arbitrary point, other types of transformations.

Windowing and Clipping: Viewing transformations, Line Clipping, Polygon clipping algorithms, Curve Clipping, Text Clipping and multiple windowing.

3-D Graphics: Transformations, Parallel Projection, Perspective Projection, Hidden surface and line Back face removal and algorithms, Z- buffers, scan line algorithm, Painters Algorithm, Comparison Techniques, Warnock's Algorithm, Franklin Algorithm, Illumination, shading algorithms.

Multimedia: Multimedia and Hypermedia, Overview of Multimedia software tools, Latest developments in field of multimedia (VOIP, video on demand and video conferencing.)

Text Books:-

1. Donald Hearn, Pauline Baker, "*Computer Graphics*: *'C' Version"*, PEA, 2E, 2004.
2. David F Rogers, "*Procedural Elements for computer Graphics"*, TMH, 2E, 2003.

References:-

1. Foley, Vandam, Feiner and Huges, "*Computer Graphics: Principles and Practice"*, PEA, 2E, 2004.
2. Newman, Sproull, "*Principles of Interactive Computer Graphics"*, MCG, 2E, 1973.

SEMESTER – V

MCA-309 (Elective 5.3.5): Content Creation and Authoring Tools

L	T	P	Total	
3	0	0	3	Credits – 3
				Duration of Exam- 3 Hours

Course Objectives: *Study of maintaining a large corporate website using CMS tools including Word Press, Drupal, Joomla -to create dynamic and flexible websites and landing pages with help of Authoring Tools.*

Introduction: Content Creation: Storyboarding, graphics and visualization, audio and podcasting, videos or simulations, web-based tools

Content Management System: Content Management System, Content Management System Framework. Popular content management systems (CMS), Terminology & Concepts: Open Source, CMS, Blog

Web-based Content Management Systems:

WORDPRESS: WordPress.org vs. WordPress.com, Installing WordPress, Exploring the admin interface, Content creation- Posts vs. pages, Content customization- images, video, audio, tags, formats, etc. Custom Theming

DRUPAL: Installing Drupal, Exploring the admin interface, Content creation- nodes, basic content, site information, Content customization- images, video, audio, tags, formats

JOOMLA: CAM model (Categories, Articles, Menus), Exploring CMS terminology, including open source, PHP, MySQL, server-side, client side, static HTML website, how CMS web pages are generated, and so forth. Website strategy and planning, site mapping, content planning. Examples.
Custom Templates:-Creation and uses of customized Joomla templates as well as modifying templates using CSS and HTML tricks.

Authoring Tools: Types of Authoring Tools, Card and page Based Authoring Tools, Icon based Authorized Tools, Time Based Authoring Tools, Object - Oriented Authoring Tools, Cross Platform Authoring Notes, Authoring Tools: Microsoft Word, Microsoft PowerPoint, Adobe Captivate Articulate.

Social Media & Internet Marketing Integration: Social Media, Landing pages, Email marketing, Tools and Methods that today's web publishers are using to create highly-tailored dynamic web content.

Text Books:-

1. Matt Beck, Jessica Neuman Beck, *"WordPress: Visual Quick start Guide",* 2E, Peachpit Press.
2. Marni Derr, Tanya Symes, *"Joomla! Visual Quick start Guide"*, 2E, Peachpit Press.

3. Angela Byron, Addison Berry, Bruno De Bondt, *"Using Drupal"*, O'Reilly.

References:-

1. Tay Vaughan, *"Multimedia: Making it work",* 4E, TMH, 1999

SEMESTER-V

MCA-311: Cyber Security Lab

L	T	P	Total	Credits – 1
0	0	2	2	

Lab Objective: *Hands on experience of various cyber threats, tools for detection and recovery of cyber crimes.*

List of Experiments:

1. Introduction to the Wireshark and analysis of a given set of protocols (HTTP, TCP, IP, UDP, DNS, ICMP and IGMP)
2. Learn to install wine / virtual box or any other equivalent software on the host os.
3. Perform an experiment to grab a banner with telnet and perform the task using netcat utility.
4. Perform an experiment for port scanning with nmap, superscan or any other software.
5. Using nmap 1)find open ports on a system 2) find the machines which are active 3)find the version of remote os on other systems 4)find the version of s/w installed on other system
6. Perform an experiment on active and passive finger printing using xprobe2 and nmap.
7. Performa an experiment to demonstrate how to sniff for router traffic by using the tool wireshark.
8. Perform an experiment how to use dumpsec.
9. Perform an wireless audit of an access point / router and decrypt wep and wpa.
10. Perform an experiment to sniff traffic using arp poisoning.
11. Install jcrypt tool (or any other equivalent) and demonstrate asymmetric, symmetric crypto algorithm, hash and digital/pki signatures
12. Introduction to network simulator ns2/ns3/opnet/omnet++
13. Configuration of voip server-client

SEMESTER-V

MCA-313: Innovative Project Dissertation

L T P Total **Credits – 6**
0 0 12 12

Guidelines

1. Students have to submit the synopsis of the extended version of the Research area to their respective supervisors till 3rd week of the semester.
2. After their Review of the Topic, the student has to Report regular to his/her concerned supervisors for guidance.
3. The focus of the Project should be on Theoretical modeling, algorithms, Problem Formulation, Objectives, Methodology, Constraints, Gantt chart and Ethical Issues, if any.
4. Student can show the progressive part / extended part of the area to the supervisors.
5. Attendance will be recorded weekly for all Project sessions and marks will be awarded for attendance.
6. Project presentations will start from first week of September.
7. After the discussion with his supervisor, the student has to perform a live demonstration of the project in Nov last week.
8. **Marks Distribution**:- **100 Marks**

Queries	Project	Dissertation	Attendance	Total
20	20	50	10	100

Note:

1. In order to get A or A+ grade one publication is mandatory throughout complete research time
2. Students have to provide weekly updates to their mentors regarding progress in Project work.
3. Students have to complete the project till last week of Nov 2016.
4. Please make it sure that the projects submitted for 5th Sem is acceptable as a quality Research project.

Dissertation:- Guidelines

1. Research Dissertation have following headings
    - Title, Members, Abstract, Keywords
    - Introduction
    - Literature survey and Comparative study
    - Challenges and Research gaps
    - Project proposal and Objectives
    - Tools and technology
    - At least 2 chapters pertaining to the project work
    - Results and discussion/Conclusion
    - Future scope

2. The dissertation should contain a certificate that will contain title, group no, name of supervisor, co-supervisor, and members and should be duly signed by supervisors.

Note:

- Project Report must be in spiral bound approximate range (40-60 pages).
- Project Report format must conform to following guidelines
    1. Single Column
    2. Size: International standard paper size A4 (297x210mm) should be used.
    3. Page Number: Page should be numbered consecutively and clearly. No page number should be indicated on title page, supervisor's certificates, declaration and acknowledgement, table of contents. From title page to abstract page Greek numbers should be used. From main text to end of thesis Indian numerals should be used.
    4. All typing should be on right hand pages only. Left side pages to be left blank.
        I. Margin: Top 1.0", Bottom 1.0" Left 1.5" Right 1.0".
        II. Line spacing: 1.5
        III. Font: Times new roman, size 12 for text, larger fonts may be used for headings & subheadings.
        IV. Text: Before producing the final copies of a project report the candidate should ensure that all the spelling, grammar, punctuation and bibliography is complete and exact.

- **Soft copy of the Report to be mailed at mcanitkuruproject@gmail.com. and the respective hard copy to be submitted to the coordinator.**

SCHEME AND SYLLABI
MASTER OF COMPUTER APPLICATIONS
NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA

Proposed (2016-2019)

SEMESTER – VI

SUBJECT CODE	COURSE TITLE	TIME DURATION	CREDITS
MCA-302A	Industrial Project*.	Full Semester	20
		Total Credits	20

* Project work shall be pursued for a minimum of 16 weeks.