Sri Sri University

FACULTY OF SCIENCE

DOCS-Department of Computer Science

M.Sc. in Computer Science with Specialization in Artificial & Intelligence & Machine Learning (2021-23) LOCF Based

MASTER OF SCIENCE DEGREE COURSE
M.Sc. COMPUTER SCIENCE WITH
SPECIALIZATION IN ARTIFICIAL
INTELLIGENCE & MACHINE LEARNING
UNDER SRI SRI UNIVERSITY
(With effect from 2020)

Preamble

Education is the key to development of any society. Role of higher education is crucial for securing right kind of employment and also to pursue further studies in best available world class institutes elsewhere within and outside India. Quality education in general and higher education in particular deserves high priority to enable the young and future generation of students to acquire skill, training and knowledge in order to enhance their thinking, creativity, comprehension and application abilities and prepare them to compete, succeed and excel globally. Sustained initiatives are required to reform the present higher education system for improving and upgrading the academic resources and learning environments by raising the quality of teaching and standards of achievements in learning outcomes in undergraduate program in professional streams of higher education like computer science. One of the significant reforms in the postgraduate education is to introduce the Learning Outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. LOCF also aims at ensuring uniform education standard and content delivery across the country which will help the students to ensure similar quality of education irrespective of the institute and location. With initiatives of University Grants Commission (UGC) for nation-wide adoption and implementation of the LOCF for PG programmes in colleges, universities and HEIs in general.So MSc Computer Science at Sri Sri University is designed as per LOCF & as per UGC guidelines.

The main objective of MSc Computer Science program at Sri Sri University is to prepare a comprehensive course structure with detailed syllabus along with quality reading material in order to have a uniform standard of education in PG Computer Science programme among students. This document shall serve as a model document across the higher education institutes (HEIs) in the country for teachers, students and academic administrators. It is a student centric framework where they are expected to learn fundamentals of computer science along with the latest trends and techniques like Artificial Intelligence, Internet of Things, Machine Intelligence,Cloud Computing alongwith advanced skillsets that include Mobile Application Development, Object Oriented Programming among many other courses. It will help the students to be equipped with fundamental as well as advanced and latest technologies in computer science after completion of the programme

Introduction

MSc Computer Science has been evolving as an important branch of science and engineering throughout the world in last couple of decades and it has carved out a space for itself like any other disciplines of basic science and engineering. Computer science is a discipline that spans theory and practice and it requires thinking both in abstract terms and in concrete terms. Nowadays, practically everyone is a computer user, and many people are even computer programmers. Computer Science can be seen on a higher level, as a science of problem solving and problem solving requires precision, creativity, and careful reasoning. The ever-evolving discipline of computer science also has strong connections to other disciplines. Many problems in science, engineering, health care, business, and other areas can be solved effectively with computers, but finding a solution requires both computer science expertise and knowledge of the particular application domain.

MSc Computer Science has a wide range of specialties. These include Computer Architecture, Software Systems, Graphics, Artificial Intelligence,M Computational Science, and Software Engineering. Drawing from a common core of computer science knowledge, each specialty area focuses on specific challenges. Computer Science is practised by mathematicians, scientists and engineers. Mathematics, the origins of MSc Computer Science, provides reason and logic. MSc Computer Science provides the methodology for learning and refinement.

MSc Computer Science will commence at Sri Sri University in this year 2020, as this discipline evolved itself to a multidisciplinary discipline. Information Technology is growing rapidly. Increasing applications of computers in almost all areas of human endeavour has led to vibrant industries with concurrent rapid change in technology. Unlike other basic disciplines, developing core competency in this discipline that can be reasonably stable becomes a challenge.

Career Objective

MSc Computer Science is aimed at postgraduate level training facilitating multiple career paths. Students so graduated, can take up postgraduate programmes in CS leading to research as well as R&D, can be employable at IT industries, or can pursue a teachers' training programme such BEd in Computer Education, or can adopt a business management career. . There are several employment opportunities and after successful completion of an MSc

Computer Science graduating students can fetch employment directly in companies as Web Developer, Software Engineer, Network Administrator, Data Scientist, or AI/ML personnel.

The Learning Outcome-based Curriculum Framework in MSc Computer Science is aimed at allowing flexibility and innovation in design and development of course content, in method of imparting training, in teaching learning process and in assessment procedures of the learning outcomes. The emphasis in computer science courses, in outcome-based curriculum framework, help students learn solving problems, accomplishing IT tasks, and expressing creativity, both individually and collaboratively. The proposed framework will help Students learn programming techniques and the syntax of one or more programming languages.

Many of the learning outcomes of MSc Computer Science can be achieved only by programming a computer for several different meaningful purposes. All students must, therefore, have access to a computer with a modern programming language installed. The computer science framework does not prescribe a specific language. The teacher and students will decide which modern programming languages students will learn. More importantly, students will learn to adapt to changes in programming languages and learn new languages as they are developed.

The present Learning Outcome-based Curriculum Framework for MSc Computer Science is intended to facilitate the students to achieve the following.

1.To develop an understanding and knowledge of the basic theory of Computer Science and Information Technology with good foundation on theory, systems and applications such as algorithms, data structures, data handling, data communication and computation.

2.To develop the ability to use this knowledge to analyse new situations

3.To acquire necessary and state-of-the-art skills to take up industry challenges. The objectives and outcomes are carefully designed to suit to the above-mentioned purpose.

4.The ability to synthesize the acquired knowledge, understanding and experience for a better and improved comprehension of the real-life problems

5.To learn skills and tools like mathematics, statistics, physics and electronics to find the solution, interpret the results and make predictions for the future developments.

Curriculum Planning- Learning Outcomes-based Approach for MSc Computer Science

MSc Computer Science in India is generally a two-year degree program which develops advanced theoretical and research skills in subject . It is an appropriate course for students who wish to pursue Mphil(CS) or Doctor of Philosophy (PhD) in CS and a research or academic career. This program facilitates students who wish to pursue an independent research project in an area of interest under the supervision of an academic.

Aims of MSc Computer Science Programmes

The MSc Computer Science emphasizes problem solving in the context of algorithm development and software implementation and prepares students for effectively using modern computer systems in various applications. The curriculum provides required computer science courses such as programming languages, data structures, computer architecture and organization, algorithms, database systems, operating systems, and software engineering; as well as elective courses in artificial intelligence, computer-based communication networks, distributed computing, information security, graphics, human-computer interaction, multimedia, scientific computing, web technology, and other current topics in computer science. The main aim of this Bachelor's degree is to deliver a modern curriculum that will equip graduates with strong theoretical and practical backgrounds to enable them to excel in the workplace and to be lifelong learners. The purpose of the MSc Computer Science programs are twofold: (1) to prepare the student for a position involving the design, development and implementation of computer software/hardware, and (2) to prepare the student for entry into Research field.

MSc Computer Science focus on the concepts and techniques used in the design and development of software systems. Students in this program explore the conceptual underpinnings of Computer Science -- its fundamental algorithms, programming languages, operating systems, and software engineering techniques. In addition, students choose from a rich set of electives that includes data science, computer graphics, artificial intelligence, database systems, computer architecture, and computer networks, among other topics. A generous allotment of free electives allows students to combine study in computer science with study in auxiliary fields to formulate a program that combines experiences across disciplines.

Programme Learning Outcomes for MSc Computer Science

The MSc Computer Science program enables students to attain, by the time of completion :

PLO-A. Demonstrate the aptitude of Computer Programming and Computer based problem solving skills.

PLO-B. Display the knowledge of appropriate theory, practices and tools for the specification, design, implementation

PLO-C. Ability to learn and acquire knowledge through online courses available at different MOOC Providers.

PLO-D. Ability to link knowledge of Computer Science with other two chosen auxiliary disciplines of study.

PLO-E. Display ethical code of conduct in usage of Internet and Cyber systems.

PLO-F. Ability to pursue higher studies of specialization and to take up technical employment.

PLO-G. Ability to formulate, to model, to design solutions, procedure and to use software tools to solve real world problems and evaluate .

PLO-H. Ability to operate, manage, deploy, configure computer network, hardware, software operation of an organization.

PLO-I.Ability to present result using different presentation tools.

PLO-J. Ability to appreciate emerging technologies and tools.

PLO-K. Apply standard Software Engineering practices and strategies in real-time software project development

PLO-L. Design and develop computer programs/computer -based systems in the areas related to algorithms, networking, web design, cloud computing, IoT and data analytics.

PLO-M.Acquaint with the contemporary trends in industrial/research settings and thereby innovate novel solutions to existing problems

PLO-N. The ability to apply the knowledge and understanding noted above to the analysis of a given information handling problem.

PLO-O. The ability to work independently on a substantial software project and as an effective team member.

The Course of Study and the Scheme of Examinations

Year / Semester	Subject	Paper	Title of the Paper	Credit	Max. Marks		
					IA	Uni. Exam	Total
I Year I Semester	Core	MCS101	Design and Analysis of Algorithms	4	40	60	100
	Core	MCS102	Computer System Architecture	4	40	60	100
	Core	MCS103	Database Systems & Implementation	4	40	60	100
	Core	MCS104	Discrete Mathematical Structures	4	40	60	100
	Elective I	MCS105	A) Optimization Techniques (or) (b) Object Oriented Programming using UML	4	40	60	100
	Core Practic	MCS106	C++ Lab	2		100	100
	Core Practic	MCS107	Database Lab	2		100	100
I Year II Semester	Core	MCS201	Computer Networks	4	40	60	100
	Core	MCS202	Advanced JAVA	4	40	60	100
	Core	MCS203	Operating System Design	4	40	60	100
	Core	MCS204	Theory of Computation	4	40	60	100
	Elective II	MCS205	(a)Introduction to Data Analytics (or) (b)Computer Graphics	4	40	60	100
	Core Practic	MCS206	JAVA Programming Lab	2		100	100
	Core Practic	MCS207	Operating Systems Lab	2		100	100
II Year III Semester	Core	MCS301	Artificial Intelligence(SP)	4	40	60	100
	Core	MCS302	Software Engineering	4	40	60	100
	Core	MCS303	Compiler Design	4	40	60	100
	Elective III	MCS304	(a) Cryptography & Cyber Security (or) (b) Cloud Computing	4	40	60	100
	Elective IV	MCS305	(a) Distributed System **(or)** (b) Mobile Computing (or) (c) Natural Language Processing	4	40	60	100
	Core Practic	MCS306	AI Programming Lab	2		100	100
	Core Practic	MCS307	Software Engineering Lab	2		100	100
II Year IV Semester		MCS401	Comprehensive Viva	4		100	100
		MCS402	Project Work and Viva Voce	12		300	300
			Total	**100**			**2500**

List of Electives *	
1	Optimization Techniques
2	Object Oriented Programming using UML
3	Computer Graphics
4	Cryptography & Cyber Security
5	Introduction to Data Science
6	Cloud Computing
7	Distributed System
8	Mobile Computing
9	Introduction to Data Analytic
10	Natural Language Processing

***Subject to availability of Faculty**

MCS101 DESIGN AND ANALYSIS OF ALGORITMS

UNIT-I

Introduction:

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework – Asymptotic Notations and its properties – Mathematical analysis for Recursive and Non-recursive algorithms. Amortized Analysis

UNIT-II

Brute Force and Divide-and-Conquer:

Brute Force – Closest-Pair and Convex-Hull Problems-Exhaustive Search – Traveling Salesman Problem – Knapsack Problem – Assignment problem. Divide and conquer methodology – Merge sort – Heap Sort- Quick sort – Binary search – Multiplication of Large Integers – Strassen's Matrix Multiplication-Closest-Pair and Convex-Hull Problems.

UNIT-III

Dynamic Programming and Greedy Techniques:

Computing a Binomial Coefficient – Warshall's and Floyd's algorithm – Optimal Binary Search Trees – Knapsack Problem and Memory functions. Greedy Technique– Prim's algorithm- Kruskal's Algorithm- Dijkstra's Algorithm-Huffman Trees.

UNIT- IV

Iterative Improvements:

The Simplex Method-The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs- the Stable Marriage Problem.

UNIT- V

Coping with the Limitations of Algorithm Power:

Limitations of Algorithm Power-Lower-Bound Arguments-Decision Trees-P, NP and NPComplete Problems–Coping with the Limitations – Backtracking – n-Queens problem – Hamiltonian Circuit Problem – Subset Sum Problem-Branch and Bound – Assignment problem – Knapsack Problem – Traveling Salesman Problem- Approximation Algorithms for NP – Hard Problems – Traveling Salesman problem – Knapsack problem.

Text Books:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.

Reference books:

1. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

2. Donald E. Knuth, “The Art of Computer Programming”, Volumes 1& 3 Pearson Education, 2009. Steven S. Skiena, “The Algorithm Design Manual”, Second Edition, Springer, 2008
3. http://nptel.ac.in/

MCS102: COMPUTER SYSTEM ARCHITECTURE

UNIT I Fundamentals of Digital Electronics: Data Types, Complements, Fixed -Point Representation, Floating-Point Representation, Binary Codes, Error Detection Codes, Logic Gates, Boolean Algebra, Map Simplification, Combinational Circuits, Flip - Flops, Sequential Circuits, Registers, Counters, Multiplexer, D-multiplexer, Decoder, Encoder.

UNIT II Register Transfer and Micro operations: Register Transfer Language, Register Transfer, Bus & Memory Transfer, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operation.

UNIT III Basic Computer Organization: Instruction codes, Computer Registers, Computer Instructions, Timing & Control, Instruction Cycles, Memory Reference Instruction, Input - Output & Interrupts, Complete Computer Description & Design of Basic Computer.

UNIT IV Processor and Control Unit: Hardwired vs. Micro programmed Control Unit, General Register Organization, Stack Organization, Instruction Format, Data Transfer & Manipulation, Program Control, RISC, CISC, Pipe-lining.

UNIT V Memory and I/O Systems: I/O Interface, Data Transfer Schemes, Program Control, Interrupt, DMA Transfer, I/O Processor. Memory Hierarchy, Processor vs. Memory Speed, High-Speed Memories, Cache Memory, Associative Memory, Interleave, Virtual Memory, Memory Management.

UNIT VI Parallelism: Instruction-level-parallelism – Parallel processing challenges – Flynn’s classification – Hardware multi-threading – Multi-core processors

Text Book:

1. Stallings, W. Computer Organization and Architecture 4/ed. (PHI)

Reference Books

1. Mano. M . M.: Computer System Architecture 3/ed. (PHI)
2. Hayes, J.P.: Computer Architecture and Organization 3/ed. (Mc. Graw-Hill Int.)
3. Quinn, M. J.: Parallel Programming in C with MPI and OpenMP (TMH)

MC103 DATABASE SYSTEMS & IMPLEMENTATION

UNIT-I

Database System : Database System Applications, Database Systems versus File Systems, View of Data & Data Models, Database Languages, Database Users and Administrators, Transaction Management, Database System Structure, Application Architecture. Entity-Relationship Model : Basic Concepts & Constraints, Keys, Design Issues, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R Features, Design of E-R Database Schema, Reduction of an E-R Schema to Tables, Overview of Relational Model and Relational Database Design.

UNIT-II

SQL : Basic Structure, Set Operations, Aggregate Functions, Null Values, Nested Sub-queries, Views, Complex Queries, Modification of the Database, Joined Relations, Data-Definition Language, Embedded SQL. Dynamic SQL. Integrity and Security: Domain Constraints, Referential Integrity, Assertions, Triggers, Security and Authorization, Authorization in SQL, Encryption and Authentication.

UNIT-III

Query Processing: Measures of Query Cost, Selection Operation, Sorting, Join and other Operations, Evaluation of Expressions. Query Optimization: Estimating Statistics of Expression Results, Transformation of Relational Expressions, Choice of Evaluation Plans, Materialized Views.

UNIT-IV

Object-Oriented Databases: Complex Data Types, Object-Oriented Data Model, Object-Oriented Languages, Persistent Programming Languages, Persistent C++ Systems, Persistent Java Systems. Object-Relational Databases: Nested Relations, Complex Types, Inheritance, Reference Types, Querying with Complex Types, Functions and Procedures, Object-Oriented Vs Object-Relational.

UNIT-V

Transactions: Transaction, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Transaction Definition in SQL, Testing for Serializability. Concurrency Control: Lock-Based, Timestamp-Based, Validation-Based Protocols Multiple Granularity, Multiversion Schemes, Deadlock Handling, Insert and Delete Operations, Weak Levels of Consistency, Concurrency in Index Structures. Recovery System : Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery, Shadow Paging, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Nonvolatile Storage, Advanced Recovery Techniques, Remote Backup Systems.

Text Book:

Silbcrschatz. A,. Korth, H.F., and Sudarshan.S. : Database System Concepts 4/ed.

(McGraw-Hill Int.)

MCS104 DISCRETE MATHEMATICAL STRUCTURES

UNIT-I
Fundamentals of logic, Prepositional equivalences, Predicates and Quantifiers, Nested Quantifiers, Methods of Proof, Sequences and summations, Mathematical Induction.

UNIT-II
Sets, set operations, properties of binary relations, equivalence relations and partitions, partial ordering relations and lattices, chains and anti-chains, functions and the pigeonhole principle.

UNIT-III
The basics of counting, permutations and combinations, recurrence relations, solving recurrence relations, generating functions, inclusion – exclusion

UNIT-IV
Introduction to graphs, graph terminology, Representing graphs and graph isomorphism, Euler and Hamilton paths, introduction to trees, applications of trees.

UNIT-V
Groups, subgroups, cosets and Lagrange's Theorem, Codes and group codes, homomorphisms and normal subgroups, Isomorphisms, Ring, Integral Domains and Fields.

Text Book:
1. C.L. Liu, "Elements of Discrete Mathematics", Mc Graw Hills International Second Edition.
2. Kenneth H. Rosen, Discrete Mathematics and its Applications, Mc Graw Hills International Fifth Edition.

Reference Books:
1. Bernardi Kolman, Robert C. Busby, Sharon Ross, "Discrete Mathematical Structure" Prentice Hall of India.

2. Mott, J.L, Kandel, A. & Baker, T.P..: Discrete Mathematics for Computer Science and Mathematics, 2/ed (P 1999)
3. N.Ch. S.N. Lyengar, Chankrasekaran, Venkatesh, Arunachalam, "Discrete Mathematics", Vikas Publication.

MCS105A- OPTIMIZATION TECHNIQUES

UNIT-I

Basics of idea of optimization of a function: Extremizer of function of single variable, and several variables, local minimizer and global minimizer of functions. Concept of critical points. feasible regions, convex region. Constrained optimization, unconstrained optimization. Introduction to linear programming problem(lpp). Formulation of lpp. Basic feasible solution of set of linear constraints. Determination feasible solutions of lpp with two variables by graphical method, use of iso-profit line. Different forms of lpp, standard form and canonical form.

UNIT-II

Solution of linear programming problem : Solution of lpp by simplex method, use of artificial variable in solving lpp. Identifying initial basic feasible solution, solution of lpp by Big-M method, and by two phase method. Duality in lpp , general rule for converting primal lpp to its dual. Dual simplex method is solving special types of lpp. Duality theorems (discussions on statements only), duality techniques in solving lpp.

UNIT-III

Special types of lpp : Introduction to transportation problem(TP) as an lpp. Solution of transportation problem: searching initial basic feasible solution of transportation problem by Vogel's method, test for optimality in TP, improving feasible solution for optimality, optimal solution of TP by MODI method. Degeneracy in TP. Introduction to assignment problem as special type of TP, solution of assignment problem by Konig's algorithm. Special type of assignment problem prohibited assignment and traveling sales man problem.

UNIT-IV

Network Scheduling Problem: Introduction to network scheduling problem, Network and basic components, rules of network construction. Network scheduling by Critical Path Method (CPM) and Program Evaluation and Review method, distinction between CPM and PERT method.

UNIT-V

Non Linear Programming : One dimensional optimization, unimodal functions and its minimizer, optimization of unimodular functions by function comparison methods-two point equal search method, bisection method, golden section method; polynomial interpolation methods- quadratic interpretation, cubic interpretation; iterative methods- Newton's method, secant method. Unconstrained gradient based optimizations; method of steepest descent method, conjugate gradient method, Newton type method. Constrained optimization of non linear functions in function of several variables- Lagrange multipliers method, optimization by using Khun-Tucker conditions.

Recommended Books:

1.Operations Research, K. Swarup, P. K. Gupta, M. Mohan, Sultan Chand & sons, New Delhi, 1990.
2. Optimization : Theory and Practice, M. C. Joshi, K. M. Moudgalya, Narosa Publishing House.
3.Optimization Techniques: An Introduction,L. R. Foulds,Springer-Verlag.
4. Optimization Techniques,Chander Mohan and Kusum Deep,New Age Science.
5. Operation Research : An Introduction, H. A Taha, Mc Millan Publishing Co, New York, 1986.

MCS105B OBJECT ORIENTED DESIGN USING UML

UNIT-I

Complexity: The inherent complexity of software – The Structure of complex systems – Bringing order to chaos – On designing complex systems. – Categories of analysis and design methods. The Object Model : The evolution of object model – Elements of object model – Applying the object model – Foundations of the object model. Classes and Objects : The nature of an object – Relationship among objects – The nature of a class – Relationship among classes

UNIT-II

Structural Modeling: Introduction to UML – Software development life cycle -RUP–Inception , Elaboration, Construction and Implementation-Classes – Relationships – Interfaces, Types and roles – Packages – Instances – Class diagram – Object diagram.

UNIT-III

Behavioral Modeling: Use cases – Use case diagram – Interaction diagram – Activity diagrams – Events and signals – State machines - Processes and Threads – State chart Diagrams.

UNIT-IV

Architectural Modeling: Components – Component Diagram - Deployment – Deployment Diagrams – Patterns and Frameworks - Systems and Models.

UNIT-V

Distributed objects communication between distributed objects-Distributed object model-Case Study: ATM, Library Information System, Payroll system, Student Information System, Railway Reservation System.

Text Book(s)

1. Grady Booch, "Object –Oriented analysis and Design with Applications", Pearson Education.
2. Grady Booch, James Rumbaugh and Ivar Jacobson, "The Unified Modeling Languages User Guide", Pearson Education.
3. H Srinath, H Eriram, A Krishnamurthy by Scitech "OOAD using UML"

References

1. Ali Bahrami, "Object Oriented Systems Development" Irwin-McGraw Hill, New Delhi, International editions, 1999.
2. Martin Fowler, Kendall Scott, "UML Distilled-Applying the standard Object Modeling Language", Addition Wesley 1977.
4. UML in a Nut Shell by Alhir SPD Orilley

MCS201 COMPUTER NETWORKS

UNIT-I

Encoding & Modulation: Digital-To-Digital, Analog-to-Digital, Digital-to-Analog and Analog-t-Analog Conversions. Transmission of Digital Data, Interfaces and Modems: Digital Data Transmission, DTE-DCE Interface Standards, Modems, 56K Modem, Cable Modem. Multiplexing: Frequency Division, Wave Division and Time Division Multiplexing, Multiplexing in the Telephone System, Digital Subscriber Line (DSL), FTTC.

UNIT-II

Data Link Control: Line Discipline, Flow Control, Error Control. Data Link Protocols: Asynchronous Protocols, Character-Oriented Protocols, Bit-Oriented Protocols, Link Access Procedures. Local Area Networks: Project 802, Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, Token Bus, Token Ring, Fiber Distributed Data Interface (FDDI).

UNIT-III

Metropolitan Area Networks: IEEE 802.6 (DQDB), Switched, Multimegabit Data Services (SMDS). Switching: Circuit Switching, Packet switching, Message Switching. Point-To-Point Protocol: Transition States, PPP Layers, Link Control Protocol (LCP), Authentication, Network Control Protocol (NCP).

UNIT-IV

Integrated Services Digital Network: Services, Scribers Access to the ISDN, ISDN layers, Broad Band ISDN. X.25 : X.25 Layers. Frame Relay: Frame Relay Operation, Frame Relay Layers, Congestion Control, Leaky Bucket Algorithm, Traffic Control.

UNIT-V

ATM: ATM Architecture, Switching, Switch Fabrics, ATM Layers, Service Classes, ATM Applications. SONET: Synchronous Transport Signals, Physical Configuration, SONET Layers, SONET Frame, Multiplexing STS Frames, Applications. Networking & Internetworking Devices: Repeaters, Bridges, Routers, Gateways, Routing Algorithms (Distance Vector & Link State Routing).

Text Book :

1. Forouzan, B. A.: Data Communications and Networking, 2/Ed (TMH)

Reference Books :

1. Tanenbaum, A. S.: Computer Networks, 4/Ed (PHI)

MCS202 ADVANCED JAVA

UNIT-I

Introduction to JAVA & its various features, JAVA Virtual Machine its architecture. Installation of JDK and 'CLASSPATH' setting, A First Java Program, Compilation and Applications, The JDK Directory Structure ,Lexical issues of java Class, Object, Instance Data and Class Data, Methods, Constructors, Access Modifiers, Destroying Objects , inheritance, overriding , Dynamic method dispatch abstract class interface ,Wrapper class boxing unboxing autoboxing and autounboxing, Package, multithreading , exception handling ., console and File I/ O

UNIT-II

GUI basic, introduction to swing difference between AWT and swing , Swing components and containers Layout managers, event handling , Applets ,life cycle of applets steps for making applet, JLabel,JButton, JCheckBox, JRadioButton, JScrollPane, JTextField , JTextArea ,JMenu, JTable ,dialog boxes.

UNIT-III

JDBC concept The JDBC Connectivity Model, JDBC drivers ,Database Programming, Connecting to Database, Working with database tables, SQLWarning Classes, Executing SQL Queries, ResultSet MetaData, PreparedStatement, Parameterized Statements, Stored Procedures and Transaction Management, Networking , Basics of Networking, Inet Address, TCP/IP Sockets ,Data Grams, Simple Client Server socket programming. Remote method invocation (RMI)

UNIT-IV

J2EE Overview, Client Tier, Middle Tier, Application Server Tier, The J2EE Platform, Servlet , life cycle of servlet steps for making servlet, deployment ,Deployment descriptor and its configuration , Session tracking The JSP Solution, JSP Syntax & Deployment, Variables and Expressions, Sessions in JSP, page and taglib Directives .

UNIT-V

Enterprise java beans(EJB) ,EJB architecture , Classification of EJB, Session Beans , Stateless and Stateful Session bean ,Bean class , Developing and running bean application ,MVC (Model View Control) architecture

JAR Concepts, Steps for creating simple jar files, Creating executable JAR Files.

Books:

1. JAVA The Complete Reference Herbert Schildt Tata McGraw-Hill
2. JAVA Server Programming Balck Book Kogent Dreamtech publication
3. Programming in JAVA Sachin Malhotra Saurabh Choudhury Oxford publication
4. Introduction to Java Programming Y. Daniel Liang Person publication

MCS203 OPERATING SYSTEM DESIGN

UNIT- I

Operating System, Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Distributed Systems, Special Purpose Systems, Computing Environments, Open-Source Operating Systems. Operating System Services, User Operating System Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating System Structure, Virtual Machines, Operating System Debugging, Operating System Generations. System Boot.

UNIT- II

Process: Process Concept, Process Scheduling, Operations on Processes, Inter-Process Communication, Examples of IPC Systems, Communication in Client-Server Systems. Multithreaded Programming: Multithreading Models, Thread Libraries, Threading Issues, Operating-System Examples.

UNIT- III

Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling. Multiple-Process Scheduling. Synchronization: The Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Monitors, Synchronization Examples, Atomic Transactions.

UNIT- IV

Deadlocks: System Model, Deadlock Characterization, Methods of Handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock Detection, Recovery from Deadlock. Memory Management Strategies: Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Example: The Intel Pentium.

UNIT- V

Virtual-Memory Management: Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory. File System: File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection.

TEXT BOOK:

Operating System Concepts**:** Silberschatz, Galvin, Gagne, 8/e (Wiley-India)

MCS204 THEORY OF COMPUTATION

UNIT I: - Regular Languages & Finite Automata:

Deterministic Finite Automata, Non-deterministic Finite Automata, Equivalence of NFA, and DFA. Regular Expressions & Languages, Conversion of DFAs to Regular Expressions, and vice versa. Properties of Regular Languages: Pumping Lemma, Closure properties: Union, Intersection, Complement, Difference, Reversal, Homomorphism, and Inverse Homomorphism. Decision Problems for Regular Languages, DFA Minimization.

UNIT II: - Context Free languages & Pushdown Automata

Context Free Languages, Context Free Grammars, Derivation, Ambiguity, Parsing. Pushdown Automata: Definition of PDAs, Acceptance of PDAs by final state and by empty stack. Conversion of CFG to PDA and vice versa. DPDAs & DCFLs, Determinism & Parsing. Simplification of CFG's, Chomsky Normal Form. The Pumping Lemma for CFL's. Closure properties: union, concatenation, *, +, Homomorphisms, and Reversal. Nonclosure under reversal and complementation. Decision Problems for CFLs, CYK Algorithm, Undecidable Problems for CFLs.

UNIT III: - Turing Machines

TM Definition and Notation; Instantaneous Descriptions, NTM & DTM, Programming tricks for TMs, Examples involving TM Computations, Extensions & Restrictions to Basic TM Model, (Multi Tape, Multi Dimensional, Counter machine, Two Stack PDAs).

UNIT IV: - Decidability Theory

The Church-Turing Thesis, Universal Turing Machines and TM Encoding. Decidable and semi-decidable languages, Recursive Enumeration and Decidability, Many-one Reductions, Hardness, Undecidability, Closure Properties. The Diagonalization Language, The Halting Problem, Post's Correspondence Problem, Undecidable Problems from Language Theory, Rice's Theorem. Linear Bounded Automata (LBA).

UNIT V: - Complexity Theory

Measuring Complexity, The Big **Oh**, **Theta, Big Omega** Notations, Time Complexity classes: P, NP, NP-Completeness, Coping with NP-Completeness. Cook-Levin's Theorem, Some NP-Complete Problems: SAT, 3-SAT, Hamiltonian Path, Vertex Cover, Independent Set. Space Complexity classes: PSPACE, L, NL.

Text Book: Introduction to Automata Theory, Language & Computation- Hopcroft, Motwani & Ullman

MCS205 INTRODUCTION TO DATA ANALYTICS

UNIT-I

Introduction: Definition of data mining - data mining vs query tools - machine learning -taxonomy of data mining tasks - steps in data mining process - overview of data mining techniques.

UNIT-II

Data Pre-Processing And Characterization: Data Cleaning - Data Integration and Transformation - Data Reduction - Discretization and Concept Hierarchy Generation - Primitives - Data Mining-Query Language - Generalization - Summarization - Analytical Characterization and Comparison

UNIT-III

Association Rule - Mining: Market basket analysis, frequent Itemset generations, The Apriori principle, Candidate Itemset generation and Pruning, Support counting using Hash tree, Multi Dimensional data from Transactional Database and Relational Database. FP-Growth Algorithm, objective measures of Interestingness

UNIT-IV

Classification: Classification - Decision Tree Induction - Bayesian Classification - Back Propagation, Lazy learners, K-Nearest Neighbour, Rule based classification, Accuracy, Prediction-Linear regression, Non-linear regression models

UNIT-V

Cluster analysis: Types of data, Distance measures, Evaluation criteria measures, Clustering Methods - Partitioning methods, K-Means, Density based method- DBSCAN, Model based clustering methods – Expectation-maximization, outlier analysis.

Text Books

1. Jiawei Han, Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufman Publishers, 2006.

Reference Books

1. Usama M.Fayyad, Gregory Piatetsky Shapiro, Padhrai Smyth, Ramasamy Uthurusamy, Advances in Knowledge Discover and Data Mining, The M.I.T.Press, 2007.
2. Ralph Kimball, Margy Ross, The Data Warehouse Toolkit, John Wiley and Sons Inc., 2002.
3. Alex Berson, Stephen Smith, Kurt Thearling, Building Data Mining Applications for CRM, Tata McGraw Hill, 2000.
4. Margaret Dunham, Data Mining: Introductory and Advanced Topics, Prentice Hall, 2002.
5. Daniel T. Larose John Wiley & Sons, Hoboken, Discovering Knowledge in Data: An Introduction to Data Mining, New Jersey, 2004.
6. M.Panda, S.Dehuri and M.R.Patra, Modern Approaches of Data Mining: Concepts and techniques, Narosa Publications, 2016

MCS301 ARTIFICIAL INTELLIGENCE

UNIT-I

Introduction to AI: History of AI, State of the Art Intelligent Agents,
Problem Solving by Searching: BFS, Uniform Cost Search, DFS, IDS, Bi-directional Search, Constraint Satisfactory Search, Informed Search Best First Search, Heuristic Function, Memory bounded search, A* and IDA*,
Game Playing: Min-Max search and Alpha-Beta pruning.

UNIT-II

Knowledge & Reasoning: Agents that reason logically, First Order Logic, Syntax and Semantics. Inference in First Order Logic: Inference Rules, Modus Ponems, Unification, Forward and Backward Reasoning,
Resolutions Planning: A simple Planning Agent, from Problem Solving to Planning, Planning in Situation Calculus.

UNIT-III

Learning: Learning from Observations. A General Model of Learning Agents, Inductive Learning; Expert Systems, Robotics.
Introduction to Machine Learning: Statistical Technique, Artificial Neural Network, Hidden Markov Model.

UNIT-IV

Introduction to Pattern Recognition: Recognition & Classification Process, learning, Classification Patterns, Visual Image Understanding, Image Transformation; Perception: Image Formation, Image Processing Operations for easy Vision, Speech, Recognition.
Introduction to Robotics: Parts of a Robot.

UNIT-V

Dealing with Uncertainty and Inconsistencies in Big Data: Truth Maintenance System, Default Reasoning, Probabilistic Reasoning, Bayesian Probabilistic Inference, Possible World Representations.
Understanding Natural Languages: Syntactic Processing, Semantic Analysis, Parsing Techniques, Efficient Parsing, Context-Free and Transformational Grammars, Recursive and Augmented Transition Nets.

Text Book:
Stuart Russel &, Peter Norvig: Artificial Intelligence A Modern Approach (Person Education Asia.) 3rd edition.

MCS302 SOFTWARE ENGINEERING

UNIT-I

Computer-Based System Engineering: Emergent System Properties, Systems and their Environment, System Modeling, System Engineering Process, System Procurement. Software Processes: Software Process Models, Process Iteration, Software Specification, Design and Implementation, Software Validation and Evaluation, Automated Process Support. Project Management: Management Activities, Project Planning, Project Scheduling, Risk Management.

UNIT-II

Software Requirements: Functional and Non-Functional Requirements, User Requirements, System Requirements, Software Requirements Document. Requirements Engineering Processes: Feasibility Studies, Requirements Elicitation and Analysis, Requirements Validation, Requirements Management. System Models: Context Models, Behavioral Models, Data Models, Object Models, CASE Workbenches.

UNIT-III

Architectural Design: System Structuring, Control Models, Modular Decomposition, Cohesion and Coupling, Data Flow-oriented design. Distributed System Architectures: Multiprocessor Architectures, Client-Server Architectures, Distributed Object Architectures, CORBA. Object-Oriented design. Real-Time Software Design: System Design, Real-Time Executives, Monitoring and Control Systems, Data Acquisition Systems. Design with Reuse: Component-Based Development, Application Families, Design Patterns.

UNIT-IV

Verification and Validation: Verification and Validation Planning, Software Inspections, Automated Static Analysis, Clean-room Software Development. Software Testing: Defect Testing, Integration Testing, Object-Oriented Testing, Testing Workbenches. Software Cost Estimation: Productivity, Estimation Techniques, Algorithmic Cost Modeling, Project Duration and Staffing.

UNIT-V

Dependability: Critical Systems, Availability and Reliability, Safety, Security. Critical Systems Specifications: Software Reliability Specification, Safety Specification, Security Specification. Critical Systems Development: Fault Minimization, Fault Tolerance, Fault Tolerance Architectures, Safe System Design.

Text Book:

Sommerville, I: Software Engineering, 6/e

Reference Book

1. Pressman, R. S: Software Engineering, 4/e (McGRAW-HILL)
2. Aggarwal, K. K. & Singh, Y: Software Engineering (New Age International)

MCS303 COMPILER DESIGN

UNIT–I

Compilers & Translators, Need of Translators, Structure of a Compiler, Phases, Lexical Analysis, Syntax Analysis, Intermediate Code Generation, Code Optimization, Code Generation, Book Keeping, A Symbol Table in brief, Semantic Analysis, L-value, r-values, Error Handling.

UNIT–II

Rules of Lexical Analyser, Need for Lexical Analysis, Input Buffering, Preliminary Scanning, A simple Approach to the Design of Lexical Analysers, Transition Diagrams, Regular Expression, String & Languages, Finite Automata, Non-deterministic Automata, Deterministic Automata, From regular Expression to Finite Automata, Context free Grammars, Derivations & Parse Trees, Parsers, Shift Reduce Parsing, Operator- Precedence Parsing.

UNIT–III

Symbol Table Management, Contents of a Symbol Table, Names & Symbol table records, reusing of symbol table spaces, array names, Indirection in Symbol Table entries, Data Structures for Symbol Tables , List, Self Organizing Lists, Search Trees, Hash Tables, Errors, Reporting Errors, Sources of Errors Syntactic Errors, Semantic Errors, Dynamic Errors, Lexical Phase Errors, Minimum Distance Matching, Syntactic Phase Error, Time of Detection, Ponic mode, Case study on Lex and Yacc.

UNIT–IV

Principal Sources of Optimization, Inner Loops, Language Implementation Details Inaccessible to the User. Further Optimization, Algorithm Optimization, Loop Optimization , Code Motion, Induction Variables, Reduction in Strength, Basic Blocks, Flow Graphs, DAG Representation of Basic Blocks, Value Numbers & Algebraic Laws, Global Data Flow Analysis, Memory Management Strategies , Fetch Strategy, Placement Strategies, Replacement Strategies, Address Binding, Compile Time, Load Time, Execution Time, Static Loading, Dynamic Loading, Dynamic Linking.

UNIT–V

Problems in Code Generation, a Simple Code Generator, Next-Use Information, Register Descriptors, Address Descriptors, Code Generation Algorithm, Register Allocation & Assignment, Global Register Allocation, Usage Counts, Register Assignment for Outer Loops, Register Allocation by Graph Coloring , Code Generation from DAG's, Peep-Hole Optimization, Redundant Loads & Stores, Un-Reachable Code, Multiple Jumps, Algebraic Simplifications, Use of Machine Idioms.

Text Book: Compilers, Techniques and Tools (2nd edition), A.V.Aho, M.S.Lam, Ravi Esthi and J.D.Ullman

MCS304 CRYPTOGRAPHY AND CYBER SECURITY

UNIT–I

Overview of cryptography, substitution and affine cipher and their cryptanalysis, Perfect Security, Block cipher, Data Encryption Standard(DES), Differential and linear Cryptanalysis, Block Cipher Design Principles, Block Cipher modes of operation, Advanced Encryption Standard.

UNIT–II

Principles of Public- key Cryptosystems, The RSA Algorithm, Key Management, Diffie-Hellman Key Exchange, Authentication Functions, Message Authentication codes(MAC), Hash Functions, Security of Hash Functions and MAC, Secure Hash Algorithm, HMAC.

UNIT–III

Discrete Logarithms, ElGamal Cryptosystem, Algorithm for Discrete Logaritlun Problem, security of EIGamal System, Schnorr signature scheme, Baby step-Gaint step, Chinese reminder, The ElGamal signature scheme, The digital signature algorithm, Provable secure signature schemes.

UNIT–IV

Elliptic curve over the reals, Elliptic curves modulo a prime, Properties of Elliptic curves Point compression, Computing point multiples on Elliptic curves, Elliptic curve digital signature algorithm, Elliptic curve factorization, Elliptic curve primality test.

UNIT–V

Network Security Practice: Kerberos, X.509 Authentication Service, Public Key Infrastructure. E-Mail Security (Pretty Good Privacy), IP Security (Architecture, Authentication Header, Encapsulating Security Payload, Combining Security, Associations, Key Management), Web Security (Secure Sockets Layer and Transport Layer Security).

Text Books:

1. W.Sta1lings- Cryptography and Network Security Principles and Practice, Person Education Asia, 2000. (3rd Edition) Chapters: [1,3, 5 , 9, 10(10.1,10.2), II, 12(12.2,12.4), 13(13.3), 14,15,16,17].

2. D.Stinsori, Cryptography: Theory and Practice, CRC press, 2006. Chapters: [1,2(2.3),6,7,12].

References:

1. A. Menezes, P. Van Oorsch, S. Vanstans- Handbook of Applied Cryptography, CRCp^{re}ss,1997. '

2. B. Schmeier- Applied Cryptography, New York, Wiley, 1996.

3. N.Koblitz: a course in number theory and cryptography, Springer verlag.

MCS305A DISTRIBUTED SYSTEMS

Module 1

Architectures of Distributed Systems:- System Architecture types, issues in distributed operating systems ,communication networks, communication primitives.

Theoretical Foundations: inherent limitations of a distributed system, lamp ports logical clocks, vector clocks, casual ordering of messages, global state, cuts of a distributedcomputation, termination detection.

Distributed Mutual Exclusion: introduction, the classification of mutual exclusion and associated algorithms , a comparative performance analysis.

Module 2

Distributed Deadlock Detection: Introduction, deadlock handling strategies in distributed systems, issues in deadlock detection and resolution , control organizationsf or distributed deadlock detection.

Centralized and distributed deadlock detectionalgorithms, hierarchical deadlock detection algorithms. Agreement protocols: classification of agreement problems, solutions to theByzantine agreement problem, applications of agreement algorithms.

Distributedresource management: introduction-architecture , mechanism for building distributed filesystems, design issues, log structured file systems.

Module 3

Distributed shared memory: Architecture, algorithms for implementing DSM, memorycoherence and protocols, design issues.

Distributed Scheduling: introduction, issuesin load distributing, components of a load distributing algorithm, performance comparison, selecting a suitable load sharing algorithm, requirements for load distributing, task migration and associated issues.

Failure Recovery and Fault tolerance: introduction, basic concepts, classification of failures, backward and forward error recovery.

Recovery:- recovery in concurrent systems , consistent set of check points, synchronous and asynchronous check pointing and recovery, check pointing for distributed database systems, recoveryin replicated distributed databases.

Module 4

Protection and security: preliminaries, the access matrix model and its implementations, safety in matrix model, advanced models of protection.

Data security: Model of cryptography, conventional cryptography, modern cryptography, privatekey cryptography, data encryption standard, public key cryptography, multiple encryption, authentication in distributed systems.

Module 5

Multiprocessor systems: basic multiprocessor system architectures, interconnection networks for multiprocessor systems ,caching, hypercube architecture.

Multiprocessor Operating System: structures of multiprocessor operating system, operating system design issues, threads, process synchronization and scheduling.

Concurrency control : introduction, database systems, a concurrency control model of database systems- the problem of concurrency control, serializability theory, distributed database systems, concurrency control algorithms, basic synchronization primitives, lock based algorithms, time stamp based algorithms, optimistic algorithms, concurrency control algorithms, data replication.

Text Books:

1. Andrew S. Tanenbaum and Maarten van Steen. “Distributed Systems: Principles and Paradigms”, Prentice Hall, 2nd Edition, 2007. (Required)

References:

1. MukeshSinghal, NiranjanG.Shivaratri, "Advanced concepts in operating systems:Distributed, Database and multiprocessor operating systems", TMH
2. PradeepK.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.

MCS305B MOBILE COMPUTING

UNIT-I

Personal Communications Services (PCS) Architecture, Cellular Telephony, Cordless Telephony and Low-Tier PCS, Third-Generation Wireless Systems. Wireless Transmission: Transmission concepts, Signal Propagation. Multiplexing Techniques: Space Division Multiplexing (SDM), Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), Code Division Multiplexing (CDM), Modulation, Spread spectrum techniques, Cellular System. Medium Access Control (MAC): Issues relating to MAC, SDMA, FDMA, TDMA, CDMA.

UNIT-II

Mobility Management: Handoff, Roaming Management for SS7 and CT2. Handoff Management: Mobility detection, Channel Assignment, Hard Handoff and Soft Handoff for Radio Link Transfer. Switching: Circuit Switched Data Services on Cellular Networks, Packet Switched Data Services on Cellular Networks. Addressing Mobile quality of service, Access point control protocol.

UNIT-III

Global System for Mobile Communication (GSM): GSM Architecture, Location Tracking and Call Setup, Data Services, Protocol Model, Mobility Management, Short Message Service (SMS), Roaming Facility and Security. Analog Mobile Phone Service (AMPS): IS-136 North American TDMA Standard, IS-95: The North American CDMA Digital Cellular Standard. General Packet Radio Service (GPRS): GPRS Architecture, GPRS Network, Interfaces and Procedures.

UNIT-IV

Third Generation Mobile Services (3G): IMT-2000, W-CDMA, CDMA-2000, Quality of Service (QoS) in 3G, Wireless Operating System for 3G Handset. Wireless LAN: Infrastructure and Ad hoc networks, IEEE 802.11, Hiperlan, Blue tooth. Mobile Multimedia (MM): Wireless ATM (WATM), WATM services, Reference model

UNIT-V

Mobile Network Layer: Mobile IP, Dynamic Host Configuration Protocol (DHCP), Ad hoc Networks. Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Security features. Wireless Application Protocol (WAP): WAP Model and Architecture, WAP Gateway, WAP Protocols, Wireless Markup Language (WML). Wireless Local Loop (WLL): WLL Architecture, WLL Technologies, and WLL Products.

TEXT BOOKS:

1. Yi-Bing Lin and Imrich Chlamtac, “Wireless and Mobile Network Architectures”, 2001, John Wiley and Sons.
2. Jochen Schiller, “Mobile Communication”, 2000, Pearson Education Asia.

REFERENCE:

1. Raj Pandya, “Mobile and Personal Communication Systems and Services”, 2001, Prentice

Hall of India.

3. C.Y. William Lee, "Mobile Cellular Telecommunications: Analog and Digital System", 2nd Edition, 1997, MC Graw Hill.

MCS305C NATURAL LANGUAGE PROCESSING

UNIT-I

Stages of NLP and ambiguity problem, Words and Transducers (FSA and FST for Morphological Parsing), Applications such as NLP tasks in syntax, semantics and pragmatics; Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of Machine Learning

UNIT-II

POS-tagging, POS-tagging perspective, POS tagging and HMM, Hidden Markov models (Forward and Viterbi algorithm and EM training), POS-tag set, Machine translation, Parsing algorithms, Probabilistic parsing, Parser Comparison

UNIT-III

Grammar, constituency and dependency, CYK algorithm, Parse tree construction, Semantics, Word sense disambiguation

UNIT-IV

Knowledge based and supervised WSD, Unsupervised EM based WSD, Multilingual Resource constrained WSD

UNIT-V

Linear and logistic Regression, Dimensionality Reduction, PCA
Machine translation, Statistical Machine translation, Binding Theory and Merger, X-bar theory

TEXT BOOKS:

1. Stuart Russel &, Peter Norvig: Artificial Intelligence A Modern Approach (Person Education Asia.) 3rd edition
2. Dan Jurafsky and James H. Martin, Speech and Language Processing, (Pearson Education Asia) 3rd Edition.

Eligibility for admission to M. Sc. Computer Science with Specialization Artificial Intelligence & Machine Learning:

1. B. Sc. Computer Science/B.Sc(Hons) Computer Science
2. B. Sc. ITM with Mathematics at +2 level,
3. BCA with Mathematics at +2 level
4. Btech(CSE)/Btech(IT)
5. Bsc(Hons) Data Science

With 50% marks

Examinations: As per University norms for M. Sc. Courses.