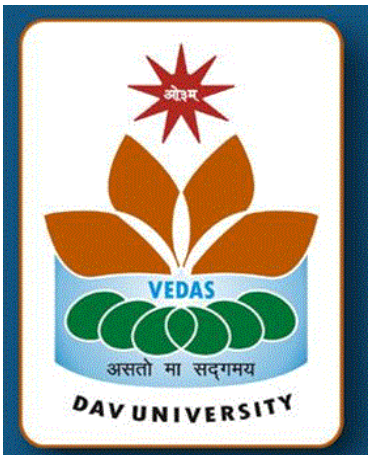
DAV UNIVERSITY JALANDHAR

FACULTY OF SCIENCE



Course Scheme and Syllabus
for

Master of Science in Computer Science
(Two Years Degree Course)
1st to 4th Semester

(As per Choice Based Credit System)

Syllabi Applicable for 2021 Batch

Duration: 2 years (4 Semesters)

Eligibility: B.Tech/BE in relevant subject/BCA/B.Sc. (CS)/B.Sc. (IT)/BIT or equivalent from any recognized university with at least 50% aggregate marks (45% in case of candidate belonging to SC/ST) or a bachelor's degree with Computers/Mathematics/ Statistics /Business Mathematics /Business Statistics/ Quantitative Techniques as compulsory/elective/optional/additional subject with at least 50% aggregate marks (45% in case of candidate belonging to SC/ST).

Master of Science in Computer Science
Syllabus 2021-23

Semester 1

S.No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	CSA517	Discrete Mathematical Structures	Core	4	0	0	4
2	CSA518	Advanced Database Management System	Core	4	0	0	4
3	CSA519	Data Structures and File Processing	Core	4	0	0	4
4	CSA520	Software Testing and Quality Assurance	Core	4	0	0	4
5	CSA521	Python Programming	Core	4	0	0	4
6	CSA522	Advanced Database Management Systems Laboratory	Core	0	0	4	2
7	CSA523	Data Structures and File Processing Laboratory	Core	0	0	4	2
8	CSA524	Python Programming Laboratory	Core	0	0	4	2
				20	**0**	**12**	**26**

Semester 2

S.No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	CSA510	Computer Networks and Data Communication	Core	4	0	0	4
2	CSA577	Design and Analysis of Algorithms	Core	4	0	0	4
3	CSA578	Computer Based Optimization Techniques	Core	4	0	0	4
4	CSA579	Interactive Computer Graphics	Core	4	0	0	4
5	CSA580	Theory of Computer Science	Core	4	0	0	4
6	CSA516	Computer Networks and Data Communication Laboratory	Core	0	0	4	2
7	CSA581	Design and Analysis of Algorithms Laboratory	Core	0	0	4	2
8	CSA582	Interactive Computer Graphics Laboratory	Core	0	0	4	2
				20	**0**	**12**	**26**

Semester 3

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	CSAXXX	**Discipline Elective-I**	DSE	4	0	0	4
2	CSA623	.NET Framework and C#	Core	4	0	0	4
3	CSA627	Research Methodology	Core	4	0	0	4
4	CSA629	Advances in Operating System	Core	4	0	0	4
5	CSA676	Artificial Intelligence	Core	4	0	0	4
6	CSA624	.NET Framework and C# Laboratory	Core	0	0	4	2
7	CSA679	Artificial Intelligence (LISP and PROLOG) Laboratory	Core	0	0	4	2
				20	**0**	**8**	**24**

Semester 4

S. No	Course Title		Course Type	L	T	P	Cr
1	CSAXXX	**Discipline Elective-I**	DSE	4	0	0	4
2	CSAXXX	**Discipline Elective-I**	DSE	4	0	0	4
3	CSAXXX	**Discipline Elective-I**	DSE	4	0	0	4
4	CSAXXX	**Discipline Elective-II**	DSE	0	0	4	2
5	CSAXXX	**Discipline Elective-II**	DSE	0	0	4	2
6	CSA689	**Major Project**	DSE	0	0	16	8
				12	**0**	**24**	**24**
OR							
7	CSA600	On Job Training*	DSE	**0**	**0**	**48**	**24**

Discipline Elective-I	
CSA605	Data Mining and Data Warehousing
CSA609	Information Systems
CSA616	System Simulation and Modeling
CSA619	Advanced Software Engineering
CSA632	Big Data Analytics
CSA633	Machine Learning
CSA634	Internet of Things
CSA635	R Programming
CSA671	Microprocessor and Its Applications
CSA675	Distributed and Parallel Processing
CSA678	Digital Image Processing
CSA682	Soft Computing
CSA683	System Software
CSA691	Natural Language Processing

Discipline Elective-II	
CSA639	Big Data Analytics Laboratory
CSA640	Machine Learning Laboratory
CSA641	Internet of Things Laboratory
CSA642	R programming Laboratory
CSA680	Digital Image Processing Laboratory
CSA689	Major Project

Note: The Major Project will include the development of application/system software under the supervision of internal supervisor assigned from the department. For evaluation, 20% weightage will be given to the synopsis of the project and 80% weightage will be given to the Viva, Project Execution, and Project Report.

*As per the university policy, in the case of **On Job Training/Live Project Training** which ranges for a period of three months to 6 months, student shall be evaluated on the basis of written report of On Job Training/Live Project Training for the award of marks in the course by the committee constituted for this purpose.

L	T	P	Credits	Marks
4	0	0	4	100

Course Title: Discrete Mathematical Structures
Course Code: CSA517
Course Duration: 45-60 Hours

Course Objective: The objective of this course is to acquaint the students with the basic concepts in Discrete Mathematics viz. sets, functions, relations, groups, graphs etc. required for the implementation of various computer science courses.

UNIT – A **12 Hours**

Set Theory

- Set and its Representations, Types of sets
- Subsets
- Operations on Sets-Union, Intersection and Difference of Sets
- Venn Diagrams, Statement Problems
- Laws- Associative Laws, Distributive Laws, Demorgan's Laws

Relation and Functions

- Relations, Pictorial Representations of Relations, Composition of Relations, Types of Relations, Closure Properties
- Equivalence Relations and Partitions, Hasse diagram, Lattices, Bounded Lattices, Distributive Lattices.
- Functions, Special functions, Composition of Functions, one-one, onto and Inverse of a function
- Mathematical functions, Exponential and Logarithmic Functions

UNIT – B

Group Theory **13 Hours**

- Group Axioms, Semi groups, Properties of Groups
- Subgroups
- Cosets, , Normal subgroup
- Permutation Group
- Dihedral Group

Recurrence relations

- Characteristic Equation
- Homogeneous and non-homogeneous linear recurrence relations with constant coefficients
- Generating Functions for some standard sequences

UNIT – C **10 Hours**

Graphs

- Basic Terminology, Special Graphs,
- Handshaking Theorem,
- Isomorphism of Graphs,
- Walks, Paths, Circuits, Eulerian and Hamiltonian Paths
- Planar and Non Planar Graphs,
- Coloring of Graph, Directed graphs, Travelling Salesman Problem

Logic and Propositional Calculus

- Propositions,

- Basic logic operators
- Logic equivalence involving Tautologies and Contradiction
- Algebra of Propositions
- Conditional and Biconditional Statements
- Logical Implication, Propositional Functions, Quantifiers

UNIT – D **10 Hours**

Vectors and Matrices

- Vectors, Matrices
- Matrix Addition, Scalar Multiplication
- Matrix Multiplication, Transpose
- Square matrices
- Invertible Matrices, Inverses, Determinants

Counting and Probability Theory

- Basic counting principle, Factorial Notation
- Binomial Coefficients, Permutations, Combinations
- Sample Space and Events
- Finite Probability Spaces
- Conditional Probability
- Independent Events, Binomial Distribution
- Random variables

Reference Books:

1. Rosen, K. H.,*Discrete Mathematics and its Applications*, 6th Edition, McGraw Hill, 2007.
2. Malik, D.S. andSen, M.K., *Discrete Mathematical Structures: Theory and Applications*, ThomsonCengagae Learning, New Delhi, 2004.
3. Lipschutz, S. and Lipson M.,*Schaum's Outline of Discrete Mathematics*,Schaum's Outlines, New Delhi, 2007
4. Ram, B., *Discrete Mathematics*, Pearson Publications, 2011.
5. Liu, C. L.,*Elements of Discrete Mathematics***,** McGraw Hill, International Edition, Computer Science Series, 1986.
6. Trembley, J.P. and Manohar, R.P., *Discrete Mathematical Structures with Applicationsto Computer Science*, McGraw Hill.
7. Joshi, K.D., *Foundations of Discrete Mathematics*, Wiley, 1989
8. Alan Doerr and Kenneth Levarseur., *Applied Discrete Structures for Computer Science*, Creative Commons, 2012.

Course Title: Advanced Database Management System
Course Code: CSA518
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The concepts related to database, database design techniques, transaction management, SQL, PL/SQL and database operations are introduced in this subject. This creates strong foundation for data base creation.

UNIT– A **10 Hours**

Data Base Concepts

- Data base vs. file oriented approach, Data Independence, Database models, General Architecture of a Data Base Management Software
- Advantages and Disadvantages of DBMS

Introduction to Data Models

- Entity Relationship model, hierarchical model from network to hierarchical, relational model, object oriented database, object relational database,

Data Base Design

- Entities, Attributes, ER Diagrams, Functional dependencies; Normalization
- Multivalued dependencies, decomposition, Relational algebra and calculus, Need and types of query optimization procedures, phases of query optimization

UNIT – B **10 Hours**

Data Base Protection

- Concurrency, recovery, Integrity, Protection, essentials of security authorization, types of database security

Relational Query Language

- SQL, client/server architecture, Technical introduction to Oracle.

Software Development using SQL

- SQL data types, Querying database tables
- Conditional retrieval of rows, working with Null values, matching a pattern from the table querying multiple tables: Equi joins, Cartesian joins, Outer joins
- Self joins; Set operator: Union, Intersect, Minus, Nested queries

UNIT – C **10 Hours**

Introduction to PL/SQL

- The PL/SQL block structure, PL/SQL data types, Variables and constants, assignment and expressions, Writing PL/SQL code, cursor management in PL/SQL
- Concept of stored procedures, Database triggers, types of triggers, Dropping triggers, storage of triggers

Parallel Databases

- **Database System Architectures:** Centralized and Client-Server Architectures, Server System Architectures, Parallel Systems,
  Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism

UNIT – D **15 Hours**

Distributed Database Concepts

- Distributed database, Characteristics of distributed databases, Distributed database design, fragments and replications; Distributed Transaction, Distributed Query Processing, Phases of Distributed query optimization, Operation site allocation plan, Reliability of distributed DBMS.

Advanced databases

- Multidimensional Databases, Temporal Databases, Spatial databases, NOSQL Databases and their characteristics

XML databases

- XML Databases, XQL and XQuery, XML Schema, XML query processing

Reference Books:

1. Desai. B.C., *An Introduction to Database Systems*, New Delhi: Galgotia Publ. Private Ltd, 2000.
2. C.J.Date, A.Kannan, S. Swamynathan, *An Introduction to Database Systems*, 8th Edition,
3. Pearson Education, 2006.
4. Silberscatz, Korth and Sudarshan, *Database System Concepts*, Third Ed., New York: McGraw Hill International Editions, Computer Science Series, 2010.
5. Peter Rob Carlos Coronel, *Data Base Systems* (3rd Edition), New Delhi: Galgotia Publications (P) Ltd, 2001.
6. Elmasri, Navathe, *Fundamentals of Database System*, 7e, Pearson India.
7. Kleinberg J., Tardos E., Algorithm Design, 1st Edition, Pearson, 2012.
8. Ivan Bayross, *SQL, PL/SQL The Programming Language of Oracle*, 4th Revised Edition, BPB Publications, 2009.
9. Peter Rob Carlos Coronel, *Database Systems*, Cengage Learning, 8th ed, 2007.

L	T	P	Credits	Marks
4	0	0	4	100

Course Title: Data Structures and File Processing
Course Code: CSA519
Course Duration: 45-60 Hours

Course Objective: The emphasis of this course is on the organization of information, the implementation of common data structures such as lists, stacks, queues, trees, and graphs.

UNIT– A **12 Hours**

Preliminaries

- Introduction to Data Structures: Primitive and Composite, Various data structures
- Common operations on data structures, algorithm complexity
- big O notation, timespace tradeoff between algorithms
- Complexity of Algorithms, Records and Pointers.

Arrays

- Arrays defined, representing arrays in memory, various operations on linear arrays
- Multi dimensional arrays, Records, Matrices, Sparse Matrices
- Linear Search, Binary Search
- Insertion Sort, Selection Sort, Bubble Sort
- Merge Sort, Radix Sort
- String, Representation and Manipulation

UNIT – B **13 Hours**

Linked Lists

- Types of linked lists, representing linked lists in memory
- Advantage of using linked lists over arrays
- Various operation on linked lists

Stacks

- Description of stack structure, implementation of stack using arrays and linked lists
- Applications of stacks converting arithmetic expression from infix notation to polish and their subsequent evaluation
- Quicksort technique to sort an array, parenthesis checker.

Queues

- Implementation of queue using arrays and linked lists
- Deques, Priority Queues and their implementation, applications of queues.

UNIT – C **10 Hours**

Trees

- Description of tree structure and its terminology, binary search tree
- Implementing binary search tree using linked lists
- Various operations on binary search trees, AVL Trees

Heaps

- Description of heap structure, implementing heaps using arrays
- Various operations on heaps, Applications of heaps
- Heapsort technique to sort an array

UNIT – D **10 Hours**

Graphs and Hash Tables

- Representation of Graphs and Applications: Adjacency Matrix, Path Matrix
- Warshall's Algorithm, Linked Representation of a Graph
- Traversing a Graph, DFS and BFS.
- Direct address tables, hash tables
- Collision resolution by chaining, hash functions
- Open addressing – linear probing, quadratic probing, double hashing

Files

- Operations on files, Types of files
- File Organizations: Sequential files, Indexed Sequential file, Directed files and multikey files
- File performance criteria and terms.

Reference Books:

1. LipschutzSeymour, *Theory and Problems of Data Structures*, Schaum Outline Series, New Delhi: Tata McGrawHill Book Company, 2001.
2. Mark Allen Weiss, *Data Structures and Algorithm Analysis In C* ,Mexico City:Addison Wesley, (An Imprint of Pearson Education),.New Delhi: Prentice Hall of India Pvt. Ltd, 1993.
3. Esakov Jeffery, Weiss Tom, *Data Structures: An Advanced Approach Using C*, New Delhi: Prentice Hall International, Inc, 2007.
4. Trembley and Sorenson,*An Introduction to Data Structures with Application*, New York : McGraw Hill Company, 1984.
5. Tanenbaum, *Data Structures using C,* New Delhi: Pearson Education, *2009*.
6. Kleinberg J., Tardos E., "Algorithm Design", 1st Edition, Pearson, 2012.

Course Title: Software Testing and Quality Assurance
Course Code: CSA520
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The students will gain the knowledge about software testing techniques**,** STEP methodology, software testing strategies, software metrics, software quality assurance tools and techniques, quality management, quality models and system configuration management.

UNIT-A

Introduction **15 Hours**

- Software Testing, Objectives of Software Testing, Software Testing Process, Static and Dynamic Analysis
- STEP Methodology, Elements of STEP and STEP Architecture

Software Testing Techniques

- BBT & its Technique, Boundary Value Analysis, Cause-Effect Graph, White-Box Testing and its Techniques
- Domain and Boundary Testing, Logic Based Testing, Data Flow Testing

UNIT-B **15 Hours**

Software Testing Strategies

- Characteristics, Integration Testing, Functional Testing
- Object Oriented Testing, Alpha and Beta Testing, Overview of Testing Tools
- Test planning, functional testing, stability testing and debugging techniques

Metrics for Software

- Importance of Metrics to Software Project, Software Quality Metrics
- Software Metrics: Product Metrics: Software Size Metrics, Control Complexity Metrics, Object-Oriented Metrics, Software Quality Metrics

UNIT-C

Quality Assurance **15 Hours**

- Concept of Software quality, product and process quality, software quality metrics, quality control and total quality management,
- Quality tools and techniques, quality standards, Software Quality Attributes, Factors Affecting Software Quality
- Building software quality assurance plan, Components of SQAP

Quality Management & Quality Models

- Software Quality System, Quality Management Principles, Essence of

International Standards

- ISO 9000 Quality Standard, SEI Capability Maturity Model

Designing software quality assurance system

- Statistical methods in quality assurance, fundamentals of statistical process control, process capability, Six-sigma quality

UNIT-D **15 Hours**

Reliability

- Basic concepts, reliability measurements, predictions and management
- Factors affecting software reliability, Software reliability vs hardware reliability, Software reliability metrics

System Configuration Management (SCM)

- Basic requirements for SCM System, SCM principles, Planning and organizing for SCM
- Benefits of SCM, Change Management, Version and Release Management

Reference Books

1. Schulmeyer G.G. and McManus J. (eds.), *Handbook of Software Quality Assurance*, New Delhi: Prentice Hall, 3rd Ed. 1999
2. Deutsch, Wills and Hall, *Software Quality Engineering: A Total Technique and Management Approach*, New Delhi: PHI, 1993.
3. FutrellRobert T., SnaferDonald F., Shafter Linda I., *Quality Software Project Management*, New Delhi: Pearson, 2002.
4. Perry, William E., *Effective Methods for Software Testing*, New York: Wiley, 2006.
5. Hutcheson, *Software Testing Fundamentals*, Wiley India Pvt. Ltd, 2007.
6. Gill Nasib Singh,*Software Engineering: Software Reliability, Testing and Quality Assurance*, Khanna Book Publishing, 2009.
7. Galin Daniel, *Quality Assurance: From theory to implementation*, New Delhi: Pearson Education Ltd., 2004
8. Kan S.H., *Metrics and Models in Software Quality Engineering*, New Delhi: Pearson, 2nd Ed, 2014.
9. Myers Glenford J., *The Art of Software Testing*, New York: John Wiley, 2nd Ed. 2011.

Course Title: Python Programming
Course Code: CSA521
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: This course provides the knowledge about developing programs and scripts using Python programming language. All the advanced concepts of programming will help benefit the students in research as well in software development.

UNIT-A

Introduction to Python Language **15 Hours**

- Programming language, History of Python, Origin of Python Programming, Features, Limitations, Applications, Getting and Installing Python, Python Environment Variables, Python Help, Python differences from other languages.

Python Data Types and Input Output

- Keywords, Identifiers, Variables, Statements, Indentation, Documentation, Data Type, Type Conversion.
- Python Input and Output.

Operators and Expressions

- Arithmetic, Comparison, Assignment, Logical, Bitwise, and Python special operators.
- Expressions, Precedence and Associatively.

UNIT-B **15 Hours**

Control Structures

- Decision Making Statements
- Python Loops

Python Native Data Types

Creation of following Data Types along with methods and functions

- Number, String, Tuple,Set, Dictionary

Python Functions and Modules

- Creating Functions, Advantages of Functions, Types of Functions, Built-In, User Defined Functions, Anonymous Functions, Call by Value, Call by Reference, Recursion.
- Designing of Modules. Importing Modules

UNIT-C **15 Hours**

Python Class and Objects

- Designing Classes, Creating Objects, Accessing Objects, __init__ method, constructor, garbage collection, destroying objects.

- Inheritance and Operator Overloading.

File Handling

- File creation, open() and close() methods, read() and write() methods, file modes, file encoding, file object attributes, renaming and deleting files, Python directory, directory methods and functions.

Exception Handling

- Python Exception, Built-in Exception, Exception Handling, Try, except, finally, Python user defined exceptions.

UNIT-D **15 Hours**

GUI Programming in Python (using Tkinter/wxPython/Qt)

- What is GUI, Advantage of GUI, Introduction to GUI, Layout Management, Events and Bindings, Fonts, Colors, Drawing on Canvas, Line, Oval, Rectangle, etc. Widget such as Frame, Label, Button, Check Box, Entry, ListBox, Radiobutton, Message, Text, Spinbox, etc.

Database connectivity in Python

- Installing mysql connector, accessing connector module module, using connect, cursor, execute & close functions, reading single & multiple results of query execution

Algorithm Sorting and Searching

- Searching and Sorting Techniques, Efficiency of Algortihms.

Reference Books:

1. M. C. Brown, *The Complete Reference Python*, Osborne/McGraw-Hill, 2001.
2. S. Maruch, A. Maruch, *Python for Dummies*, John Wiley & Sons, 2011.
3. A. B. Downey, *Think Python*, O'Reilly Media Inc., 2012.
4. B. Slatkin, *Effective Python*, Addison Wesley Professional, 2015.
5. J. M. Zelle, *Python Programming: An Introduction to Computer Science*, Franklin, Beedle & Associates, Inc., 2004.

Course Title: Advanced Database Management Systems Laboratory
Course Code: CSA522

L	T	P	Credits	Marks
0	0	4	2	50

1. Implementation of SQL: DDL, DML, DCL, TCL
2. Implementation of Nested Queries and Join Queries.
3. Implementation of Cursors.
4. Implementation of Procedures and Functions
5. Implementation of Triggers
6. Implementation of various DBA roles/techniques: Creation of user, Granting of privileges to the users, Creation of roles, Loading of privileges into user defined roles,
7. Import/Export data between various databases and flat files

Course Title: Data Structures and File Processing Laboratory
Course Code: CSA523

L	T	P	Credits	Marks
0	0	4	2	50

1. Implementation of Data Structures: **Arrays Linked List, Stack, Queues, Trees**, etc
2. Implementation Searching: Linear and Binary
3. Implement Sorting: Bubble, Selection, Insertion, and Quick
4. Binary tree using pre-order, post-order and in-order traversals
5. Implementation of Traversal on graph using Depth First Search and Breadth First Search
6. Implement AVL Trees as well as various operations of searching, insertion and deletion on AVL Trees.

Course Title: Python Programming Laboratory
Course Code: CSA524

L	T	P	Credits	Marks
0	0	4	2	50

1. Implementation of Python programs: Control Structures, Lists, Tuples,
2. Strings, Dictionary, Sets, Files,
3. Exception handling, Classes and Objects,
4. Inheritance, Overloading, GUI Programming,
5. Database Connectivity, etc

Course Title: Computer Networks and Data Communication
Course Code: CSA510
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: As part of this course, students will be introduced to computer networks and data communication paradigms, about network models and standards, network protocols and their use, wireless technologies.

UNIT – A **18 Hours**

Introduction to Data Communication

- Components of Data Communication, Data Representation
- Transmission Impairments, Switching, Modulation, Multiplexing

Review of Network Hardware

- LAN, MAN, WAN
- Wireless networks, Internetworks

Review of Network Software

- Layer, Protocols, Interfaces and Services

Review of Reference Models

- OSI, TCP/IP and their comparison

Physical Layer

- Transmission Media**:** Twisted pair, Coaxial cable, Fiber optics
- Wireless transmission (Radio, Microwave, Infrared)
- Introduction to ATM, ISDN
- Cellular Radio and Communication Satellites

UNIT – B **15 Hours**

Data Link Layer

- Framing, Error control, Sliding window protocols (one bit, Go back n, selective repeat)
- Examples of DLL Protocols–HDLC, PPP

Medium Access Sub layer

- Channel Allocation, MAC protocols – ALOHA, CSMA protocols
- Collision free protocols, Limited Contention Protocols
- Wireless LAN protocols
- IEEE 802.3, 802.4, 802.5 standards and their comparison

Bridges

- Transparent, source routing, remote

UNIT – C **15 Hours**

Network Layer

- Design Issues, Routing Algorithms (Shortest Path, Flooding, Distance Vector, Hierarchical, Broadcast, Multicast
- Internetworking, IP Protocol, ARP, RARP.

UNIT – D **12 Hours**

Transport Layer

- Addressing, Establishing and Releasing Connection
- Flow Control, Buffering
- Internet Transport Protocol (TCP and UDP).
- Congestion Control Algorithms (Leaky bucket, Token bucket, Load shedding)

Application Layer

- Domain name system, Email, File transfer protocol
- HTTP, HTTPS, World Wide Web.

Reference Books:

1. Tanenbaum. Andrew S. ,*Computer Networks*, 4th Edition, New Delhi: PHI, 2013.
2. Forouzan B. A.,*Data Communications and Networking*, Fifth Edition, New Delhi: Tata McGraw Hill, 2017.
3. Stallings William,*Data Computer Communications*, (8th Edition), New Delhi: PHI, 2008.
4. Bary Nance, *Introduction to Networking*, 4th Edition, New Delhi: PHI, 1997.

Course Title: Design and Analysis of Algorithms
Course Code: CSA577
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The objective of the module is to create skills in students to design and analysis of algorithms.

UNIT – A **10 Hours**

Algorithms and Analysis

- Introduction
- Algorithms specification
- Recursive algorithms
- Space and Time Complexity
- Asymptotic Notation (O, Θ and Ω) practical complexities, Best, average and worst case performance of algorithms
- Introduction to recurrence relations

Divide and Conquer

- General method
- Binary Search, Merge sort, Quick sort, Selection sort,
- Analysis of these problems

UNIT – B **10 Hours**

String Processing and Greedy Method

- KMP
- Boyre-Moore
- Robin Karp algorithms

Greedy Method

- General Method, Knapsack problem
- Job sequencing with deadlines
- Minimum spanning Trees
- Single Source Shortcut paths and analysis of these problems

UNIT – C **10 Hours**

Dynamic Programming

- General method, Optimal Binary Search Trees
- 0/1 Knapsack
- The Travelling Salesperson Problem

Back Tracking

- General method, 8 queen's problem
- Graph Coloring
- Hamiltonian Cycles
- Analysis of these Problems

UNIT – D **15 Hours**

Branch and Bound

- Least Cost Search and LC Branch and Bound
- Bounding
- FIFO Branch and Bound
- 0/1 Knapsack Problem
- Travelling Salesperson Problem

Introduction to Complexity Theory

- NP-Hard and NP-Complete Problem
- Basic concepts, Cook's theorem, examples of NP-Hard problems
- Approximation Algorithms

Reference Books:

1. Horowitz, Ellis and Sahni, *Fundamentals of Computer Algorithms*, New Delhi: Galgotia Publications, 2nd Edition, 2008
2. Aho, A.V., Hopcroft, J.E., Ullman, J.D., *The Design and Analysis of Computer Algorithms*, Addison-Wesley, First Edition, 2003.
3. Bentley, J.L., *Writing Efficient Programs*, New Delhi: Prentice-Hall India, Eastern Economy Edition, 2009.
4. Goodman, S.E. & Hedetniemi,*Introduction to the Design and Analysis of Algorithms*, New Delhi: Tata McGraw-Hill Book Comp, 2004.
5. Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, Pearson Education, 3rd Edition, 2012.
6. Michael T Goodrich and Roberto Tamassia : Algorithm Design, Wiley India, 2002.

L	T	P	Credits	Marks
4	0	0	4	100

Course Title: Computer Based Optimization Techniques
Course Code: CSA578
Course Duration: 45-60 Hours

Course Objective: To introduce linear programming, dynamic programming and related Optimization Theories to solve real life / simulated problems.

UNIT – A **10 Hours**

Introduction

- The Historical development
- Nature, Meaning and Management Application of Operations Research Modelling
- Its Principal and Approximation of O.R.Models
- Main Characteristic and Phases
- General Methods of solving models
- Scientific Methods, Scope, Role on Decision Making
- Development of Operation Research in India

UNIT – B **15 Hours**

Linear Programming

- Mathematical formulation of linear programming problems
- Canonical and standard forms of linear programming problems
- Solution by Graphical & Simplex method
- Revised simplex method
- Two phase & Big-M method, Duality, Primal-Dual Relationship
- Simplex Method
- Economic Interpretation of Optimal simplex Solution

Special Types of Linear Programming Problems

- Transportation
- Assignment Problems

UNIT – C **10 Hours**

Integer & Dynamic Programming

- Integer programming problem

1. Branch and Bound Techniques

- Characteristics

2. Deterministic DP Problems, Recursive Approach and Tabular method

PERT / CPM

- Project Planning
- Scheduling
- Activity Cost

- Network Diagram Representation
- Difference between CPM and PERT
- Floats and Slack Times

UNIT-D **10 Hours**

Queuing Models

- Introduction, Applications
- Characteristic, Waiting and Ideal time costs
- Transient and Steady states
- Kendall's Notations
- M/M/1, M/M/C, M/Ek/1 and Deterministic Models

Reference Books:

1. Hiller, F.S. &Liberman, G.J., *Introduction to Operations Research*, 10th Ed. London Holden Day Inc., 2017.
2. Tara, H.A., *Operations Research*, 8th Edn., New Delhi:PHI, 2007.
3. Beightler, C.S. & Phillips, D.T., *Foundations of Optimisation*, 2nd.Edn. New Delhi: Prentice-Hall, 1979.
4. McMillan Claude Jr., *Mathematical Programming*, 2nd. Edn., J. Wiley Series, 1975.
5. Srinath, L.S., *Linear Programming*, New Delhi: East-West, 1983..
6. Churchman, C.W. &Arnchoff, E.L.,*Introduction to Operations Research*, New York: John Wiley and Sons, 1988.
7. Srinivasan G., *Operations Research: Principles and Applications*, PHI,2010
8. Prasad Durga, M.V, *Operations Research* , Cengage Publications, 2012.

L	T	P	Credits	Marks
4	0	0	4	100

Course Title: Interactive Computer Graphics
Course Code: CSA579
Course Duration: 45-60 Hours

Course Objective: The aim is to introduce the students to key concepts of Computer Graphics like display devices, co-ordinate system, transformations, line and circle drawing, pointing ,positioning, projections, etc.

UNIT – A **15 Hours**

Display Devices

- Line and point plotting systems
- Raster, vector, pixel and point plotters
- Continual Refresh and storage displays
- Digital frame buffer
- Plasma panel displays, Display processors
- Character generators
- Color-display techniques : shadow mask and penetration CRT, Color look-up tables

Elementary Drawing Algorithms

- Line drawing using direct method, simple DDA, integer DDA
- Incremental method, and Bresenham's algorithm
- Circle drawing using incremental method,Bresenham's and MidPoint algorithm
- drawing arcs, sectors
- Flood Fill Algorithms, Boundary Fill Algorithms

UNIT – B **15 Hours**

Geometric Transformations.

- Two Dimensional Translation, rotation, scaling, reflection and shear
- Concept of homogenous coordinates
- Building composite transformations

Viewing Transformations

- Concept of Windows & Viewport
- Window-To-Viewport Mapping
- Clipping Operations - Point Clipping
- Line Clipping Algorithms (Cohen - Sutherland, Mid-Point, Subdivision, Cyrus - Beck),
- Sutherland - Hodgeman Polygon Clipping Algorithm

UNIT – C **15 Hours**

Three-dimensional concepts

- 3-D representations and transformations
- perspective and parallel projections
- spline curves and surfaces

- Quadtree and Octree data structures

Hidden line/surface Removal

- Back Face Removal
- Z-Buffer Algorithm
- Painters (Depth Sort) Algorithm
- Subdivision Algorithms - Warnock's Algorithm
- Scan Line Algorithms - Scan Line

UNIT – D **15 Hours**

Rendering

- Introduction, a simple illumination model
- Shading - Gouraud shading &Phong Shading
- Ray Tracing, Shadows, Textures

Open GL

- Primitives of the language and interface with C/C++

Reference Books:

1. D. Hearn and M.P. Baker, *Computer Graphics*(2nd ed.), New Delhi, Prentice–Hall of India, 2004.
2. Foley. J.D., Dam A van, Feiner S.K. and Hughes J.F., *Computer Graphics: Principals and Practices* (3rd ed.), Pearson Education India, 2013..
3. Rogers D.F., *Procedural Elements in Computer Graphics (2nd ed.)*, New Delhi:McGraw Hill Book Company, 2001.
4. Plastock Roy A., Kalley Gordon,*Computer Graphics*, New Delhi: McGraw Hill Book Company, 1996.

L	T	P	Credits	Marks
4	0	0	4	100

Course Title: Theory of Computer Science
Course Code: CSA580
Course Duration: 45-60 Hours

Course Objective: Understanding and development of theoretical models of computations and their analysis. The models of computations include (i) Finite Automata (and Regular Languages), (ii) Push Down Automata (and Context-free Languages), (iii) Turing Machine (and their Languages).

UNIT – A **15 Hours**

Automata Theory

- Deterministic Finite Automata, Moves
- Non Deterministic Finite Automata
- Moore and Mealy Machines
- Minimization Algorithm

Regular Languages

- Regular Sets
- Regular Expressions
- Pumping Lemma for Regular Sets

UNIT – B **15 Hours**

Context Free Grammars

- Context free grammars (CFG)
- Derivation Graphs
- Ambiguities in Grammars and Languages
- Properties of Context Free Languages
- Normal Forms
- Pumping Lemma for CFL
- Closure Properties

Pushdown Automaton

- Pushdown Automaton (PDA)
- Deterministic Pushdown Automaton (DPDA)
- Non-equivalence of PDA and DPDA
- Language Accepted by PDA

UNIT – C, **15 Hours**

Linear Bounded Automata (LBA)

- Power of LBA
- Closure properties

Turing Machines

- Turing Machine as A Model of Computation
- Programming with a Turing Machine
- Variants of Turing Machine and Their Equivalence

- Turing Machines and Languages

UNIT – D **15 Hours**

Undecidability

- **Chomsky Hierarchy of Languages**
- Recursive and Recursive-Enumerable Languages
- Halting Problem, Undecidable Problems about Turing machines
- Rice theorem
- The Equivalence of the Automata and the Appropriate Grammars

Reference Books:

1. G.E. Reevsz, *Introduction to Formal Languages*, New Delhi: McGraw Hill 1983.
2. HopcroftJ. E., MotwaniR., and Ullman J. D., *Introduction to Automata Theory, languages, and computation*(2nd ed.), New Delhi: Addison-Wesley, 2001
3. Lewis H.R., Papadimitriou C.H., *Elements of the Theory of Computation* (2nd ed.), NJ:Prentice-Hall,1997.
4. Anderson J.A., *Automata Theory with Modern Applications*, New York: Cambridge University
Press, 2006.

Course Title: Computer Network and Data Communication Laboratory

L	T	P	Credits	Marks
0	0	4	2	50

Course Code: CSA516

- Specifications of latest desktops and laptops.
- Familiarization with Networking Components and Devices: LAN Adapters, Hubs, Switches, Routers etc.
- Familiarization with Transmission media and Tools: Co-axial cable, UTP Cable, Crimping Tool, Connectors etc.
- Preparing straight and cross cables.
- Study of various LAN topologies and their creation using network devices, cables and computers.
- Configuration of TCP/IP Protocols in Windows and Linux.
- Implementation of file and printer sharing.
- Designing and implementing Class A, B, C Networks
- Subnet planning and its implementation
- Installation of ftp server and client
- Implementation of Various routing protocol (With the help of simulation)

Course Title: Design and Analysis of Algorithms Laboratory

L	T	P	Credits	Marks
0	0	4	2	50

Course Code: CSA581

Implementation of various algorithms divide and conquer, string processing, greedy methods, dynamic programming, etc.

Course Title: Interactive Computer Graphics Laboratory
Course Code: CSA582

L	T	P	Credits	Marks
0	0	4	2	50

Implementation of various algorithms of drawing line, circle, ellipse, etc. and2D transformations

Course Title: .NET Framework and C#
Course Code: CSA623
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective:

- To build web applications using ASP and client side script technologies use with Microsoft's IIS.
- To build XML applications with DTD and style sheets that span multiple domains ranging from finance to vector graphics to genealogy for use with legacy browsers.

UNIT—A **15 Hours**

Introduction to Three-Tier Architecture

- Overview of .NET Framework , Common Language Runtime (CLR)
- The .NET Framework Class Library, familiarization with visual studio .NET IDE, Design Window, Code Window, Server.
- Explorer, Toolbox, Docking Windows, Properties Explorer, Solution Explorer, Object Browser, Dynamic Help, Task List Explorer.
- Features of VS.NET, XML Editor, Creating a Project, Add Reference, Build the Project, Debugging a Project.

UNIT—B **15 Hours**

Introducing C# Programming

- Introduction, Basic Language Constructs, Types (Reference and Value, Relations Between Types)
- Delegates, Generics, Collections
- Strings , Exceptions, Threads , Networking

UNIT—C **15 Hours**

Windows Forms, Adding Controls

- Adding An Event Handler, Adding Controls at Runtime
- Attaching An Event Handler at Runtime, Writing a Simple Text Editor, Creating a Menu Adding a New Form,
- Creating a Multiple Document Interface, Creating a Dialog Form Using form Inheritance, Adding a Tab-Control, Anchoring Controls,
- Changing the Startup Form, Connecting The Dialog, Using Listview and Treeview Controls,
- Building an Image list and add Them To The Listview, Using Details inside The Listview,
- Attaching A Context Menu, Adding a Treeview, Implementing Drag And Drop, Creating Controls at Run Time, Creating a User Control, Adding a Property, Adding Functionality,
- Writing a Custom Control, Testing the Control.

UNIT—D **15 Hours**

ADO.NET Architecture

- Understanding the Connectionobject
- Building the Connection String, Understanding the Commandobject,

- Understanding Datareaders,Understanding Datasets and Dataadapters, Datatable, Datacolumn, Datarow
- Differences between Datareader Model and Dataset Model, Understanding the Dataviewobject, Working with System.Data.Oledb
- Using Datareaders, Using Datasets, Working with SQL.NET, Using Stored Procedures, Working With Odbc.NET, Using DSN Connection

Introducing The ASP.NET Architecture

- ASP.NET Server Controls, Working with User, Controls, Custom Controls, Understanding the Web.Config File, Using the Global.asax Page

Reference Books:

1. Paul J. Deitel and Harvey M. Deitel, *C# 2010 for Programmers*, Forth Edition New Delhi: Pearson 2010.
2. ImarSpaanjaars, *Beginning ASP.NET 4: in C# and VB (Wrox)*, Paperback Edition, 2010.
3. George Shepherd, *Microsoft ASP.NET 4 Step by Step (Microsoft)*, Paperback Edition, 2010.
4. Scott Mitchell, *Teach Yourself ASP.NET 4 in 24 Hours*, Complete Starter Kit, 2010.
5. Shukla Charul, *Asp.Net 2.0 Black book*, Paraglyph Press, 2006.

Course Title: Research Methodology
Course Code: CSA627
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Objectives: The objective of the study is to let students understand basics of Research design and activities. The focus will be on data analysis and their effective presentation.

UNIT – A **10 Hours**

- Scientific Research: Nature and Objectives of research;
- Methods of research: historical, descriptive and experimental. Motivation in Research, Study and formulation of research problem.
- Scope of research and formulation of hypothesis; Feasibility, preparation and presentation of research proposal.
- Reviewing the literature, Reviews, Meta-analysis, differences between uses of internet networks in research activities in searching material, paper downloading, submission of papers, relevant websites for journals and related research work.

UNIT-B **12 Hours**

- Statistical Analysis: Introduction to statistical analysis: Measures of central tendency and dispersion; mean, median, mode, range, mean deviation and standard deviation.
- Regression and Correlation Analysis, Random Variables and Probability Distribution

UNIT – C **12 Hours**

- Test of Hypothesis: Test of Hypothesis: Basic ideas of testing of hypothesis; Tests of significance based on normal, t and Chi-square distributions. Analysis of variance technique. Design of Experiments: Basic principles, study of completely randomized and randomized block designs.

UNIT – D **11 Hours**

- Introduction to dissertation design and report writing
- Presentation: Tabular and graphical representation of results, quoting of references and preparing bibliography.
- Plagiarism: Introduction, types of plagiarism, plagiarism detection tools.

Reference Books:

1. Hogg, R.V. & Craig, A. T, *Introduction to Mathematical Statistics*, MacMillan, 1965.
2. Goon, A. M., Gupta, M. K. & Dasgupta, *Fundamentals of Statistics*, Vol. I, World Press, 1975.
3. Gupta, S.C. & Kapoor, V. K, *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, 1994.
4. Dowdy, S., Wearden, S. and Chilko, D., *Statistics for Research*, Wiley Series (2004)
5. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., *Probability and Statistics for Engineers and Scientists*, Pearson Education (2002).
6. Borth, Wayne C, et. Al. *The Craft of Research Chicago Guides to Writing Edition and Publishing*.
7. Johnson, R.A., *Probability and Statistics*, PHI, New Delhi, 1994.
8. Meyer, P. L, *Introduction to Probability & Statistical Applications*, Oxford, IBH, 1986.

Course Title: Advances in Operating Systems
Course Code: CSA629
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To understand and learn the fundamentals of Operating System including dealing with memory management, process management, CPU scheduling, deadlocks and also learn about the distributed operating systems, distributed resource management and real time operating systems.

UNIT– A **15 Hours**

Fundamentals of Operating Systems

- Overview: Synchronization Mechanisms, Processes and Threads , Process Scheduling
- Deadlocks: Detection, Prevention and Recovery, Models of Resources, Memory Management Techniques.

Distributed Operating Systems

- Issues in Distributed Operating System, Architecture, Communication Primitives
- Lamport's Logical clocks,Causal Ordering of Messages
- Distributed Mutual Exclusion Algorithms-Centralized and Distributed Deadlock Detection Algorithms, Agreement Protocols.

UNIT – B **10 Hours**

Distributed Resource Management

- Distributed File Systems, Design Issues, Distributed Shared Memory
- Algorithms for Implementing Distributed Shared memory, Issues in Load Distributing
- Scheduling Algorithms, Synchronous and Asynchronous Check Pointing and Recovery,
- Fault Tolerance, Two-Phase Commit Protocol, Nonblocking Commit Protocol, Security and Protection.

UNIT– C **10 Hours**

Real Time And Mobile Operating Systems

- Basic Model of Real Time Systems, Characteristics, Applications of Real Time Systems, Real Time Task Scheduling, Handling Resource Sharing,Mobile Operating Systems
- Micro Kernel Design - Client Server Resource Access, Processes and Threads, Memory Management, File system.

UNIT – D
CASE STUDIES

- Linux System: Design Principles - Kernel Modules - Process Management Scheduling
- Memory Management, Input-Output Management, File System - Interprocess

- Communication. iOS and Android: Architecture and SDK Framework - Media Layer -
- Services Layer, Core OS Layer, File System.

Reference Books:

1. Galvin and Silberschatz A.,*Operating System Concepts*, Eigth Addition, New York: J. Wiley & Sons, 2009.
2. Crowley, *Operating Systems: A Design Oriented Approach*, New Delhi: Tata McGraw Hill, 2008.
3. Donovan J.J,*Systems Programming*, New York: McGraw Hill, 1972.
4. Dhamdhere. D.M, *System Programming and Operating Systems*, New Delhi: Tata McGraw Hill, 1999.
5. Madnick and Donovan, *Operating System*, New York: McGraw Hill, 1978.
6. Beck Leland L., *System Software*, Delhi: Pearson Education, 2000.
7. Henson P.B., *Operating System Principles*, Delhi: Prentice Hall
8. Tenenbaum A.S., *Operating System: Design and Implementation*, New Delhi: PHI, 2013.

Title: Artificial Intelligence
Course Code: CSA676
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective The objective of this course is to familiarize students with concepts of AI, its tools & technologies.

UNIT – A **15 Hours**

Introduction

- Background and History
- Overview of AI applications Areas

The Predicate Calculus

- Syntax and Semantic for Propositional Logic and FOPL
- Clausal Form, Inference Rules
- Resolution and Unification

Knowledge Representation

- Network Representation-Associative Network & Conceptual Graphs
- Structured Representation- Frames & Scripts

UNIT – B **15 Hours**

Search Strategies

- Strategies For State Space Search-Data Driven And Goal Driven Search
- Search Algorithms- Uninformed Search (Depth First, Breadth First, Depth First With Iterative Deepening) And Informed Search (Hill Climbing, Best First, A* Algorithm, Etc.)
- Computational Complexity
- Properties of Search Algorithms-Admissibility
- Monotonicity, Optimality, Dominance

Expert Systems

- Introduction, Examples
- Characteristics Architecture, People Involved and Their Role in Building an Expert Systems
- Case Studies of Expert Systems, MYCIN And DENDRAL; Features of Knowledge Acquisition Systems : MOLE And SALT

UNIT – C **15 Hours**

Natural Language Processing

- Component Steps of Communication
- Contrast Between Formal and Natural Languages in the Context of Grammar
- Grammars and languages
- Basic parsing techniques

Introduction to AI languages

- Introduction to LISP
- Introduction to Prolog

UNIT-D **15 Hours**

Planning

- Basic Representation for Planning
- Symbolic-Centralized Vs. Reactive-Distributed

Pattern Recognition

- Introduction
- Recognition & Classification Process
- Learning classification patterns
- Clustering

Reference Books:

1. Elaine Rich, Kevin Knight and Nair Shiva Shankar B,*Artificial Intelligence*, Third Edition, New Delhi: Tata-McGraw Hill, 2017.
2. Winston, P.H. and Horn, B.K.P, *LISP*, Pearson, 1993.
3. Rajasekharan, S. and VijayalakshmiPai, G. A., *Neural Networks, Fuzzy Logic and Genetic Algorithms*, New Delhi: Prentice Hall of India, 2013.
4. Luger George F., *Artificial Intelligence*, 5th edition, Pearson Education, 2001.
5. Patterson Dan W., *Introduction to Artificial Intelligence and Expert system*, New Delhi: PHI, 2005.
6. Bharti & Chaitany, *Natural Language Processing*, New Delhi: PHI, 2006.

Course Title: .NET Framework and C# Laboratory
Course Code: CSA624

L	T	P	Credits	Marks
0	0	4	2	50

- Implementation of ASP.NET classes and Tools
- Connectivity with database

Course Title: Artificial Intelligence (LISP and PROLOG) Laboratory
Course Code: CSA679

L	T	P	Credits	Marks
0	0	4	2	50

Implementation of LISP and PROLOG based programs. Natural Language Processing, etc

Course Title: Data Mining and Data Warehousing
Course Code: CSA605
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To introduce the concepts and techniques of data mining and data warehousing, including concept, principle, architecture, design, implementation, applications of data warehousing and data mining.

UNIT-A **10 Hours**

Introduction

- Basic Systems Concepts, Differences between Operational Database system and Data Warehouse, Need of Separate Data Warehouse, Data Warehouse Models (Enterprise, Data Mart and Virtual Data Warehouse), Extraction Transformation and Loading, Metadata repository
- Data Warehouse Design Process, Two Tier and Three-Tier Data Warehouse Architecture, Data Warehouse Modelling (Data Cube and OLAP), Data Warehouse Implementation, From online Analytical Processing to Multidimensional Data Mining.
- OLAP, ROLAP, MOLAP and HOLAP, Data Warehouse Back-End Tools and Utilities, Data Cubes, Efficient Computation of Data Cubes

UNIT-B **13 Hours**

Data Mart

- Types of Data Marts, Loading a Data Mart, Metadata for a Data Mart, Monitoring requirements for a Data Mart, Security in Data Mart
- From Data Warehouse to Data Mining, Steps of Data Mining Process, Types of Data Mining Tasks, Trends and Application of Data Mining, Statistical Data Mining, Visual and Audio Data Mining, Ubiquitous and invisible Data Mining.
- Privacy, Security and Social Impacts on Data Mining
- Machine Learning, Information Retrieval, Business Intelligence, Major issues in Data Mining.
- Data Objects and Attribute Types, Statistical Description of Data, Data Visualization, Measuring Data Similarity and Dissimilarity, Data Cube Computation, General Strategies for Data Cube Computation

UNIT-C **12 Hours**

Data Preprocessing:

- Major Tasks in Data Preprocessing, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

Outlier detection:

- Outliers and their Types, Challenges of Outlier Detection, Statistical Approach to Outlier Detection
- Market Basket Analysis, Frequent Itemsets, Closed Itemsets and Association Rules

- Apriori Algorithm, Improving Efficiency of Apriori algorithm, From Association to Correlation Analysis.

UNIT-D **10 Hours**

Classification:

- General Approach to Classification, Decision Tree Induction, Bayes Classification, Rule based Classification, Genetic Algorithm, Random forest, Support Vector Machine Rough Set Approach, Confusion Matrix, Metrics for Evaluating Classifier Performance, Cross Validation

Clustering:

- Cluster Analysis, Requirement for Cluster Analysis, Partitioning Methods, Hierarchical Methods, DBSCAN, OPTICS, CLIQUE, Clustering Graph and Network Data.

Reference Books:

1. Inmon W. H., *Building the Data Warehouse*, New York: John Wiley 2002.
2. Inmon W. H., *Data Warehousing and Knowledge Management*, ork: New YJohn Wiley 1996.
3. Romez Elmasri, Shamkant B., Navathe, *Fundamentals of Database Systems*, New Delhi:Pearson Education, 2009.
4. Han, Kamber, Morgan Kaufmann, *Data Mining: Concepts and Techniques*, 2nd Edition, Elsevier, 2012.
5. Inmon, W.H., C. L. Gassey,*Managing the Data Warehouse*, New York:John Wiley 1999.
6. Fayyad, Usama M., *Advances in Knowledge Discovery and Data Mining*, MIT Press, 1996.
7. Charu C. Aggarwal, *Data Mining: The Textbook*, Springer, 2015.
8. Hongbo Du, *Data Mining Techniques and Applications: An Introduction*, Cengage India, 2010.
9. Tan, Steinbach, Kumar, *Introduction to Data Mining*, Pearson India. 2016.
10. Alex Berson, Stephen Smith, *DATA WAREHOUSING, DATA MINING, & OLAP*, McGraw Hill Education, 1997.
11. Prasad R.N., *Fundamentals of Business Analytics*, Wiley India, Second Edition, 2016
12. Shroff G., *The Intelligent Web: Search, smart algorithms, and big data*, Oxford University Press, 2013.

Course Title: Information Systems
Course Code: CSA609
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: This course provides a comprehensive understanding of the information systems, types of systems, subsystems, management information systems, decision support systems, expert systems, enterprise information systems and decision making and analysis.

UNIT-A **15 Hours**

System and Information Concepts

- General Model, Types of systems, Subsystems
- Attributes of Information, Evolution of Information Systems, categories of Information Systems, Building and Maintaining Information Systems
- Feedback Control, Systems approach to organization, Law of requisite variety, Control by exception
- Information Concepts, Types of Information, Quality of Information, Value of Information

Management Information System

- Definitions, Role of MIS, MIS in Academics
- Structure of MIS based on management activity and functions System and Information concepts to MIS

UNIT-B **10 Hours**

Decision Support Systems

- Conceptual Foundations of DSS, Concepts of DSS
- DSS Software, Strategies for DSS, GDSS, and Executive Support System (ESS),
- Fundamentals of Knowledge Management systems, Knowledge Based Decision Support
- DSS Application, Case Study

UNIT-C **10 Hours**

Expert System

- Basic concepts of Expert System, Structure of Expert System, How Expert System works
- Expert System Application, Comparison of Conventional & Expert System
- Case Study

Executive Information and Support Systems

- Enterprise & Executive Information System, Concept and Definition

- Information needs of Executives, Characteristics and benefits of EIS
- Comparing and Integrating EIS and DSS.

UNIT-D **10 Hours**

Decision Making Systems, Modelling and Analysis

- Decision Making Definition and Concept, Phases of Decision Making Process
- Modelling Process, Static and Dynamic Models
- Sensitivity Analysis
- Heuristic programming, Simulation

Reference Books:

1. Murdick Robert, Joel E. Ross, *Information Systems for Modern Management*, New Delhi: PHI, 3rd Ed, 1971.
2. Turban E fraim, *Decision Support Systems & Intelligent Systems*, New Delhi: Pearson Education, 2004.
3. Laudon C. Kenneth &Laudon P. Janes, *Management Information Systems*, Pearson Education, 2018.
4. Bellavista Paolo and CorradiAntonio (Eds.), *Handbook of Mobile Middleware*, Auerbach Publication, 2006.
5. Steven Alter, *Information Systems* , 4th Edition, Pearson Education, 2003.
6. McNurlin C.Barbara & Spargue H. Ralph, *Information Systems Management in Practice*, fifth Edition, Pearson Education, 2003
7. V.Rajaraman, *Analysis and Design of Information System*,PHI, 3rd Ed, 2011.

Course Title: System Simulation and Modelling
Course Code: CSA616
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: In this course, students will analyze specified systems such as inventory system, queuing models and environmental dynamics. They introduce with how to simulate system, simulation techniques, statistical models, random number generations, design and analysis of simulation.

UNIT-A **12 Hours**

Systems and environment

- Concept of model and model building
- Model classification and representation, Use of simulation as a tool, steps in simulation study.

System simulation

- Why & when to simulate, nature and techniques of simulation, comparison of simulation and analytical methods
- Types of system simulation, real time simulation, hybrid simulation
- Simulation of pure-pursuit problem, single-server queuing system and an inventory problem
- Monte-Carlo simulation, Distributed Lag models, Cobweb model

UNIT-B **10 Hours**

Continuous-time and Discrete time Systems

- Laplace transform, Transfer functions, state-space models
- Order of Systems, z-transform, feedback systems, Stability, observability, controllability
- Statistical Models in Simulation: Common Discrete and Continuous Distribution, Poisson process empirical distribution

UNIT-C **13 Hours**

Random Numbers

- Properties of random numbers, generation of pseudo random numbers
- Techniques of random number generations, tests for randomness
- Random variate generation using inverse transformation
- Direct transformation, convolution method, acceptance-rejection

Design and Analysis of Simulation Experiments

- Data collection, identifying distributions with data, parameter estimation
- Goodness of fit tests, selecting input models without data
- Multivariate on time series input models, static and dynamic simulation

- output analysis
- Steady state simulation, terminating simulation confidence interval estimation, output analysis for steady state stimulation, variance reduction techniques

UNIT-D **10 Hours**

Queuing Models

- Characteristics of queuing systems, notation, transient and steady-state behaviour performance, network of queue

Large Scale System

- Model reduction, hierarchical control
- Decentralized control structural properties of large scale systems

Reference Books:

1. Law Averill, *System Simulation Modeling and Analysis*, New Delhi: Tata McGraw-Hill, 2014.
2. Gordan G., *System Simulation*, New Delhi: Pearson Education, 2nd Ed. 2015
3. Deo Narsingh, *System Simulation with Digital Computer*, New Delhi: Prentice Hall of India, 2011.
4. Banks J., Garson J.S., Nelson B.L., *Discrete Event System Simulation*, New Delhi: Prentice Hall of India, 4th Ed. 2005.
5. SeilaA.F., Ceric V. and TadikamallaP., *Applied Simulation Modeling*, Thomsan Learning, International Student Edition, 2004
6. Banks Jerry, *Handbook of Simulation: Principles, Methodology, Advances, Application and Practice*, New York: Wiley Inter Science, 1998

Course Title: Advanced Software Engineering
Course Code: CSA619
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: This course provides the understanding of software project planning, various software process models, system design analysis, various testing techniques and software engineering tools.

UNIT-A **15 Hours**

Introduction

- Software Engineering goals, Characteristics, Components Applications
- Software Process Models: Waterfall, Spiral, Prototyping, Fourth Generation Techniques
- Concepts of Project Management, Role of Metrics And Measurement
- Software requirements, Definition, Software requirements specifications (SRS), Components of SRS.
- Software engineering features (data abstraction exception handling and concurrency mechanism).

Software Project Planning

- Objectives, Decomposition Techniques: Software Sizing, Problem Based Estimation
- Process Based Estimation, Cost Estimation Models: COCOMO Model, The Software Equation

UNIT-B **10 Hours**

System Analysis

- Principles of Structured Analysis, Requirement Analysis
- DFD, Entity Relationship Diagram, Data Dictionary

Software Design

- Objectives, Principles, Concepts
- Design Mythologies: Data Design, Architecture Design
- Procedural Design, Object–Oriented Concepts

UNIT-C **10 Hours**

System Administration and Training

- User manual, Implementation Documentation, Operation plan and maintenance

Hardware and Software Selection

UNIT-D **10 Hours**

Testing Fundamentals

- Objectives, Principles, Testability
- Test Cases: White Box & Blackbox Testing

- Testing Strategies: Verification& Validation
- UNIT Test, Integration Testing, Validation Testing, System Testing
- Software documentation procedures, Software reliability and quality assurance. Quality Matrics and software models
- Software maintenance and configuration management

Software engineering tools and environment

- International software engineering standards and their relevance
- Case studies in software engineering

Reference Books:

1. Fairley, R.E., *Software Engineering Concepts*, New Delhi: McGraw Hill, 1997.
2. Lewis, T.G., *Software Engineering*, New Delhi: McGraw Hill, 1982.
3. Ochoa Sergio and RomanGruia-Catalin, *Advanced Software Engineering*, Spinger, 2006.
4. Pressman, *Software Engineering*, New Delhi: Tata McGraw Hill, 2002.
5. Meyers, G., *The Art of Software Testing*, NJ: Wiley-Inter-Science, 2004.
6. Sommerville, Ian, *Software Engineering*, Addison Wesley, 9th Ed, 2010.

Course Title: Big Data Analytics
Course Code: CSA632
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective:

- To explore the fundamentals concepts of big data analytics.
- To learn and understand the concept of big data intelligent techniques, various search methods and visualization techniques.

UNIT – A **10 Hours**

Introduction to Big Data

- Overview of Big Data, Stages of analytical evolution.
- Challenges of Conventional Systems
- Intelligent data analysis, Nature of Data
- Analytic Processes and Tools
- Analysis vs Reporting, Modern Data Analytic Tools
- Statistical Concepts:
    - Sampling Distributions - Re-Sampling
- Statistical Inference - Prediction Error

UNIT-B **10 Hours**

Mining Data Streams

- Introduction To Streams Concepts, Stream Data Model and Architecture
- Stream Computing, Sampling Data in a Stream
- Filtering Streams, Counting Distinct Elements in a Stream
- Estimating Moments, Counting Oneness in a Window, Decaying Window
- Real time Analytics Platform(RTAP) Applications

UNIT – C **15 Hours**

Hadoop

- History of Hadoop, The Hadoop Distributed File System
- Components of Hadoop, Analyzing the Data with Hadoop
- Scaling Out- Hadoop Streaming, Design of HDFS-Java interfaces to HDFSBasics
- Developing a Map Reduce Application
- How Map Reduce Works
- Anatomy of a Map Reduce Job run-Failures
- Job Scheduling-Shuffle and Sort, Task execution
- Map Reduce Types and Formats, Map Reduce Features

UNIT – D **10 Hours**

Frameworks

3. Applications on Big Data Using Pig and Hive
4. Data processing operators in Pig
5. Hive services, HiveQL, Querying Data in Hive

6. Fundamentals of HBase and ZooKeeper
7. Visualizations
    - Visual data analysis techniques, interaction techniques
8. Systems and applications

Reference Books:

1. Michael Berthold, David J. Hand, *Intelligent Data Analysis*, Springer, 2007.
2. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, *Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data*, 2012.
3. Tom White, *Hadoop: The Definitive Guide* Third Edition, O'reilly Media, 2012.
4. Anand Rajaraman and Jeffrey David Ullman, *Mining of Massive Datasets*, Cambridge University Press, 2012.
5. Bill Franks, *Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics*, JohnWiley & sons, 2012.
6. Michael Minelli (Author), Michele Chambers (Author), Ambiga Dhiraj (Author), *Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses*,Wiley Publications, 2013.
7. Jiawei Han, Micheline Kamber, *Data Mining Concepts and Techniques*, Second Edition, Elsevier, Reprinted 2008.
8. Thomas Erl, Wajid Khattak, Paul Buhler, *Big Data Fundamentals: Concepts, Drivers & Techniques*, Pearson India, 2016.

Course Title: Machine Learning
Course Code: CSA633
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The main objective of this course is to acquaint students with an in-depth introduction to two main areas of Machine Learning and analyze a given problem in the language/framework of different AI methods (e.g., standard search algorithms or dynamic programming). Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports

UNIT – A **10 Hours**

Introduction

- Machine intelligence and applications
- Pattern recognition concepts classification, regression, feature selection
- Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured / Unstructured, Forms of Learning
- Supervised learning class conditional probability distributions, Examples of classifiers bayes optimal classifier and error, learning classification approaches.

UNIT-B **10 Hours**

Linear machines

- General and linear discriminants, decision regions
- Single layer neural network, linear separability, general gradient descent, perceptron learning algorithm, mean square criterion and widrow-Hoff learning algorithm, backpropagation learning, on-line, off-line error surface, important parameters.

Learning decision trees

- Inference model, general domains, symbolic decision trees, consistency, learning trees from training examples entropy, mutual information, ID3 algorithm criterion, C4.5 algorithm continuous test nodes, confidence, pruning, learning with incomplete data

UNIT – C **15 Hours**

Instance-based Learning

- Nearest neighbor classification, k-nearest neighbor, nearest neighbor error probability

Machine learning concepts and limitations

- Learning theory, formal model of the learnable, sample complexity, learning in zero-bayes and realizable case, VC-dimension
- Fundamental algorithm independent concepts, hypothesis class, target class, inductive bias, occam's razor, empirical risk, limitations of inference machines, approximation and estimation errors, Tradeoff.

UNIT – D **10 Hours**

Machine learning assessment and Improvement

- Statistical model selection, structural risk minimization, bootstrapping, bagging, boosting.

Support Vector Machines

- Margin of a classifier, dual perceptron algorithm, learning nonlinear hypotheses with perceptron kernel functions, implicit non-linear feature space, theory, zero-Bayes, realizable infinite hypothesis class, finite covering, margin-based bounds on risk, maximal margin classifier**.**

Reference Books:

1. E. Alpaydin, *Introduction to Machine Learning*, Prentice Hall of India, 2015.
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2009 (freely available online).
3. C. M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.
4. Kevin Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.
5. T. M. Mitchell, *Machine Learning*, McGraw-Hill, 2017.
6. Willi Richert, Luis Pedro Coelho, *Building Machine Learning Systems with Python*, Packt Publishing, 2013.
7. Toby Segaran. *Programming Collective Intelligence: Building Smart Web 2.0 Applications*, 2007

Course Title: Internet of Things
Course Code: CSA634
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: Students will be explored to the interconnection and integration of the physical world and the cyber space. They are also able to design & develop IOT Devices.

UNIT – A **15 Hours**

- An Overview of Internet of things, Internet of Things Technology.
- Behind Io Ts Sources of the Io Ts, M2M Communication, Examples of IoTs,
- Design Principles For Connected Devices Internet Connectivity Principles, Internet connectivity
- Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.
- Business Models for Business Processes in the Internet of Things, IoT/M2M systems LAYERS AND designs standardizations, Modified OSI Stack for the IoT/M2M Systems ,ETSI M2M domains and High-level capabilities

UNIT-B **10 Hours**

- Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability
- Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices

UNIT – C **10 Hours**

- Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage
- Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

UNIT – D **10 Hours**

- Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models
- IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology ,Sensing the World.

Reference Books:

1. Rajkamal, *Internet of Things: Architecture, Design Principles And Applications*, McGraw Hill Higher Education, 2017.
2. A.Bahgya and V.Madisetti, *Internet of Things*, Univesity Press, 2015
3. Adrian McEwen and Hakim Cassimally, *Designing the Internet of Things*, Wiley, 2013.
4. CunoPfister, *Getting Started with the Internet of Things*, Oreilly, 2011.

Course Title: R Programming
Course Code: CSA635
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: Understand the basics in R programming in terms of constructs, control statements, string functions and the use of R for Big Data analytics. Students explore that how to apply R programming for text processing, able to appreciate and apply the R programming from a statistical perspective.

UNIT – A **10 Hours**

Introduction

- Introducing to R , R Data Structures
- Help functions in R, Vectors, Scalars, Declarations
- Recycling, Common Vector operations,
- Using all and any Vectorized operations, NA and NULL values
- Filtering, Vectorized if-then else, Vector Equality, Vector Element

UNIT-B **10 Hours**

Matrices, Arrays And Lists

- Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists

UNIT – C **10 Hours**

Data Frames

- Data Acquiring, Organizing and Analytics in IoT/M2M, Applications/ Services /Business Processes, IOT/M2M Data Acquiring and Storage
- Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

UNIT – D **15 Hours**

OOP

- S3 Classes, S4 Classes, Managing your objects, Input/Output – accessing keyboard and monitor, reading and writing files, accessing the internet, String Manipulation, Graphics, Creating Graphs, Customizing Graphs, Saving graphs to files, Creating three-dimensional plots

Interfacing

- Interfacing R to other languages , Parallel R, Basic Statistics , Linear Model, Generalized Linear models, Non-linear models, Time Series and Auto-correlation, Clustering

Reference Books:

1. Norman Matloff, *The Art of R Programming: A Tour of Statistical Software Design*, McGraw No Starch Press, 2011.
2. Jared P. Lander, *R for Everyone: Advanced Analytics and Graphics*, Addison-Wesley Data & Analytics Series, 2013.
3. Mark Gardener, *Beginning R – The Statistical Programming Language*, Wiley, 2013.
4. Robert Knell, *Introductory R: A Beginner's Guide to Data Visualisatio*n, Statistical Analysis and Programming in R, Amazon Digital South Asia Services Inc, 2013.

Course Title: Microprocessors and Its Applications
Course Code: CSA671
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The purpose of this course is to teach students the fundamentals of microprocessor and to introduce students to features and technology of microprocessor systems. The students studying the subject are supposed to learn the architecture of a typical microprocessor and also get general information about microprocessor based control systems.

UNIT – A **15 Hours**

Introduction

- Introduction to Microprocessor
- Microcontroller and Microcomputer

Microcomputer structure

- Processor, memory and I/O; Bit slices and 8/16/32- bit microprocessors
- Microprocessor architecture (registers, index and stack pointers, addressing modes)
- I/O interface adapters (parallel and serial) interface devices, system clock, clock phase and bit rates

Architecture of 8085/ 8086 Microprocessor

- Description of various pins
- Configuring the 8086/8088 microprocessor for minimum and maximum mode systems description of system mode interfaces
- Internal architecture of the 8086 / 8088 microprocessor, system clock, Bus cycle, instruction execution sequence.

UNIT – B **15 Hours**

Memory Interface

- Memory Devices
- Address Decoding, 8-bit, 16-bit, 32-bit and 64-bit memory interfaces
- Dynamic RAM

Basic I/O Interface

- I/O Port Address Decoding
- Programmable Peripheral Interface
- 8279 Programmable Keyboard/Display Interface
- 8254 Programmable Interval Timer
- 16550 Programmable Communication Interface

UNIT – C **15 hours**

Interrupts

- Basic Interrupt Processing
- Hardware Interrupts
- Expanding the Interrupt Structure
- 8259A Programmable Interrupt Controller

Direct Memory Access (DMA)

- Basic DMA Operations

- 8237 DMA Controller
- Shared Bus Operations

UNIT – D **15 Hours**

Bus Interface

- ISA, EISA
- VESA Buses, PCI, USB Bus

Assembly Language Programming

- Addition, Subtraction, Complement First and Second, Shifting of 8 and 16-bit number by one and two bits.

Reference Books:

1. Barry B. Brey, *The Intel Microprocessors 8086/8088, 80186/80188,80286, 80386, 80486, Pentium, Pentium Pro Processors, Pentium II, Pentium III, Pentium 4 and Core2 with 64-bit Extensions: Architecture, Programming and Interfacing*, 8th Edition, New Delhi: Pearson Education-2009.
2. Khambata J., *Microprocessor and Microcomputer*, New York: John Wiley and Sons, 1987.
3. Liu, Y., Gibson, and G.A., *Microcomputer Systems: The 8086/8088 Family*, New Delhi: Prentice Hall, 2nd Edition, 1986.
4. Tribel Walter, *The 80386, 80486, and Pentium Processors:Hardware, Software, and Interfacing*, New Delhi: Prentice Hall, ISBN #0-13-533225-7, 1998.
5. Douglas V. Hall, *Microprocessors and Interfacing - Programming and Hardware*, New Delhi :TataMcGraw Hill Publishing Company Ltd, 2006.

Master of Science in Computer Science
Syllabus 2021-23

Course Title: Distributed and Parallel Processing
Course Code: CSA675
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
0	0	4	2	50

Course Objective: The objective of this course is to introduce students to the fundamentals and techniques of distributed computing, distributed operating systems and provides them with the basic skills of how to write distributed programs. Topics to be covered include: distributed computing, parallel processing, parallel processing architecture, concurrency, inter-process communications, distributed objects, application programming interfaces (RMI, RPC).

UNIT-A **15 Hours**

Introduction

- Definition, Characteristics, Goals and applications of Distributed Computing,
- Basic design issues and user requirements

Inter-process Communication

- Client Server Communication, Group Communication
- IPC in UNIX. Remote Procedure Calls
- Design issues and implementation

UNIT-B **15 Hours**

Distributed Operating Systems

- Introduction, Kernel, Process and Threads, Communication.
- Simple distributed transactions and Nested transactions, Atomic Commit protocols
- Concurrency control, N distributed transaction,
- Distributed deadlocks
- Transactions with replicated data.

Parallel Processing

- Introduction, Need for Computational speed; Applications of parallel computers in various fields including Mathematics, Physics, Chemistry and Computer Science

UNIT-C **15 Hours**

Parallel Processing Architectures

- Parallelismin Sequential Machines, Abstract model of parallel computer
- Multiprocessor architecture, programmability issues

Data Dependency Analysis

- Types of Dependencies, Loop and Array Dependence
- Loop Dependence Analysis, Solving Diophantine Equations.

Thread Based Implementation

- ThreadManagement, Thread Implementation

UNIT-D **15 Hours**

Recovery and Fault Tolerance

- Transaction recovery, Fault tolerance, Hierarchical and group masking of faults.

Algorithms for Parallel Machines

- Speedup, Complexity and Cost, Parallel Reduction
- Quadrature Problem, Matrix Multiplication
- Parallel Sorting Algorithms and Solving Linear System

Reference Books:

1. Sasikumar. M., Shikhara, Dinesh and Prakash Ravi, *Introduction to Parallel Processing*, New Delhi: PHI (2nd Ed), 2014.
2. Coulouris George, Dollimore Jean, Kindberg Tim, *Distributed Systems: Concepts and Design*, New Delhi: Pearson Education 5th edition, 2011.
3. Madnick and Donovan, *Operating System*, New delhi: McGraw Hill, 1997
4. Wilkinson and Barry, *Parallel Programming Techniques & Applications*, New Delhi: Pearson Education, 2007.
5. Crichlow and Joel M., *An Introduction to Distributed and Parallel Computing*, New delhi: PHI, 1997.
6. Rajaraman V., *Elements of Parallel Computing*, New Delhi:PHI, 1990
7. A.S. Tenenbaum, *Operating System: Design and Implementation*,New Delhi:PHI, 2006.

Course Title: Digital Image Processing
Course Code: CSA678
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To introduce basic image processing techniques, sptial and frequency domain, linear programming, color image processing, image compression, etc.

UNIT – A **15 Hours**

Introduction

- Fundamental Steps in Image Processing
- Element of Visual Perception
- A simple image model, sampling and quantization
- Some Basic Relationships Between Pixel
- Image Geometry in 2D

Image Processing Techniques

- Basic Intensity Transformation Functions
- Image Restoration
- Histogram Processing: Histogram Equalization, Histogram matching, Local Histogram Processing, Using Histogram Statistics for Image Enhancement
- Image Subtraction, Image Averaging
- Filtering: Smoothing Spatial Filters, Sharpening Spatial Filters

UNIT – B **10 Hours**

Introduction to the Fourier Transformation

- Discrete Fourier Transformation
- Fast Fourier Transformation
- Image Smoothing Using Frequency Domain Filters: Ideal Lowpass Filters, Butterworth low pass filters, Gaussian Lowpass Filters
- Image Sharpening Using Frequency Domain Filters: Ideal Highpass Filters, Butterworth High pass filters, Gaussian High pass Filters, Unsharp Masking, Highboost Filtering and High Frequency-Emphasis filtering.

UNIT – C **10 Hours**

Techniques of Color Image Processing

- Color image signal representation
- Color System Transformations
- Extension of Processing Techniques to Color Domain

Morphological Image Processing

- Erosion and Dilation
- Opening and Closing
- Hit – or- miss Transformations

Applications of Image Processing

- Picture Data Archival
- Machine Vision

- Medical Image Processing

UNIT-D **10 Hours**

Introduction to Image Compression

- Coding Redundancy
- Spatial and Temporal Redundancy
- Irrelevant Information
- Measuring Image Information

Basic Compression Methods

- Huffman Coding
- LZW Coding
- Run Length Coding
- Wavelet Coding

Reference Books:

1. Gonzalez Rafael C. and Woods Richard E., *Digital Image Processing*, New Delhi: Prentice–Hall ofIndia, 2002.
2. Pratt William K., *Digital Image Processing: PIKS Inside*(3rd ed.), New Jersy: John Wiley & Sons,
   Inc., 2001.
3. Bernd Jahne, *Digital Image Processing*, (5th revised and extended edition), Springer, 2002
4. AnnaduraiS. and ShanmugalakshmiR., *Fundamentals of Digital Image Processing*, New Delhi: Pearson Education, 2007
5. Joshi M.A., *Digital Image Processing: An Algorithmic Approach*, New Delhi: Prentice-Hall ofIndia, 2006
6. Sridhar , *Digital Image Processing* 2ed, Oxford University Press.

Course Title: Soft Computing
Course Code: CSA682
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To introduce the concepts of artificial neural networks, fuzzy sets, fuzzy logics, various search techniques, genetic algorithms, supervised and unsupervised learning, neuro-fuzzy systems and their applications.

UNIT-A **15 Hours**

Introduction

- Introduction to soft computing; introduction to biological and artificial neural network, genetic algorithm
- Introduction to fuzzy sets and fuzzy logic systems

Genetic Algorithm and Genetic Programming

- Introduction to Genetic Algorithm, Genetic Operators and Parameters, Genetic Algorithms in Problem Solving, Theoretical Foundations of Genetic Algorithms, Implementation Issues.
- Genetic Programming: Characteristics of genetic programming: Human, Competitive, High-Return, Routine, Machine Intelligence; Data Representation: Crossing Programs, Mutating Programs, The Fitness Function.
- Advantages and Limitations of Genetic Algorithm.
- Applications of Genetic Algorithm.

UNIT-B **15 Hours**

Artificial Neural Networks and Applications

- Introduction, Basic models of ANN, Important terminologies, Supervised Learning Networks, Perception Networks, Adaptive Linear Neuron
- Backpropogation Network. Associative Memory Networks. Training Algorithms for pattern association, BAM and Hopfield Networks
- Neural network applications in control systems. Neural Nets and applications of Neural Network.

Unsupervised Learning Network

- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps
- Learning Vector Quantization, Counter Propogation Networks, Adaptive Resonance Theory Networks. Special Networks-Introduction to various networks

UNIT-C **15 Hours**

Fuzzy Systems and Applications

- Introduction to Classical Sets (crisp Sets)and Fuzzy Sets- operations

and Fuzzy sets

- Fuzzy reasoning; fuzzy inference systems; fuzzy control; fuzzy clustering
- Membership functions- Features, Fuzzification, membership value assignments, Defuzzification, applications of fuzzy systems
- Neuro-fuzzy systems : neuro-fuzzy modeling; neuro-fuzzy control

UNIT-D **15 Hours**

Applications

- Pattern Recognitions, Image Processing, Biological Sequence Alignment and Drug Design
- Robotics and Sensors, Information Retrieval System, Share Market Analysis, Natural Language Processing

Reference Books:

1. Sivanandam S N and Deepa S N, *Principles of Soft Computing*, New Delhi: Wiley India (2nd Ed), 2011.
2. Karray Fakhreddine O,Silva Clarence D, *Soft Computing and Intelligent System Design*, New Delhi: Pearson Edition, 2009.
3. Mitchell M., *An Introduction to Genetic Algorithms*, New Delhi: Prentice-Hall, 2000.
4. Jang J.S.R., Sun C.T. and Mizutani E.,*Neuro-Fuzzy and Soft Computing*, New Delhi: PHI, Pearson Education, 2004.
5. Rich Elaine andKnight Kevin, *Artificial Intelligence*, New Delhi: TMH, 2008
6. Ross Timothy J., *Fuzzy Logic with Engineering Applications*, New Jersy: Wiley (3rd Ed), 2011.
7. Rajasekaran S. and Pai G.A.V., *Neural Networks, Fuzzy Logic and Genetic Algorithms*, PHI, 2013.
8. Goldberg Davis E., *Genetic Alorithms, Search, Optimization and Machine Learning*, Addison Wesley, 1989.
9. Jang J.S.R., Sun C.T., MizutaniE, *Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence*, Prentice Hall, 1997.
10. Melanie Mitchell, *An Introduction to Genetic Algorithms*, London: MIT press, 1999.

Course Title: System Software
Course Code: CSA683
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: This course demonstrates an in-depth understanding system software loader, linker, assembler, compiler, and parsing techniques.

UNIT – A **15 Hours**

System Software

- Definition, Evolution of System Software

Assemblers

- Elements of Assembly Language Programming
- Overview of Assembly Process
- Design Options- One Pass Assembler & Multi Pass Assembler
- Macro Processors: Basic Functions
- Design Options-Recursive Macro Expansion
- General Purpose Macro Processors
- Macro Processing Within Language Translators

UNIT-B

Loaders & Linkage Editors **15 Hours**

- Loading, Linking & Relocation
- Program Relocatibility
- Overview of Linkage Editing
- linking for Program Overlays

Compilers

- Phases of Compilation Process
- Logical Analysis
- Parsing, Storage Management Optimisation
- Incremental Compilers
- Cross Compilers
- P Code Compilers

UNIT – C **15 Hours**

Compilers

- Phases And Passes
- Analysis-Synthesis Model of Translation

Compiler Construction Tools

- Lexical Analysis
- Process of Lexical Analysis
- Finite State Automata, DFA And NFA
- Recognition of Regular Expressions, LEX

UNIT – D **15 Hours**

Parsing Techniques

1. Top Down & Bottom-Up Parsing
- Shift Reduce Parsing, Operator Precedence Parsing
- Predictive Parsers Automatic Construction of Efficient Parsers
- LR Parsers
- The Canonical Collection of LR(0) Items
- Constructing SLR Parsing Tables
- Constructing Canonical LR Parsing Tables, Constructing LALR Parsing Tables

Reference Books:

1. Beck Leland L.,*System Software, An introduction to system programming*, New Delhi: Addison Wesley, 2009.
2. Dhamdhere D.M., *Introduction to System Software*, New Delhi: Tata McGraw Hill, 1990.
3. Dhamdhere D.M., *System Software and Operating System*, New Delhi: Tata McGraw Hill, 1992
4. Alfred V Aho and Ullman Jeffery D, *Principles of Compiler Design*, New Delhi: Narosa/Addison Wesley, 1986.
5. Donovan J. John, *System Programming*, New Delhi: Tata McGraw Hill, 1999.

Course Title: Natural Language Processing
Course Code: CSA691
Course Duration: 45-60 Hours

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To provide basic knowledge about Natural language processing viz. Morph, Part of speech tagging, syntactic analysis, semantic analysis etc.

UNIT – A **15 Hours**

Introduction to Natural Language Processing

- Definition, History
- Applications, Goals
- Regular expressions and Automata
- Morphology and Finite State Transducers

UNIT-B

Syntax **15 Hours**

- Word Classes and Part-of Speech Tagging
- Context Free Grammars for English
- Parsing with Context-Free Grammars.

UNIT – C **15 Hours**

Word Sense Disambiguation

- Selection Restriction Based Disambiguation
- Robust WSD: Machine Learning, Supervised Learning Approaches, Bootstrapping Approaches, Unsupervised Methods, Dictionary Based Approaches.

UNIT – D **15 Hours**

Introduction to various statistical techniques used in NLP

- Introduction to computation al linguistic
- Hidden Markov Model
- Support Vector Machine
- CRF, N-Gram, HMMs

Reference Books:

1. Grosz, B.J., Sparck Jones, K. & Webber, B.L. (eds)., *Readings in natural language processing*, Los Altos, CA. Morgan Kaufmann, 1986.
2. Allen, J., *Natural Language Understanding*, Redwood City, CA. Benjamin/Cummings, 1995.
3. Bharti, Akshar,Chaitanya Vineet, Sangal Rajeev, *Natural Language Processing*, Prentice Hall.
4. Jurafsky, D. & J. Martin, *Speech and Language Processing: An Introduction to Natural Language Processing Computational Linguistics, and Speech Recognition*, Prentice Hall, 2000.

Course Title: Elective-II Laboratory
Course Code: CSAXXX

L	T	P	Credits	Marks
0	0	4	2	50

Implementation of the concepts of the course chosen from Elective-I