DAV UNIVERSITY JALANDHAR

FACULTY OF SCIENCE

Course Scheme and Syllabus
for

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

(NEP-2020)

Syllabi Applicable for 2025-27

Master of Computer Science
Syllabus 2025-27

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).

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).

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PROGRAMME EDUCATIONAL OBJECTIVES

PEO-1. Work productively as successful Computer professionals in diverse career paths including supportive and leadership roles on multidisciplinary teams or be active in higher studies.

PEO-2. Communicate effectively, recognize and incorporate societal needs and constraints in their professional endeavors, and practice their profession with high regard to ethical responsibilities.

PEO-3. Engage in life-long learning and to remain current in their profession to foster personal and organizational growth.

PROGRAM SPECIFIC OUTCOMES

PSO-1: Provides technology-oriented students with the knowledge and ability to develop creative solutions.

PSO-2: Apply computer science theory and software development concepts to construct computing-based solutions.

PSO-3: Design and develop computer programs/computer-based systems in the areas related to algorithms, networking, web design, cloud computing, Artificial Intelligence, Mobile applications.

PSO-4: Know about computing principles and business practices employed as software solutions in industries.

PROGRAM OUTCOMES:

PO-1: Apply mathematics and computing fundamental and domain concepts to find out the solution of defined problems and requirements. (Computational Knowledge)

PO-2: Use fundamental principle of Mathematics and Computing to identify, formulate research literature for solving complex problems, reaching appropriate solutions. (Problem Analysis)

PO-3: Understand to design, analyze and develop solutions and evaluate system components or processes to meet specific need for local, regional and global public health, societal, cultural, and environmental systems. (Design/Development of Solutions)

PO-4: Use expertise research-based knowledge and methods including skills for analysis and development of information to reach valid conclusions. (Conduct Investigations of Complex Computing Problems)

PO-5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. (Modern tool usage)

PO-6: Exhibiting ethics for regulations, responsibilities and norms in professional computing practices. (Professional Ethics)

PO-7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development (Environment and sustainability).

PO-8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice (Ethics).

PO-9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (Individual and team work).

PO-10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (Communication).

PO-11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments (Project management and finance).

PO-12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (Life-long learning).

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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	CSA540	Software Engineering and Testing	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**

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Semester 3

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	CSA627	Research Methodology	Core	4	0	0	4
2	CSA541	Advanced Operating System	Core	4	0	0	4
3	CSA542	AI & Machine Learning	Core	4	0	0	4
4	CSA654	Web Technology	Core	4	0	0	4
5	CSA655	Web Technology Laboratory	Core	0	0	4	2
6	CSA693	Cyber Security	Core	4	0	0	4
7	CSA543	AI & Machine Learning Laboratory	Core	0	0	4	2
8	CEC103	Community Engagement Course	Core	1	0	2	2
				21	**0**	**10**	**26**

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 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	CSAXXX	Discipline Elective II	DSE	0	0	4	2
6	CSA689	Major Project	DSE	0	0	12	6
				16	**0**	**24**	**28**

Discipline Elective-I	
CSA605	Data Mining and Warehousing
CSA608	Distributed and Parallel Processing
CSA616	System Simulation and Modelling
CSA619	Advanced Software Engineering
CSA620	Compiler Design
CSA627	Research Methodology
CSA632	Big Data Analytics
CSA634	Internet of Things
CSA635	R Programming
CSA636	Mobile Application Development
CSA637	Scientific Computing using MATLAB
CSA671	Microprocessor and Its Applications
CSA678	Digital Image Processing
CSA682	Soft Computing
CSA683	System Software
CSA691	Natural Language Processing
CSA694	Blockchain Technology
CSA695	Cloud Computing
CSA692	Digitizing Industry knowledge for Software Development
Option to adopt MOOC course having 4 Credits.	

Discipline Elective-II	
CSA639	Big Data Analytics Laboratory
CSA641	Internet of Things Laboratory
CSA642	R Programming Laboratory
CSA643	Mobile Application Development Laboratory
CSA644	Scientific Computing using MATLAB Laboratory
CSA680	Digital Image Processing Laboratory
CSA696	Blockchain Technology laboratory
CSA697	Cloud Computing Laboratory
CSA698	Natural Language Processing Laboratory
Option to adopt MOOC course having 2 Credits.	

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.

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L	T	P	Credit
4	0	0	4

Course Code	**CSA517**						
Course Title	**Discrete Mathematics Structures**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: CO1: Understand and apply the fundamental concepts of set theory, including setoperations, Venn diagrams, and laws CO2: Analyze and solve problems related to relations and functions, including closure properties, equivalence relations, partitions CO3: Demonstrate a comprehensive understanding of group theory, including subgroups, cosets, normal subgroups CO4: Apply concepts of graph theory to solve real-world problems, focusing on walks, circuits, Eulerian and Hamiltonian paths, planar graphs, and the Traveling Salesman Problem.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	Attendance
Weightage	**10**	**10**	**25**	**0**	**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**Theory** Set and its Representations, Types of Sets Subsets, Operations on Sets: Union, Intersection, andDifference of sets, Venn Diagrams, Statement Problems Laws: Associative Laws, Distributive Laws, DeMorgan's Laws						CO1
	Relation and Function Relations, Pictorial Representations of Relations,Composition of Relations Types of Relations, Closure Properties Equivalence Relations, Partitions Hasse Diagram, Lattices, Bounded Lattices,Distributive Lattices Functions, Special Functions, Composition of Functions, One-One, Onto and Inverse of Functions Mathematical Functions, Exponential andLogarithmic Functions						
Unit 2	**Group Theory** Group Axioms, Semi groups, Properties of groups.						CO2

	Subgroups. Cosets, Normal subgroup.Permutation Group. Dihedral Group	
	Recurrence Relations Characteristic Equations Homogeneous and Non-Homogeneous Linear recurrence relations with constant coefficients. Generating Functions for some standard sequences.	
Unit 3	**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 SalesmanProblem.	CO3
	Logic and Propositional Calculus Propositions Basic Logic Operators. Logic Equivalence involving Tautologies and Contradiction. Algebra of Propositions. Conditional & Biconditional Statements. Logical Implication, Propositional functions, Quantifiers.	
Unit 4	**Vectors and Matrices** Vector, Matrices. Matrix Addition, Scalar Multiplication. Matrix Multiplication, Transpose. Square Matrices. Invertible Matrices, Inverse, Determinants.	CO4
	Counting and Probability Theory Basic Counting Principle, Factorial Notations. Binomial Coefficients, Permutations, Combinations. Sample Space and Events. Finite Probability Spaces. Conditional Probability. Independent Events, Binomial Distribution. Random Variables	
Reference Books	1. *Kolman, Busby, Ross: Discrete Mathematical Structure, PEARSONEducation, 5th Edition.* 2. *C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill College,* 3. *Rajaraman, V., Computer Oriented Numerical Methods, Prentice Hall of India.* 4. *Seymor Lipschutz, Marc Lipson, Discrete Mathematics, McGraw Hill Professional,* 5. *J. P. Tremblay & R. Manohar., Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill, Inc.* 6. *K.E. Atkinson, W. Han, Elementary Numerical Analysis,*	

	3rd Edition, Wiley ***7.*** *Rosen, K. H., Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007.*	

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L	T	P	Credit
4	0	0	4

Course Code	**CSA518**						
Course Title	**Advanced Database Management System**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: CO1- Understand the fundamental concepts of database systems, including the comparison between file-oriented approaches and databases, data independence, and different database models CO2- Analyze and design database structures using ER diagrams, entities, attributes, and functional dependencies, and apply normalization techniques CO3-Demonstrate the ability to use relational algebra and calculus for formulating complex queries and understand various query optimization techniques. CO4-Apply principles of database protection, including concurrency control, recovery mechanisms, integrity constraints, and security measures.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MSP	ESE	ESP	ATTEN DANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**Data Base Concepts** Data base vs. file-oriented approach, Data Independence Data Base Models General Architecture of a Data Base Management Software, Components of a DBMS Advantages and Disadvantages of DBMS						CO1
	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 Diagram, Functional Dependencies; Normalization, Multivalued dependencies, decomposition, relational algebra and calculus, need and types of query optimization procedures, phases of query optimization.						
Unit 3	**Data Base Protection**						CO3

	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 tables querying multiple tables: Equi joins, Cartesian joins, outer joins Self joins; set operators: union, interest, minus, nested queries.	
Unit 4	**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	CO4
	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	
	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.*	

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L	T	P	Credit
4	0	0	4

Course Code	**CSA519**						
Course Title	**Data Structures and File Processing**						
Course Outcomes	On the completion of the course the student will be able to: CO1: Understand the fundamentals of data structures, including arrays, algorithmcomplexity, time-space trade-offs, and perform basic operations CO2: Implement and manipulate linked lists, stacks, and queues using arrays andlinked lists CO3: Comprehend tree structures, including binary search trees, AVL trees, B- trees, and heaps, and perform operations CO4: Represent and traverse graphs using adjacency matrices and linked representations, and implement (DFS) and (BFS) algorithms CO5: Understand and apply hashing techniques, including collision resolution strategies						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MSP	ESE	ESP	ATTEN DANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**Preliminaries** Introduction to Data Structures: Primitive and Composite, Various data structures Common operations on data structures, algorithm complexity big O notation, time space trade-off between algorithms Complexity of Algorithms, Records and Pointers.						CO1
	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 2	**Linked Lists** Types of linked lists, representing linked lists in memory Advantage of using linked lists over arrays Various operation on linked lists						CO2

	Stacks Description of stack structure, implementation of stackusing arrays and linked lists Applications of stacks converting arithmetic expression frominfix 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,application of queues	
Unit 3	**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 Threaded Binay Trees, B Trees, B+ trees	CO3
	Heaps Description of heap structure, implementing heaps usingarrays Various operations on heaps, Applications of heaps Heapsort technique to sort an array	
Unit 4	**Graphs** Representation of Graphs and Applications: Adjacency Matrix, Path Matrix, Marshall's Algorithm, Linked Representation of a GraphTraversing a Graph, DFS and BFS**.**	CO4
	Hash Tables 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	
References Books	1. *Kanetkar ,Yashavant, 2021, Let Us C, BPB Publications.* *2. Cooper, Mullish, 1998: The Spirit of C, An Introduction to Modern Programming, JaicoPubl.* *House, New Delhi.* *3. Kerninghan, B.W. &Ritchie, D.M.: The C Programming Language, Prentice Hall of* *International, 2015.* *4. Gottfried, B.: Theory and Problems of Programming in C, Schaum Series,1996.*	

	5. Horwitz, E., and Sahni, S., 2008: Fundamentals of data structures in C, Computer Science *Press.* *6. Aho, A. V., Hopcroft, and Ullman, J.E., 2002: Data structures and algorithms, Addison* *Wesley.*	

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L	T	P	Credits	Marks
4	0	0	4	100

Course Code	**CSA540**						
Course Title	**Software Engineering and Testing**						
Course Outcomes	On the completion of the course the student will be able to: CO 1: Understand lifecycle processes and agile approaches of software Development. CO 2: Apply novel software models and techniques to bring out innovative and solutions for the growth of the society. CO 3: Model and Analyze structure and behaviour of a software system. CO 4: Design a solution to a given problem and evaluate the same in various scenarios. CO 5:Create efficient software development approaches for service of technical as well as common society needs.						
Examination Mode	Theory+Practical.						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MTP	ESE	EPR	ABL/PBL
Weightage	10%	10%	25%	-	50%	-	5%
Syllabus							CO Mapping
Unit 1	**Introduction (15 Hours)**						CO1
	Software Engineering goals, Characteristics, Components Applications.						
	Software Process Models: Software Process, Generic Process Model – Framework Activity, Task Set and Process Patterns; Process Lifecycle, Prescriptive Process Models, Project Management, Component Based Development, Aspect-Oriented Software Development, Formal Methods						
	Agile Process Models – Extreme Programming (XP), Adaptive Software Development, Scrum, Dynamic System Development Model, Feature Driven Development, Crystal, Web Engineering						
Unit 2	**(19 Hours)**						CO2
	Software Requirements						
	Functional and Non-Functional Requirements; Eliciting Requirements, Developing Use Cases, Requirement Analysis and Modelling						
	Requirements Review, Software Requirement and Specification (SRS) Document.						
	Software Design						
	Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Cohesion and Coupling						

	Object-Oriented Design, Data Design, Architectural Design, User Interface Design, Component Level Design.	
Unit 3	**Software Quality (10Hours)**	CO 3
	McCall's Quality Factors, ISO 9126 Quality Factors, Quality Control, Quality Assurance, Risk Management, Risk Mitigation, Monitoring and Management(RMMM).	
	Estimation and Scheduling of Software Projects: Software Sizing, LOC and FP based Estimations; Estimating Cost and Effort; Estimation Models, Constructive Cost Model(COCOMO) Project Scheduling and Staffing; Time-line Charts.	
Unit 4	**Software Testing (10 Hours)**	CO 4
	Verification and Validation; Error, Fault, Bug and Failure; Unit and Integration Testing; White-box and Black-box Testing; Basis Path Testing, Control Structure Testing, Deriving Test Cases, Alpha and Beta Testing; Regression Testing, Performance Testing, Stress Testing.	
	Software Configuration Management: Change Control and Version Control; Software Reuse, Software Re-engineering, Reverse Engineering.	
Reference Book/s	*1. Lewis, T.G., Software Engineering, New Delhi: McGraw Hill, 1982.* *2. Ochoa Sergio and Roman Gruia- Catalin, Advanced Software Engineering, Spinger, 2006.* *3. Meyers, G., The Art of Software Testing, NJ: Wiley-Inter-Science, 2004.* *4. Pressman: Software Engineering, Tata McGraw Hill.* *5. Sommerville, I.: Software Engineering, Narosa Publ. House.* *6. Mall ,Rajib, : Fundamentals of Software Engineering, 5th Edition.* *7. Fairley, R.E.: Software Engineering Concepts, McGraw Hill.* *8. Walker Royce: Pearson Education: Software Project Management.* 9. *Joel Henry, Pearson Education: Software Project Management.*	

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L	T	P	Credits	Marks
4	0	0	4	100

Course Code	**CSA521**						
Course Title	**Python Programming**						
Course Outcomes	On the completion of the course the student will be able to: CO 1: Familiar with Python environment, data types, operators used in Python. Compare and contrast Python with other Programming languages. CO 2: Learn the use of control structures and numerous data types with their methods CO 3: Design and define functions, modules, packages and exception handling methods. CO 4: Create and handle files in Python and learn Object oriented programming Concepts. CO 5: GUI Programming in Python (using Tkinter/wxPython/Qt) and Database Connectivity.						
Examination Mode	Theory/ Practical/ Theory+ Practical.						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MTP	ESE	EPR	ABL/PBL
Weightage	10%	10%	25%	-	50%	-	5%
Syllabus							**CO Mapping**
Unit 1	**Introduction to Python Language (15 Hours)**						CO1
	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 2	**Control Structures (15 Hours)**						CO2
	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 3	**Python Class and Objects (15 Hours)**						CO3
	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 4	GUI Programming in Python (15 Hours)	CO4
	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, List Box, Radio button, Message, Text, Spin box, 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.	
Reference Book/s	*1. Fabrizio Romano; Learn Web Development with Python: Get hands-on with Python Programming and Django web development; Packt Publishing Ltd.* *2. William S Vincent; Django for Beginners: Build Websites with Python and Django; Welcometocode.* *3. Martin C. Brown Python: The Complete Reference, TMH Publisher.* *4. M. C. Brown, The Complete Reference Python, Osborne/McGraw-Hill, 2018.* *5. S. Maruch, A. Maruch, Python for Dummies, John Wiley & Sons, 2011.* *A. B. Downey, Think Python, O'Reilly Media Inc., 2012.* *6. J. M. Zelle, Python Programming: An Introduction to Computer Science, Franklin, Beedle & Associates, Inc., 2004.* *7. Dr. R. Nageswara Rao, Core Python Programming, 3rd Edition.*	

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L	T	P	Credit
0	0	4	2

Course Code	CSA522					
Course Title	**Advanced Database Management Systems Laboratory**					
Course Outcomes	On the completion of the course the student will be able to CO-1 Implementation of SQL: DDL, DML, DCL, TCL. CO-2 Implementation of Nested Queries, Join Queries, Cursors, Procedures and Functions. CO-3 Implementation of Triggers, various DBA roles/techniques: Creation of user, granting of privileges to the users, Creation of roles, Loading of privileges into user defined roles CO-4 Import/Export data between various databases and flat files.					
Examination Mode	Practical					
Assessment Tools	Quiz	Lab Performance	Attendance	MSP	ESP	Total
Weightage	-	20	-	30	50	100
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.					

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L	T	P	Credit
0	0	4	2

Course Code	CSA523					
Course Title	**Data Structures and File Processing Laboratory**					
Course Outcomes	On the completion of the course the student will be able to CO1: Understand and implement the core concepts of data structures like arrays, linkedlists, stacks, and queues, focusing on their operations CO2: Analyse and apply efficient algorithms to manipulate tree structures, such as binarytrees, AVL trees, and binary search trees CO3: Develop problem-solving skills by applying data structures to real-world problems, emphasizing algorithm complexity, time-space trade-offs, and efficient memory utilization.					
Examination Mode	Practical					
Assessment Tools	Quiz	Lab Performance	Attendance	MSP	ESP	Total
Weightage	-	20	-	30	50	100
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 BreadthFirst Search					
6.	Implement AVL Trees as well as various operations of searching, insertionand deletion on AVL Trees.					

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L	T	P	Credit
0	0	4	2

Course Code	CSA524					
Course Title	**Python Programming Laboratory**					
Course Outcomes	On the completion of the course the student will be able to CO1: Ability to analyse algorithms and algorithm correctness. CO2: To extend the knowledge of summarize searching and sorting techniques. CO3: Ability to describe stack, queue and linked list operation. CO4: Ability to have knowledge of tree and graphs concepts					
Examination Mode	Practical					
Assessment Tools	Quiz	Lab Performance	Attendance	MSP	ESP	Total
Weightage	-	20	-	30	50	100
1.	Implementation of Python programs: Control Structures, Lists, Tuples					
2.	Strings, Dictionary, Sets, Files					
3.	Exception handling, Classes and Object,					
4.	Inheritance, Overloading, GUI Programming					
5.	Database Connectivity, etc.…					

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L	T	P	Credit
4	0	0	4

Course Code	**CSA510**						
Course Title	**Computer Network and Data Communication**						
Course Outcomes	On the completion of the course, the student will gain the following knowledgeand skills: CO1: Interaction with different hardware devices present in computer networksand discuss various network models. CO2: Interaction with data link layer and its protocols. CO3: Interaction various Routing algorithms. In addition to that functionality ofnetwork layer. CO4: Functionality of Transport layer. CO5: Implementation of Application layer protocols in real-world scenarios.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MSP	ESE	ESP	ATTEN DANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**Introduction to Data Communication** Components of Data Communication, DataRepresentation. Transmission Impairments, Switching, Modulation,Multiplexing.						CO1
	Review of Network Hardware LAN, MAN, WAN. Wireless networks, Internetworks.						
	Review of Network Software Layer, Protocols, Interface 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 2	**Data Link Layer** Framing, Error control, sliding window protocols (one bit, Go back n, selective repeat). Examples of DLL Protocols–HDLC, PPP.	CO2
	Medium Access Sublayer 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 3	**Network Layer** Design Issues, Routing Algorithms (Shortest Path, Flooding, Distance Vector, Hierarchical, Broadcast, Multicast). Internetworking, IP Protocol, ARP, RARP.	CO3
Unit 4	**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).	CO4
	Application Layer Domain name system, Email, File transfer protocol. HTTP, HTTPS, World Wide Web.	

Reference Books	1. *Tanenbaum, Andrew S., 2009: Computer Networks (5th Edition), PHI.* 2. *Forouzan, B. A., 2009: Data Communications and Networking, Fourth Edition, Tata McGraw Hill.* 3. *Atul Kahate, Cryptography and Network Security (2nd Edition), Tata McGraw Hill.* 4. *William Stalling: Cryptography and Network Security, Principles and Practise, 7th Edition, Pearson.* 5. *Forouzan: Cryptography and Network Security,(3rd Edition), Tata McGraw Hill.*	

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L	T	P	Credit
4	0	0	4

Course Code	**CSA577**						
Course Title	**Design and Analysis of Algorithms**						
Course Outcomes	On the completion of the course the student will be able to: CO1: To develop proficiency in problem solving and Analysis of various Algorithms for mainly Time and Space Complexity. CO2: To understand the String processing and Greedy techniques. CO3: To get a good understanding of dynamic programming and back tracking techniques. CO4: To develop a base for Branch and Bound algorithms and Complexity Theory						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MSP	ESE	ESP	ATTEN DANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Unit 1	**Algorithms and Analysis** Introduction. Algorithms Specification. Recursive Algorithms. Space and Time Complexity. Asympotic Notation (O, Θ and Ω) practical complexities, Best, average and worst-case performance of algorithms. Introduction to recurrence relations.						CO1
	Divide and Conquer General method. Binary Search, Merge Sort, Quick Sort, Selection sort. Analysis of these problems**.**						
Unit 2	**String Processing and Greedy Method** KMP Boyre-Moore. Robin-Karp algorithms						CO2
	Greedy Methods General Method, Knapsack Problem. Job Sequencing with deadlines						
Unit 3	**Dynamic Programming** General method, Optimal Binary Search Trees.						CO3

	0/1 Knapsack. The Travelling Salesperson Problem	
	Back Tracking General method, 8 Queen's Problem. Graph Coloring. Hamiltonian Cycles. Analysis of these Problems Minimum Spanning Trees. Single Source Shortcut paths and analysis of theseproblems	
Unit 4	**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, example of NP-Hard Problems. Approximation Algorithms.	CO4
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.* 7. *Brassad, Gilles and Bartley, Paul 1996: Fundamentals of Algorithms, Prentice Hall of India.* 8. *Mark Allen Weiss: Data Structure an AlgorithmAnalysis in C++, Pearson Education.*	

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L	T	P	Credit
4	0	0	4

Course Code	**CSA578**						
Course Title	**Computer Based Optimization Techniques.**						
Course Outcomes	On the completion of the course the student will be able to: CO1: Acquainted with various quantitative techniques which are of great importance for quantitative decision-making. CO2: Acquainted with the application of statistical techniques in business decision-making. CO3: This course is an introduction to a broad range of mathematical techniques for solving problems that arise in management to allocate resources and their effective utilization. CO4: Understand the concepts and techniques of Operations Research for business, decision making and to acquire required skills to solve various problemsin OR.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MSP	ESE	ESP	ATTEN DANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						CO Mapping
Syllabus							
Unit 1	**Introduction** The Historical Development. Nature, Meaning and Management Application of Operations research modelling. Its principal and approximation of OR models Main Characteristic and Phases. General methods of solving models Scientific methods, scope, Role on Decision Making. Development of Operation Research in India.						CO1
Unit 2	**Linear Programming** Mathematical Formulations of Linear Programming Problems. Canonical and standard forms of linear programmingproblems. Solution by Graphical and Simplex method. Revised Simplex method. Two Phase &Big-M method, Duality, Primary-DualRelationship						CO2

	Simplex Method. Economic Interpretation of Optimal Simplex Solution.	
	Special Types of Linear Programming Problems Transportation Assignment Problems	
Unit 3	**Integer and Dynamic Programming** Integer Programming Problem. Branch and Bound Techniques. Characteristics. Deterministic DP Problems, Recursive Approach and Tabularmethod.	CO3
	PERT / CPM Project Planning. Scheduling. Activity Cost. Network Diagram Representation. Difference Between CPM and PERT. Float and Slack Times	
Unit 4	**Queuing Models** Introduction, Applications Characteristic, Waiting and Ideal time costs Transient and Steady States. Kendall's Notation. 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, 8thEdn., 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 andApplications, PHI,2010.* 8. *Prasad Durga, M. V,Operations Research, Cengage Publications, 2012.*	

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L	T	P	Credit
4	0	0	4

Course Code	**CSA579**						
Course Title	**Interactive Computer Graphics**						
Course Outcomes	On the completion of the course the student will be able to: CO1: Understand the fundamental concepts of interactive computer graphics, including graphics hardware, software, and pipeline architecture. CO2: Apply geometric modeling, transformations, and rendering techniques (lighting, shading, texture mapping) to develop visually rich 2D and 3D graphical content. CO3: Design and implement interactive computer graphics applications using standard graphics programming APIs (such as OpenGL/WebGL/Vulkan). CO4: Create and evaluate interactive user interfaces and animations that respond to real-time input while optimizing performance and visual quality.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MSP	ESE	ESP	ATTEN DANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Unit 1	**Display Devices** Line and point plotting systems Raster, vector, pixel and point plotters Continual Refresh and storage display Digital frame buffer Plasma panel displays, Display processors Character generators Color-display techniques: shadow mask and penetrationCRT, Color look-up tables						CO1
	Elementary Drawing Algorithms Line drawing using direct method, simple DDA, integerDDA 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 2	**Geometric Transformations.** Two-Dimensional Translation, rotation, scaling, reflection and shear, Concept of homogenous coordinates, Building composite transformations						CO2
	Viewing Transformations						

	Building composite 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 3	**Three-dimensional concepts** 3-D representations and transformations, perspective and parallel projections, spline curves and surfaces, Quadtree and Octree data structures	CO3
	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 4	**Rendering** Introduction, a simple illumination model Shading - Gouraud shading &Phong Shading Ray Tracing, Shadows, Textures	CO4
	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.*	

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L	T	P	Credit
4	0	0	4

Course Code	**CSA580**						
Course Title	**Theory of Computer Science.**						
Course Outcomes	On the completion of the course the student will be able to: CO1: Understanding of regular language, various types of finite automata along with minimization of automata. CO2: Ability to develop the finite automata for various regular languages. CO3: Understanding of context free language and grammar, ambiguity in grammar and simplification of context free grammar. CO4: Understanding of push down automata and ability to develop the push downautomata for various context free languages. CO5: Understanding of Linear bound automata and ability to develop the Turing machine for various linear bound automata. Understanding of Halting and Undesirability of problem and the Chomsky hierarchy.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MSP	ESE	ESP	ATTEN DANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Unit 1	**Automata Theory** Deterministic Finite Automata, Moves. Non-Deterministic Finite Automata. Moore and Mealy Machine. Minimization Algorithms.						CO1
	Regular Languages Regular Sets. Regular Expressions. Pumping Lemma for Regular sets.						
Unit 2	**Context Free Grammars** Context Free grammars. Derivative Graphs. Ambiguities in Grammars and Languages. Properties of Context Free Languages. Normal Forms. Pumping Lemma for CFL Closure Properties.						CO2

	Pushdown Automata Pushdown Automation (PDA). Deterministic Pushdown Automata (DPDA). Non-Equivalence of PDA and DPDA. Language Accepted by PDA.	
Unit 3	**Linear Bounded Automata (LBA)** Power of LBA. Closure Properties.	CO3
	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 4	**Undecidability** Chomsky Hierarchy of Languages. Halting Problem, undecidable Problems about TuringMachines. Rice theorem. The Equivalence of the Automata and the AppropriateGrammars	CO4
Reference Books	1. *G.E. Reevsz, Introduction to Formal Languages, New Delhi: McGraw Hill 1983.* 2. *Lewis H.R., Papadimitriou C.H., Elements of the Theory of Computation (2nd ed.), NJ: Prentice-Hall,1997.* 3. *Anderson J.A., Automata Theory with Modern Applications, New York: Cambridge University Press, 2006.* 4. *Lewis, Harry R. and Papadimitriou, Christos H.: Theory of Computation, Prentice Hall of India, 1996.* 5. *Hopcroft, John E. and Ullman, Jefrey D.: Introduction to Automata Theory, Languages and Computation, Addison-Wesley Publishing Company Inc.* 6. *Brady, J.M.: Theory of Computer Science, Wiley.* 7. *Dewire, Dawna Tranis: Client Server Computing, McGraw Hill.* 8. *Aho, Lam, Sethi and Ullman: Compilers* Principles, *Techniques and Tools, Publisher Pearson.*	

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L	T	P	Credit
4	0	0	4

Course Code	**CSA516**						
Course Title	**Computer Networks and Data Communication**						
Course Outcomes	On the completion of the course the student will be able to: CO1: Interaction with different hardware devices present in computer networksand discuss various network models. CO2: Interaction with data link layer and its protocols. CO3: Interaction various Routing algorithms. In addition to that functionality ofnetwork layer. CO4: Functionality of Transport layer. CO5: Implementation of Application layer protocols in real-world scenarios						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MSP	ESE	ESP	Attendence
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Unit 1	**Introduction to Data Communication** Components of Data Communication, Data Representation. Transmission Impairments, Switching, Modulation, Multiplexing.						CO1
	Review of Network Hardware LAN, MAN, WAN. Wireless networks, Internetworks**.**						
	Review of Network Software Layer, Protocols, Interface and services.						
	Review of Reference Models OSI, TCP/IP and their Comparison.						
	Physical Layer Transmission Media: Twisted pair, Coaxial cable, Fiberoptics. Wireless transmission (Radio, Microwave, Infrared). Introduction to ATM, ISDN. Cellular Radio and Communication Satellites						

Unit 2	**Data Link Layer** Framing, Error control, sliding window protocols (one bit, Go back n, selective repeat). Examples of DLL Protocols–HDLC, PPP.	CO2
	Medium Access Sublayer 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 3	**Network Layer** Design Issues, Routing Algorithms (Shortest Path, Flooding, Distance Vector, Hierarchical, Broadcast, Multicast). Internetworking, IP Protocol, ARP, RARP.	CO3
Unit 4	**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).	CO4
	Application Layer Domain name system, Email, File transfer protocol. HTTP, HTTPS, World Wide Web	
Reference Books	1. *Tanenbaum, Andrew S., 2009: Computer Networks (5th Edition), PHI.* 2. *Forouzan, B. A., 2009: Data Communications and Networking, Fourth Edition, Tata McGraw Hill.* 3. *William Stalling: Cryptography and Network Security, Principles and Practise, 7th Edition, Pearson.* 4. *Forouzan: Cryptography and Network Security, (3rd Edition), Tata McGraw Hill.*	

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L	T	P	Credit
0	0	4	2

Course Code	CSA581					
Course Title	**Design and Analysis of Algorithms Laboratory.**					
Course Outcomes	On the completion of the course the student will be able to CO1: Understand and implement the divide-and-conquer technique to solve complex problems by breaking them into simpler subproblems, with applications in algorithms likemerge sort and quicksort. CO2: Develop efficient string processing algorithms, such as pattern matching and string manipulation, to solve text-based problems with applications in data retrieval and bioinformatics. CO3: Apply greedy methods to optimize problem-solving approaches in algorithms, including those for shortest path, minimum spanning tree, and job sequencing problems, ensuring optimal and near-optimal solutions. CO4: Demonstrate proficiency in dynamic programming by solving problems with overlapping subproblems and optimal substructure, such as the knapsack problem and the traveling salesman problem, enhancing skills in optimization and efficiency.					
Examination Mode	Practical					
Assessment Tools	Quiz	Lab Performance	Attendance	MSP	ESP	Total
Weightage	-	20	-	30	50	100
1.	Implementation of various algorithms divide and conquer, strings processing, greedy methods, dynamic programming, etc..					

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L	T	P	Credit
0	0	4	2

Course Code	CSA582					
Course Title	**Interactive Computer Graphics Laboratory.**					
Course Outcomes	On the completion of the course the student will be able to CO1: Understand and implement basic line-drawing algorithms like DDA and Bresenham'sline algorithm, and apply them for accurate and efficient line rendering in 2D graphics CO2: Apply circle and ellipse drawing algorithms, such as Bresenham's circle and midpoint ellipse algorithms, to generate smooth and mathematically precise geometric shapes in computer graphics. CO3: Demonstrate proficiency in 2D transformation techniques such as translation, rotation, scaling, and reflection, and implement these transformations using homogeneous coordinates. CO4: Analyse and develop programs to perform composite transformations and apply various algorithms for clipping lines and polygons, ensuring efficient rendering and manipulation of 2D graphical objects.					
Examination Mode	Practical					
Assessment Tools	Quiz	Lab Performance	ATTENDANCE	MSP	ESP	Total
Weightage	-	20	-	30	50	100
1.	Implementation of various algorithms of drawing lines, circle, ellipse, etc.and 2D transformation.					

L	T	P	Credit
4	0	0	4

Course Code	**CSA627**						
Course Title	**Research Methodology**						
Course Outcomes	CO1: Student must be able to understand Scientific Research, Methods of research, Scope of research and reviewing the literature. CO2: Student must be able to learn Statistical Analysis and Regression & Correlation Analysis. CO3: Student must be able to understand Hypothesis testing. CO4: Student must be knowing dissertation design and report writing.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Unit 1	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.						CO1
Unit 2	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.						CO2
Unit 3	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.						CO3

Unit 4	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.	CO4
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.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA541**						
Course Title	**Advanced Operating System**						
Course Outcomes	CO1: To extend the concepts of synchronization and deadlock detection in case ofcooperating processes. CO2: To understand the intricacies of Distributed systems viz Distributed Mutual exclusion and deadlock detection, Agreement protocols. CO3: To understand Distributed Resource Management techniques. CO4: To identify the different features of real time and mobile operating system and to understand the real-life implementation of various concepts in various operating systems like Linux, iOS, Android etc.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MSP	ESE	ESP	ATTEN DANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Unit 1	**Basics of Operating Systems:** Operating System Structure, Operations and Services. System Calls, Operating-System Design and Implementation; System Boot. **Process Management**: Process Scheduling and Operations. Interprocess Communication, Communication in Client–Server Systems. Process Synchronization, Critical-Section Problem, Peterson's Solution, Semaphores, Synchronization. Threads: Multicore Programming, Multithreading Models, Thread Libraries, Implicit Threading, Threading Issues. **CPU Scheduling:** Scheduling Criteria and Algorithms. Thread Scheduling, Multiple Processor Scheduling, Real-Time CPU Scheduling. **Deadlocks:**Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance and Detection; Recovery from Deadlock.						CO1

	Distributed Operating System 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 2	**Memory Management:** Contiguous Memory Allocation, Swapping, Paging, Segmentation. Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files. Storage Management: Mass-Storage Structure, Disk Structure, Scheduling and Management, RAID Structure.	CO2
Unit 3	**File and Input/Output Systems:** Access Methods, Directory and Disk Structure. File System Mounting, File Sharing, File-System Structure and Implementation. Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance. Recovery, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Requests to Hardware Operations. Security: Protection, Access Matrix, Access Control, Revocation of Access Rights, Program Threats, System and Network Threats. Cryptography as a Security Tool, User Authentication, Implementing Security Defences. **Virtual Machines:** Types of Virtual Machines and Implementations; Virtualization.	CO3
Unit 4	**Linux Operating Systems:** Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, File Systems, Input and Output; Inter process Communication, Network Structure. Windows Operating Systems: Design Principles, System Components, Terminal Services and Fast User Switching; File System, Networking. **Distributed Systems:** Types of Networks based Operating Systems, Network Structure, Communication Structure and Protocols; Robustness, Design Issues, Distributed File Systems.	CO4

Reference Books	1. *Operating System Principles, Abraham Silberchatz, Peter B. Galvin, Greg Gagne,8th Edition, Wiley Student Edition* *2. Operating System-Internals and Design Principles, W. Stallings, 6th Edition, Pearson.* *3.Modern Operating System, Andrew s Tanenbaum, 3rd Edition, PHI* *4. Operating System A concept-based Approach, 2nd Edition, D.M. Dhamdhere, TMH.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA542**						
Course Title	**AI and Machine Learning**						
Course Outcomes	CO-1 Learn the fundamentals of Artificial Intelligence, intelligent agents, searching algorithms, and logical reasoning techniques. CO-2 Implement supervised and unsupervised learning algorithms to solve classification, regression, and clustering problems. CO-3 Use ensemble models and evaluation metrics to enhance and assess machine learning models. CO-4 Understand and apply neural networks like CNNs, RNNs, and LSTMs for advanced problem-solving.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**Artificial Intelligence:** Definition, Current AI Systems, Intelligent Agents, Different types of Agents, Searching Algorithms: Heuristic Search, Breadth First Search, Depth First Search, A* Search, Introduction to Expert Systems, Logic and Inferences: Propositional Logic, First Order Logic (FOL), Forward and Backward Chaining						CO1
Unit 2	**Introduction:** Introduction to Machine Learning, Applications, Types: Supervised Learning, unsupervised Learning, semi-supervised learning and reinforcement learning. **Supervised Learning Algorithms**: Naïve Baves, Decision Tree, KNN, SVM, Bayesian Network, Multilayer perceptron or back propagation neural network, linear regression, logistic regression.						CO2
Unit 3	**Unsupervised Learning Algorithms:** K-means Clustering, Hierarchical clustering **Ensemble Machine Learning models:** Ensemble Machine Learning techniques such as Bagging, Boosting and Voting						CO3

	Model Selection: Metrics, Feature Selection, Principal Component Analysis, Confusion Matrix, Overfitting, Underfitting, Bias- Variance Trade-off.	
Unit 4	**Deep Learning:** Basics of Deep Learning, Need of deep learning, Difference between machine learning and deep learning, Classification of Deep Learning Approaches Types: Recursive Neural Networks (RNN), Convolutional Neural Network, Recurrent Neural Network: LSTM	CO4
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.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA654**						
Course Title	**Web Technology**						
Course Outcomes	CO-1 Working with React Modules, importing and exporting the modules. CO-2 Learn what is JSX and how it works behind the scenes. CO-3 Creating dynamic websites with help of re-usable components. CO-4 Build web applications using React JS with MongoDB						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	Introduction to React, Original DOM vs Virtual DOM, React Components, React Components with JSX, React Components with ES6. Basics of Node and Installation, Introduction to Npm, Adding and removing modules						CO1
Unit 2	Creating an application using Create React App, Life Cycle, Debugging, Default values, Set State in depth, Creating Forms, Creating Table, Handling Events, Applying Filters, JSX in depth, Validations, Applying Styles, Backend calls.						CO2
Unit 3	Stateful Components, Stateless Components, Local Storage, Routing, Basic Routing and Passing Params, Hyperlinks, Master Pages, Reconciliation, Creating Reusable Components, React. Component vs React. pure Component, Composition vs Inheritance, Code Reusability and Optimization, Fragments, Bundling, Deploying.						CO3
Unit 4	MongoDB: Introduction: What is MongoDB? Why Mongo DB? (using JSON, Creating or generating a unique key, Support for Dynamic Queries, Storing Binary Data, Replication, Shading,						CO4

	updating information in –place), Terms used in RDBMS and Mongo DB, Data types in Mongo DB, MongoDB Query Language.	
Reference Books	1. Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, "MongoDB in Action", Dream Tech Press, 2nd Edition ,2016. 2. MongoDB: The definitive guide by Kristina Chodorow 3. MongoDB Complete guide by Manu Sharma 4. React JS for beginners by Mayur Patil 5. The road to learn React: your journey to master plain yet pragmatic React.jS by Robin Wieruch. 6. React.js: Easy learning by Sandeep Bisht	

L	T	P	Credit
0	0	4	2

Course Code	CSA655					
Course Title	Web Technology Laboratory					
Course Outcomes	CO-1 Working with React Modules, importing and exporting the modules. CO-2 Learn what is JSX and how it works behind the scenes. CO-3 Creating dynamic websites with help of re-usable components. CO-4 Build web applications using React JS with MongoDB					
Examination Mode	Practical					
Assessment Tools	Quiz	Lab Performance	ATTENDANCE	MSP	ESP	Total
Weightage	-	20	-	30	50	100
1.	Implementation of Stateful and Stateless Components Implementation of Validations controls Working web forms and event handling React component lifecycle and different lifecycle methods Learn to Use MongoDB Atlas (The Cloud Version of MongoDB) and Install and configure MongoDB					

L	T	P	Credit
4	0	0	4

Course Code	**CSA693**						
Course Title	**Cyber Security**						
Course Outcomes	CO-1 Student should understand cyber-attack CO-2 Types of cybercrimes CO-3 Cyber laws and also how to protect them self and ultimately society from such attacks						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**Introduction to Security: Need for security.** Security approaches, principles of security, types of attacks. Digital Privacy, Online Tracking, Privacy Laws, Types of Computer Security risks (Malware, Hacking, Pharming, Phishing, Ransomware, Adware and Spyware, Trojan, Virus, Worms, WIFI Eavesdropping, Scareware, Distributed Denial-Of-Service Attack, Rootkits, Juice Jacking),						CO1
Unit 2	Antivirus and Other Security solution, Password, Secure online browsing, Email Security, Social Engineering, Secure WIFI settings, Track yourself online, Cloud storage security, IOT security, Physical Security Threads. Systems Vulnerability Scanning Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit.						CO2
Unit 3	Networks Vulnerability Scanning - Netcat, Socat,, Understanding port and services tools-Datapipe, Fpipe, WinRelay, Network Reconnaissance-Nmap. Network Defense tools Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding the basis of Virtual Private Networks, Linux Firewall, Window Firewall, Snort: Introduction Detection System						CO3

Unit 4	Introduction to Cyber Crime and law Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world.	CO4
Reference Books	1. Cryptography and Network Security: Behrouz A. Forauzan 2/e 2. Cryptography and Network Security: William Stallings 4/e 3. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill. 4. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication Wiley.	

L	T	P	Credit
0	0	4	2

Course Code	CSA543					
Course Title	**AI & ML Laboratory**					
Course Outcomes	CO-1 Implement basic and advanced AI/ML algorithms using tools like Python and Scikit-learn. CO-2 Preprocess and analyze data for building effective machine learning models. CO-3 Evaluate model performance using metrics like accuracy, precision, recall, and F1-score. CO-4 Develop AI/ML-based solutions to real-world problems through hands-on projects.					
Examination Mode	Practical					
Assessment Tools	Quiz	Lab Performance	ATTENDANCE	MSP	ESP	Total
Weightage	-	20	-	30	50	100
1.	• Implement BFS and DFS algorithms. • Apply A* Search to solve pathfinding problems. • Create a simple Propositional Logic solver. • Use Forward and Backward Chaining for rule-based reasoning. • Build an expert system for decision-making. • Clean and visualize data using Python. • Implement Naïve Bayes, Decision Tree, KNN, and SVM for classification. • Create linear and logistic regression models for prediction. • Train and test a Multilayer Perceptron (MLP). • Perform K-means and Hierarchical clustering on datasets. • Apply bagging, boosting, and voting techniques for model improvement. • Evaluate models using confusion matrix and metrics like precision and recall. • Use PCA for dimensionality reduction. • Build a basic neural network for binary classification. • Implement a CNN for image classification. • Train an RNN or LSTM for sequential data. • Compare deep learning and traditional machine learning models.					

DAV UNIVERSITY

Empowering Students with 21st century Skills

In hours			
L	T	P	Credit
1	0	2	2

Course Code	**CEC103**						
Course Title	**Community Engagement Course**						
Course Outcomes	On the completion of the course, the student will gain the following knowledge and skills: **CO1:** Gain an understanding of rural life, culture and social realities. **CO2:** Develop a sense of empathy and bonds of mutuality with local community. **CO3:** Appreciate significant contributions of local communities to Indian society and economy. **CO4:** Learn to value the local knowledge and wisdom of the community. **CO5:** Identify opportunities for contributing to community's socio-economic improvements.						
Examination Mode	**Theory/ Practical/ Theory + Practical**						
Assessment Tools	**W Quiz**	**Assignment/ Project Work**	**MSE**	**MTP**	**ESE**	**EPR**	**ABL/PBL**
Weightage	**10%**	--------	--------	**25%**	**25%**	**35%**	**5%**
Syllabus							CO Mapping
Unit 1:	**Appreciation of Rural Society** Appreciation of Rural Society: Rural life style, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages" (Gandhi), rural infrastructure. **Teaching Methodology:** Classroom Discussions **Assignment:** Prepare a map (physical, visual or digital) of the village you visited and write an essay about inter-family relations in that village. **Mode of Assignment Submission:** Written Assignment						**CO1**
Unit 2:	**Understanding Rural Economy and Livelihood** Understanding rural economy and livelihood: Agriculture, farming, landownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets. **Teaching Methodology:** Group Discussions in Class						**CO2**

	Assignment: Describe your analysis of rural household economy, its challenges and possible pathways to address them. **Mode of Assignment Submission:** Written Assignment	
Unit 3:	**Rural Institutions** Rural Institutions: Traditional rural organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), local civil society, local administration. **Teaching Methodology:** Classroom Discussions **Assignment:** How effectively are Panchayati raj institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). **Mode of Assignment Submission:** Group presentations of Assignment	**CO3**
Unit 4:	**Rural Developmental Programmes** Rural Developmental Programmes: History of rural development in India, current national programmes, Sarva Shiksha Abhiyan, Beti Bachao Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awas Yojana, Skill India,Gram panchayat Decentralised Planning, NRLM, MNREGA etc. **Teaching Methodology:** Classroom Discussions	**CO4 & CO 5**
	Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community; give suggestions about improving implementation of the programme for the rural poor. **Mode of Assignment Submission:** Written Assignment	

L	T	P	Credit
4	0	0	4

Course Code	**CSA605**						
Course Title	**Data Mining and Data Warehousing**						
Course Outcomes	CO-1 To understand Basic Systems Concepts and Data Warehouse Design Process. CO-2 To understand Data Mart in detail. CO-3 Student must be able to understand Data Preprocessing and Outlier detection. CO-4 Student must know Classification and Clustering.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**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						CO1
Unit 2	**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.						CO2

	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 3	**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 Item sets, Closed Item sets and Association Rules Apriori Algorithm, Improving Efficiency of Apriori algorithm, From Association to Correlation Analysis.	CO3
Unit 4	**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.	CO4
Reference Books	1. Cryptography and Network Security: Behrouz A. Forauzan 2/e 2. Cryptography and Network Security: William Stallings 4/e 3. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill. 4. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication Wiley	

L	T	P	Credit
4	0	0	4

Course Code	**CSA609**						
Course Title	**Information Systems**						
Course Outcomes	CO-1 To understand basic concepts System and Information Concepts and Management Information System. CO-2 To understand Decision Support Systems. CO-3 Student must be able to Expert System and Executive Information and Support Systems. CO-4 Student must know Decision Making Systems, Modelling and Analysis.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**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						CO1
	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 2	**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	CO2
Unit 3	**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	CO3
	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 4	**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	CO4
Reference Books	1. *Murdick Robert, Joel E. Ross, Information Systems for Modern Management, New Delhi: PHI, 3rd Ed, 1971.* 2. *Turban Efraim, 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 Corradi Antonio (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. *Rajaraman, Analysis and Design of Information System, PHI, 3rd Ed, 2011.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA616**						
Course Title	**System Simulation and Modelling**						
Course Outcomes	CO-1 To understand basic concepts in the Systems and environment and System simulation. CO-2 To understand Continuous-time and Discrete Time Systems. CO-3 Student must be able to understand Random Numbers. CO-4 Student must know Queuing Models and Large Scale System.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**Systems and environment** Concept of model and model building Model classification and representation, Use of simulation as a tool, steps in simulation study.						CO1
	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 2	**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						CO2

Unit 3	**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	CO3
	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 4	**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	CO4
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. *Seila A.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* 7. *Rajaraman, Analysis and Design of Information System, PHI, 3rd Ed, 2011.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA619**						
Course Title	**Advanced Software Engineering**						
Course Outcomes	CO-1 Understand lifecycle processes and agile approaches of software Development. CO-2 Apply novel software models and techniques to bring out innovative and solutions for the growth of the society. CO-3 Model and Analyze structure and behavior of a software system. CO-4 Design a solution to a given problem and evaluate the same in various scenarios. CO-5 Create efficient software development approaches for service of technical as well as common society needs.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**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).						CO1
	Software Project Planning Objectives, Decomposition Techniques: Software Sizing, Problem Based Estimation Process Based Estimation, Cost Estimation Models: COCOMO Model, The Software Equation						

Unit 2	**System Analysis** Principles of Structured Analysis, Requirement Analysis DFD, Entity Relationship Diagram, Data Dictionary	CO2
	Software Design Objectives, Principles, Concepts Design Mythologies: Data Design, Architecture Design Procedural Design, Object–Oriented Concepts	
Unit 3	**System Administration and Training** User manual, Implementation Documentation, Operation plan and maintenance	CO3
Unit 4	**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 Metrics and software models	CO4
	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.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA632**						
Course Title	**Big Data Analytics**						
Course Outcomes	CO-1 Student must be Able to understand the building blocks of Big Data. CO-2 Student must be able to articulate the Mining Data Streams. CO-3 Student must be able to represent the analytical aspects of Big Data using Hadoop. CO-4 Student must be knowing the different Frameworks.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**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						CO1
Unit 2	**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						CO2
Unit 3	**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 HDFS Basics Developing a Map Reduce Application How Map Reduce Works						CO3

	Anatomy of a Map Reduce Job Run-Failures Job Scheduling-Shuffle and Sort, Task execution Map Reduce Types and Formats, Map Reduce Features	
	Software Design Objectives, Principles, Concepts Design Mythologies: Data Design, Architecture Design Procedural Design, Object–Oriented Concepts	
Unit 4	**Frameworks** Applications on Big Data Using Pig and Hive Data processing operators in Pig Hive services, HiveQL, Querying Data in Hive Fundamentals of HBase and Zoo Keeper Visualizations Visual data analysis techniques, interaction techniques Systems and applications	CO4
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, John Wiley& 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.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA634**						
Course Title	**Internet of Things**						
Course Outcomes	CO-1 Learn and usage of the term "internet of things" in different contexts. CO-2 Understand the key components that make up an IoT system. CO-3 Understand the concepts of Data Acquiring and Business Models for Business Processes. CO-4 To learn about Data Collection and IOT cloud-based services.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	An Overview of Internet of things, Internet of Things Technology. Behind IoTs Sources of the IoTs, 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						CO1
Unit 2	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 Real time Analytics Platform (RTAP) Applications						CO2
Unit 3	Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage						CO3

	Business Models for Business Processes in the Internet of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.	
Unit 4	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	CO4
Reference Books	1. *Rajkamal, Internet of Things: Architecture, Design Principles And Applications, McGraw Hill Higher Education, 2017.* 2. *Bahgya and V. Madisetti, Internet of Things, University 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.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA633**						
Course Title	**Machine Learning**						
Course Outcomes	CO-1 Introduction to machine learning. CO-2 Understand the Linear machines and Learning decision trees. CO-3 Understand the concepts of Instance-based Learning and Machine learning concepts and limitations. CO-4 To learn about Machine learning assessment and Improvement and Support Vector Machines.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**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.						CO1
Unit 2	**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.						CO2

Unit 3	**Instance-based Learning** Nearest neighbour classification, k-nearest neighbour, nearest neighbour error probability	CO3
	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, Trade-off.	
Unit 4	**Machine learning assessment and Improvement** Statistical model selection, structural risk minimization, bootstrapping, bagging, boosting.	CO4
	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*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA635**						
Course Title	**R Programming**						
Course Outcomes	CO-1 Introduction to R Programming. CO-2 To learn about Matrices, Arrays and Lists. CO-3 Understand the concepts of Data Frames. CO-4 To learn about OOP and Interfacing of R with other languages.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**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						CO1
Unit 2	**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						CO2
Unit 3	**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.						CO3
Unit 4	**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						CO4

	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 Visualisation, Statistical Analysis and Programming in R, Amazon Digital South Asia Services Inc, 2013.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA671**						
Course Title	**Microprocessors and Its Applications**						
Course Outcomes	CO-1 Learn the history of microprocessors, Microcomputer structure and Architecture of 8085/ 8086 Microprocessor CO-2 Understand the Memory Interface. CO-3 Understand the Interrupts and Direct Memory Access (DMA). CO-4 Acquired the knowledge about Bus Interface and Assembly Language Programming.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**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.						CO1
Unit 2	**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						CO2

	8254 Programmable Interval Timer 16550 Programmable Communication Interface	
Unit 3	**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	CO3
Unit 4	**Bus Interface** ISA, EISA VESA Buses, PCI, USB Bus	CO4
	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: Tata McGraw Hill Publishing Company Ltd, 2006.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA608**						
Course Title	**Distributed and Parallel Processing**						
Course Outcomes	CO-1 To understand basic concepts distributed systems and Inter-process Communication CO-2 To understand Distributed Operating Systems and Parallel Processing. CO-3 Student must be able to understand Parallel Processing Architectures, Data Dependency Analysis and Thread Based Implementation. CO-4 Student must know Recovery and Fault Tolerance and Algorithms for Parallel Machines.						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**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						CO1
Unit 2	**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.						CO2
	Parallel Processing Introduction, Need for Computational speed; Applications of parallel computers in various fields including Mathematics, Physics, Chemistry and Computer Science						

Unit 3	**Parallel Processing Architectures** Parallelism in Sequential Machines, Abstract model of parallel computer Multiprocessor architecture, programmability issues	CO3
	Data Dependency Analysis Types of Dependencies, Loop and Array Dependence Loop Dependence Analysis, Solving Diophantine Equations. Thread Management, Thread Implementation	
Unit 4	**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	CO4
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.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA678**						
Course Title	**Digital Image Processing**						
Course Outcomes	CO-1 Fundamentals of image processing, basic filters and image processing operations CO-2 Image Enhancement operations in Spatial and Frequency domain CO-3 Color and Morphological Image Processing and applications of image processing CO-4 Image Compression and its methods						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping
Unit 1	**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						CO1
	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 2	**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 High pass Filters, Butterworth High pass filters, Gaussian High pass Filters,						CO2

	Unsharp Masking, High boost Filtering and High Frequency-Emphasis filtering.	
Unit 3	**Techniques of Color Image Processing** Color image signal representation Color System Transformations Extension of Processing Techniques to Color Domain	CO3
	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 4	**Introduction to Image Compression** Coding Redundancy Spatial and Temporal Redundancy Irrelevant Information Measuring Image Information	CO4
	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 of India, 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. Annadurai S. and Shanmuga Lakshmi., Fundamentals of Digital Image Processing, New Delhi: Pearson Education, 2007* *5. Joshi M.A., Digital Image Processing: An Algorithmic Approach, New Delhi: Prentice-Hall of India, 2006* *6. Sridhar, Digital Image Processing 2ed, Oxford University Press.*	

L	T	P	Credit
4	0	0	4

Course Code	**CSA691**						
Course Title	**Natural Language Processing**						
Course Outcomes	CO-1 Understand the basics of Natural Language Processing. CO-2 Understand Syntax: Word Classes, Context Free Grammars and Parsing CO-3 Understand the Word Sense Disambiguation. CO-4 Acquired the knowledge about various statistical techniques used in NLP						
Examination Type	Theory						
Assessment Tools	Written Quiz	Assignment/Project Work	MSE	MSP	ESE	ESP	ATTENDANCE
Weightage	**10**	**10**	**25**		**50**		**5**
Examination Mode	Theory						
Syllabus							CO Mapping

UNIT – A	**15 Hours**
Foundations of NLP & Linguistic • **Introduction to NLP**	

• Definition, scope, and challenges
• NLP vs Computational Linguistics
• Applications: MT, Chatbots, IR, Speech, Sign Language
• **History and Evolution of NLP**
  ○ Rule-based NLP
  ○ Statistical NLP
  ○ Neural NLP
  ○ Transformer & LLM era
• **Text Processing Basics**
  ○ Tokenization
  ○ Normalization
  ○ Stemming and Lemmatization
  ○ Stop-word handling
• **Regular Expression and Finite Automata**
  ○ Regex for text processing
  ○ Finite State Automata (FSA)
  ○ Finite State Transducers (FST)
  ○ Morphological analysis	

UNIT-B	
Syntax & Classical NLP Techniques	**15 Hours**

• **Word Classes and POS Tagging**
  o Parts of Speech
  o Rule-based POS tagging
  o Statistical POS tagging
  o Evaluation metrics
• **Syntax & Grammers**
  o Phrase structure
  o Constituency vs Dependency grammar
  o Context-Free Grammars (CFG)
  o Parse trees
• **Parsing Techniques**
  o Top-down parsing
  o Bottom-up parsing
  o CYK algorithm
  o Dependency parsing (intro)	

UNIT – C	**15 Hours**
Semantics, WSD & Traditional ML NLP	

• **Lexical Semantics**
  o Word meaning
  o Synonymy, Polysemy, Homonymy
  o Lexical resources (WordNet)
• **Word Sense Disambiguation (WSD)**
  • Knowledge-based approaches
  • Selectional restriction
  • Dictionary-based methods
  • Unsupervised WSD
  • Supervised ML-based WSD
• **Feature-Based NLP**
  o Bag of Words (BoW)
  o TF-IDF
  o N-grams
  o Feature engineering
• **Classical ML for NLP**
  • Naive Bayes
  • Support Vector Machines
  • Conditional Random Fields (CRF)
  • Applications: NER, text classification	

UNIT – D	***15 Hours***
Statistical and Neural NLP	

• **Statistical NLP**
  o Probability basics
  o Language Modeling
  o N-gram models
  o Smoothing techniques	

• **Sequence Models**
  o Hidden Markov Models (HMM)
  o POS tagging using HMM
  o CRF vs HMM
• **Word Embeddings**
  o Distributional hypothesis
  o Word2Vec (CBOW, Skip-Gram)
  o GloVe
  o FastText
  o Limitations of static embeddings	

Reference & Text 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.
5. Jurafsky, D. & Martin, J. H. (2026). Speech and Language Processing (3rd ed., online draft). Available from Stanford University (online).

L	T	P	Credits	Marks
4	0	0	4	100

Course Code	**CSA694**						
Course Title	**Blockchain Technology**						
Course Outcomes	On the completion of the course the student will be able to: CO1: Understand the applications of blockchain in different domains. CO2: Understand basic technologies like cryptographic hash functions, blocks, Merkle trees, elliptic curve cryptography and digital signatures. CO3: To Have knowledge of decentralized consensus algorithms like Proof of Work, Proof of Stake, Proof of Capacity etc. CO4: To Learn how to record transactions in blockchain, computing Bitcoin addresses etc.						
Examination Mode	Theory/ Practical/ Theory+ Practical.						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MTP	ESE	EPR	ABL/PBL
Weightage	10%	10%	25%	-	50%	-	5%
Syllabus							**CO Mapping**

UNIT – A	**15 Hours**
Introduction	
• History, Digital currencies, Ledgers, Cryptography, Centralized and decentralized systems, Peer-to-peer systems, Purpose of Blockchain, Types of blockchain (public, private, semi-private), Applications of blockchain (in government, healthcare, real estate, voting, insurance, NFTs, metaverse, Web 3.0).	
UNIT-B	
Cryptocurrency & Design	**13 Hours**
• Concept of cryptocurrency, History of Bitcoin, Mining concept, Challenges of blockchain/Bitcoin design (performance, scalability, efficiency, security, governance, public policy and legal framework).	
UNIT – C	**12 Hours**
Blockchain Technology	
• Properties of hash functions, Cryptographic hash functions, Hashes, Blocks, Block headers, Merkle trees, Chain forks, Asymmetric cryptography, Digital signatures **Decentralized Network Consensus**.	

• Introduction to decentralized networks, Native currency, Consensus, Proof of Work (PoW), Proof of Stake (PoS), Proof of Capacity (PoC), Proof of Burn (PoB), PBFT, Proof of Elapsed Time (PoET).	
UNIT – D	**15 Hours**
Permissioned and Permissionless Blockchain	
Blockchain systems vs traditional databases, Permissioned and permissionless blockchains, Applications, Advantages and disadvantages, Solidity. **Blockchain and Money Transactions** Satoshi and Bitcoin, Recording of transactions in blockchain, Transaction inputs, outputs and format, Bitcoin addresses.	

Text Book:

1. Imran Bashir Mastering blockchain Distributed ledger technology, decentralization, and smart contracts explained, 2nd edition, Packt Publication, 2018.
2. Lorne Lantz and Daniel Cawrey Mastering Blockchain Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, 1st edition, O'Reilly Publication, 2020.
3. Chris Dannen Introducing Ethereum and Solidity Foundations of Cryptocurrency and Blockchain Programming for Beginners, 1st edition, Apress Publication, 2017.