Department of Computer Science and Applications

School of Mathematical and Physical Sciences (SMPS)

Curriculum Framework & Syllabus
of
MASTER OF COMPUTER APPLICATIONS
(M.C.A.)

Semester I to IV
Based on NEP-2020

(Approved by BoS: 29/05/2024)
w.e. f.
Academic Session 2024-2025 & Onward

Doctor Harisingh Gour Vishwavidyalaya, Sagar
Madhya Pradesh 470003
(A Central University)

29.05.24

Post Graduate Curriculum Framework for Master of Computer Applications (MCA)

1. Name of the program: **Master of Computer Applications (MCA)**
2. Duration of the program : 2 Years
   - **(a)** Minimum duration : 2 Years
   - **(b)** Maximum duration : As per University Ordinance
3. Structure of the program: : MCA Credit Distribution

Semester	Discipline Specific Major	Multi-disciplinery Major	Skill Enhancement Course (SEC)	Total Credits
I	14	4	6	**24**
II	14	4	6	**24**
III	14	4	6	**24**
IV	6	-	20	**26**
TOTAL	**48**	**12**	**38**	**98**

4. **Medium of Instruction & Examination:** The medium of instruction as well as examination will be English only.
5. **Attendance:** Students must secure a minimum of 75% attendance in each course to appear in the End Semester Examination. Relaxation may be granted as per University Ordinance.
6. **Scheme of Examination:**
   - **(a)** Mid Semester Examination (**ME**) : **20 Marks**
   - **(b)** Internal Assessment (**IA**) : **20 Marks**
   - **(c)** End Semester Examination (**ESE**) : **60 Marks**

   a. **Mid Semester Examination: 20 Marks**
   The syllabus and pattern of examination will be decided by the corresponding course instructor(s).

   b. **Internal Assessment: 20 Marks**
   20 marks of internal assessment will be evaluated on any one or more than one method of the following:
      i. Classroom activities.
      ii. Presentation
      iii. Assignment
      iv. Quizzes
      v. Practical based Test

   c. **End Semester Examination : 60 Marks**
   The END SEMESTER Paper shall be of 60 marks of 3 hours duration. The pattern of Questions asked shall be as mentioned in the University Ordinance No 22.

   Note: A student shall be eligible to appear in the End Semester Examination of course if he/she appeared in Mid Semester Examination and Internal Assessment and fulfills the requirement attendance, failing which he/she will not be permitted to appear in the End Semester Examination of the respective course.

d. Dissertation Evaluation:

The dissertation work is evaluated based onthefollowing heads:

I.	Mid 1- Presentation&evaluation of Synopsis:	20 Marks
II.	Mid 2- Presentation & evaluation of Progress of work:	20 Marks
III.	End Semester:	
	a. Evaluation of Dissertation:	30 Marks
	b. Presentation:	15 Marks
	c. Viva :	15 Marks

Dissertation copied from other students will be considered to have used unfair means. If two dissertations are found identical by more than 40% then zero marks will be awarded to both of them. In such a case the dissertation will have to be resubmitted on the new topic.

Committee for Evaluation:

The evaluation of components I and II is carried out by a course co-ordinator appointed by the Head of the Department.

Components III will be evaluated by a committee consisting of the Chairman of BoS or his/her nomineeand an external examiner invited from other University/Industry/Society /Community/other departments within the University.

7. Credit and Teaching hours:

The credit and teaching hours shall be distributed as under:

Theory	1- Credit = 15 hours / per semester 2- Credit = 30 hours / per semester 3- Credit = 45 hours / per semester 4- Credit = 60 hours / per semester
Practical	1- Credit = 30 hours / per semester 2- Credit = 60 hours / per semester
Tutorial	1- Credit = 15 hours / per semester

The teacher-to-student ratio for tutorial/practical can be 1:10 i.e. class will be divided into groups of 10 students for tutorial and practical classes.

8. Credit requirement: As per the guidelines of curriculum and credit framework for PG programmes under NEP 2020

9.Curriculum Framework based on National Education Policy 2020 : NEP-2020 has conceptualized the idea to develop well rounded competent individuals for making the nation a self-reliant and global leader. In the same spirit, we have developed a curriculum frame work to encompass the goals of NEP-2020 & the guidline provided by the our Vishwavidhyalaya. To this end, we have incorporated choice of subject/disciplines of study, creating academic pathways having constructive combinations of disciplines for study with multiple entry and exit points as well as focus on experiential learning for students by introducing multidisciplinary and skill enhancement courses and actual Hand's on training in the recent and trending aspects of the area concerned.

Course Objective and Outcomes

The broad objective of the two-year MCA program is to prepare students' productive careers in the software industry, corporate sector, Govt. organizations, and academia by providing a skill-based environment for teaching and research in the core and emerging areas of the discipline.

The Programme's thrust is on giving the students a thorough and sound background in theoretical and skill-oriented courses relevant to the latest computer software development. The program emphasizes the application of software technology to solve mathematical, computing, communications/networking, and commercial problems.

This two-yearProgramme has been designed with a semester approach in mind.The first two semesters provide theoretical knowledge and basic computing skills of computer science. The third semester focuses on advanced computing knowledge and techniques. The final semester has dissertation/project work and specialized papers of different domains and applications of computer science.

Master of Computer Applications (MCA) program is a theoretical and practical based course having the following objectives:

1. Produce knowledgeable and skilled human resources which are employable in the IT industry, research work, and higher education.
2. Impart knowledge required for planning, designing, and building complex Application Software Systems as well as providing support to automated systems or applications.
3. Produce entrepreneurs who can develop customized solutions for small to large Enterprises.
4. Develop academically competent and professionally motivated personnel, equipped with objective, critical thinking, right moral and ethical values that compassionately foster the scientific temper with a sense of social responsibility.
5. Develop students to become globally competent.

After completing this course students shall be experts in the following areas:

1. Planning, designing, and building complex Application Software Systems as well as providing support to automated systems or applications.
2. Skilled entrepreneurs can develop customized solutions for small to large Enterprises.
3. Academically competent and suitable for academics and scientific research with a sense of social responsibility.
4. Students will be able to work in the latest and emerging technologies.

After completion of the Programme the learner will be able to work as:

1. Software Developer/Engineer
2. Web Developer
3. System Analyst
4. Network Administrator
5. Database Administrator (DBA)
6. IT Consultant
7. Data Scientist/Analyst
8. Cybersecurity Analyst

Postgraduate Curriculum Framework under NEP 2020
Master of Computer Applications

M.C.A.: First Semester

Level / Semester	Nature of Course	Courses Code	Course Title	MM	L	T	P	C
L-8 First Semester	Discipline Specific: Major	CSA-DSM-1201	Data Structure	100	4	0	0	4
		CSA-DSM-1202	Lab Based on Data Structure	100	0	0	2	2
		CSA-DSM-1203	Operating System	100	4	0	0	4
		CSA-DSM-1204	Computer Organization and Architecture	100	4	0	0	4
	Mulit-Disciplinary: Major	CSA-MDM-1201	Discrete Mathematics	100	4	0	0	4
	Skill Enhancement Course (SEC)	CSA-SEC-1201	Programming using C	100	4	0	0	4
		CSA-SEC-1202	Lab Based on C Programming	100	0	0	2	2
							Total Credits	24

#DSM: Discipline SpecificMajor, MDM: Multi – Disciplinary Major, SEC: Skill Enhancement Course

M.C.A.: Second Semester

Level / Semester	Nature of Course	Courses Code	Course Title	MM	L	T	P	C
L-8 Second Semester	Discipline Specific: Major	CSA-DSM-2201	Database Management Systems	100	4	0	0	4
		CSA-DSM-2202	Lab Based on DBMS	100	0	0	2	2
		CSA-DSM-2203	Data Communication & Computer Networks	100	4	0	0	4
		CSA-DSM-2204	Theory of Computation	100	4	0	0	4
	Multi-Disciplinary :Major	CSA-MDM-2201	Design and Analysis of Algorithm	100	4	0	0	4
	Skill Enhancement Course (SEC)	CSA-SEC-2201	Java Programming	100	4	0	0	4
		CSA-SEC-2202	Lab Based on Java Programming	100	0	0	2	2
							Total Credits	24
Exit with Post Graduate Diploma in Computer Application								

#DSM: Discipline Specific: Major, MDM: Multi – Disciplinary Major, SEC: Skill Enhancement Course

M.C.A.: Third Semester

Level / Semester	Nature of Course	Courses Code	Course Title	MM	L	T	P	C
L-9 Third Semester	Discipline Specific: Major	CSA-DSM-3201	Web Application Design using PHP	100	4	0	0	4
		CSA-DSM-3202	Lab Based on Web Application	100	0	0	2	2
		CSA-DSM-3203	Software Engineering	100	4	0	0	4
		CSA-DSM-3204	Cryptography & Network Security	100	4	0	0	4
	Multi-Disciplinary:Major	CSA-MDM-3201	AI & Machine Learning	100	4	0	0	4
	Skill Enhancement Course (SEC)	CSA-SEC-3201	Programming with Python	100	4	0	0	4
		CSA-SEC-3202	Lab Based on Python Programming	100	0	0	2	2
Total Credits								24

M.C.A.: Fourth Semester

Level / Semester	Nature of Course	Courses Code	Course Title	MM	L	T	P	C
L-9 Fourth Semester	Discipline Specific: Major		Elective 1 (Opt any one of the following)	100	3	0	0	3
		CSA-DSM-4201-A	Data Mining and Knowledge Discovery					
		CSA-DSM-4201-B	Cloud computing					
		CSA-DSM-4201-C	Information Hiding Techniques					
		CSA-DSM-4201-D	Cyber Security					
		CSA-DSM-4201-E	Big Data and Analytics					
			Elective 2 (Opt any one of the following)	100	3	0	0	3
		CSA-DSM-4202-A	Ad-Hoc & Sensor Network					
		CSA-DSM-4202-B	Natural Language Processing					
		CSA-DSM-4202-C	Information Retrieval & Web Mining					
		CSA-DSM-4202-D	Digital Image Processing					
		CSA-DSM-4202-E	Fundamental of Data Science					
	Skill Enhancement Course (SEC)	CSA-SEC-4201	Dissertation	100	-	-	-	20
							Total Credits	26
Exit withMaster in Computer Applications								

#DSM: Discipline Specific: Major, SEC: Skill Enhancement Course

Summary				
Semester	I	II	III	IV
Semester-wise Total Credits	24	24	24	26
Total Credits	98			

L- Lecture, T- Tutorial, P – Practical, C – Credit, ME -Mid Exam, IA – Internal Assessment

Detailed Syllabus

MCA (Semester – I)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-1201	Data Structure	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. The student learns to implement basic data structures like stacks, queues, linked lists, trees, and graphs.
2. Ability to develop some simple applications, like a desk calculator using stacks.
3. Understanding of advanced searching methods like B-tree, B+ tree, AVL/red-black trees.

Course Learning Outcome:

Upon successful completion of the course, students will be able to:

1. Explain the concept of data structure, abstract data types, algorithms, and basic data organization schemes such as arrays and linked lists.
2. Describe the applications of stacks and queues and implement various operations on them using arrays and linked lists.
3. Describe the properties of graphs and trees and implement various operations such as searching and traversal on them.

UNIT-I:Introduction to data structure: Data, Entity, Information, Difference between Data and Information, Data type, Build in data type, Abstract data type, Definition of data structures, Types of Data Structures: Linear and Non-Linear Data Structure. **Arrays:** Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Derivation of Index Formulae for 1-D,2-D Array Application of arrays, Sparse Matrices and their representations.**Linked lists:** Array Implementation and Pointer Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition Subtraction & Multiplications of Single variable

UNIT– II:Stacks: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression Hanoi towers. **Queues:**Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array, and linked implementation of queues in C, Dequeue, and Priority Queue.

UNIT –III:Searching: Concept of Searching, Sequential search, Index Sequential Search, Binary Search. Concept of Hashing & Collision resolution Techniques used in Hashing.Sorting: Insertion Sort, Selection Sort, Bubble Sort, Heap Sort.

UNIT –IV:Graphs: Terminology used with Graph, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Adjacency. Graph Traversal: Depth First Search and Breadth-First Search, Spanning Treee, Prims and Kruskal algorithm, Shortest path Dijkstra Algorithm,

UNIT –V: Binary Trees, Binary Tree Representation: Array Representation and Pointer (Linked List) Representation, Binary Search Tree, Complete Binary Tree, A Extended Binary Trees, Tree Traversal algorithms: Inorder, Preorder, and Postorder, Constructing Binary Tree from given Tree Traversal, Operation of Insertion, Deletion, Searching & Modification of data in Binary Search Tree. Threaded Binary trees, Huffman coding using Binary Tree, AVL Tree,

Essential Reading:

1. "Fundamentals of Computer Algorithms", Horowitz Ellis, Sahni Sartaj and Rajasekharan S., Universities Press.
2. "Data Structures and Algorithms Made Easy", Narasimha Karumanchi , Second Edition, 2023.
3. "Theory and Problems of Data Structures", Lipschutz S., Schaum's Series.,First edition ,2014

Suggested Reading and links:

4. Aho, Ullman, and Hopcroft, "Design and Analysis of Algorithms", Pearson Education., first edition.
5. "Data Structures and Algorithm Analysis in C++" by Mark Allen Weis ,Forth Edition, 2018.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – I)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-1202	Lab Based on Data Structure	-	-	2	2	20	20	60	100

Course Learning Objectives:
To train the students to implement the theory and concepts of data structure in programming.

CourseLearning Outcomes:
After completing this course students will be capable enough to implement various concepts of data structure

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The list of practicals will be decided by the course coordinator as per syllabus of theory paper of Data Structure.

Any other as per teacher concern.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – I)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-1203	Operating System	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. the basic function of the operating system
2. the resource management aspect of the operating system
3. the command of UNIX standard libraries.

Course Learning Outcome:

Upon successful completion of the course, students will be able to:

1. handlechallenges of the resource handling of a computer using an operating system.
2. To apply the basic command of UNIX

UNIT – I: Introduction: What is an Operating System, Simple Batch Systems, Multiprogrammed Batches systems, Time-Sharing Systems, Personalcomputer systems, Parallel systems, Distributed Systems, Real-Time Systems. **Processes:** Process Concept, Process Scheduling, Operation on Processes, Cooperating Processes, Interprocess Communication

UNIT– II:CPUScheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple- Processor Scheduling, Real-Time Scheduling, Algorithm Evaluation

UNIT –III: Process Synchronization: Background, The Critical-Section Problem, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Critical Regions, Monitors.
Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined Approach to Deadlock Handling

UNIT –IV: Memory Management: Background, Logical versus Physical Address space, swapping, Contiguous allocation, Paging, Segmentation, Segmentation with Paging Virtual Memory: Demand Paging, Page Replacement, Page replacement Algorithms, Performance of Demand Paging, Allocation of Frames, Thrashing, Other Considerations, Demand Segmentation

UNIT –V: Basic Commands of Unix, File System, General Model of a File System, Symbolic File System, Basic File System, Access Control Verification, Logical File System, Physical File System File-System Interface: File Concept, Access Methods, Directory Structure, Protection, Consistency Semantics File-System Implementation: File-System Structure, Allocation Methods, Free-Space Management, Directory Implementation, Efficiency and Performance, Recovery

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Essential Reading:

1. Abraham Silberschatz "Silberschatz's Operating System Concepts", 1st edition, 2023
2. Milan Milankovic, "Operating Systems, Concept and Design" McGraw Hill, 2nd edition, 2001

Suggested Reading and links:

1. Douglas E. Comer"Operating System Design", Wiley , 2nd edition, 2020.
2. Harvey M Ddeital "Operating System" Addison Wesley, 3rd edition, 2017

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – I)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-1204	Computer Organization and Architecture	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. To be aware of the number system
2. Get a clear idea of the internal architecture of the central processing unit.
3. To learn the functioning of the exchange of information of electronic devices embedded on the motherboard.
4. To learn memory classification and organization.

Course Learning Outcome:

Upon successful completion of the course, students will be able to:

1. understand the roles, functions, and duties of components of the internal architecture of the central processing unit.
2. Describe the memory organization

UNIT-I: Representation of information and Basic Building Blocks: Number System: Binary, Octal, Hexadecimal, and their conversion, CharacterCodes: BCD, ASCII, EBCDIC. Digital Codes: Gray Code, XS-3 Code.

UNIT– II: Logic circuits: Basic Logic Functions, Synthesis of Logic Functions Using AND, OR and NOT Gates, Minimization of Logic Expression, Synthesis with NAND and NOR Gates, Implementation of Logic Gates, Flip-Flops, Registers and Shift Registers, Counters, Decoders, Multiplexers, Programmable Logic Devices, Sequential Circuits.

UNIT –III: Basic Structure of Computer Hardware and Software: Functional units, Basic operational concepts, Bus structures, Software, Performance, Distributed Computing.

Addressing Methods: Basic Concepts, Memory Locations, Main Memory Operations, Addressing Modes, Basic I/O operations, Stacks and Queues, Subroutines

UNIT –IV: Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Hardwired Control, Performance Considerations, Micro Programmed Control, Signed Addition and Subtraction, Arithmetic and Branching Conditions, Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations.

UNIT –V:,Input-output Organization: Accessing I/O Devices, Interrupts, Direct Memory Access, I/O Hardware, Standard I/O Interfaces.
Memory: Semiconductor RAM, Read-Only Memory, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements

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Essential Reading:

1. Computer Architecture: A Quantitative Approach" by John L. Hennessy and David A. Patterso, 6th edition 2021.
2. "Structured Computer Organization" by Andrew S. Tanenbaum 6th edition (2016).
3. Computer Organization and Architecture: Designing for Performance" by William Stallings, 11th edition 2019.

Suggested Reading and links:

1. "Computer Systems: A Programmer's Perspective" by Randal E. Bryant and David, 3rd edition. 2016.
2. "Advanced Computer Architecture" by Smruti R Sarangi,1st edition 2021.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – I)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-MDM-1201	Discrete Mathematics	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. Understand the basic concepts of discrete mathematics
2. Design & apply the rules of inference and methods of proof including direct and indirect proof forms, proof by contradiction, and mathematical induction
3. Formulate & use tree and graph algorithms to solve problems
4. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra

Course Learning Outcome:

Upon successful completion of the course, students will be able to:

1. use mathematical and logical notation to define and formally reason about basic discrete structures such as Sets, Relations, and Functions
2. Apply mathematical arguments using logical connectives and quantifiers to check the validity of an argument through truth tables and propositional and predicate logic
3. Formulate and solve recurrences and recursive functions
4. Apply the concept of combinatorics to solve basic problems in discrete mathematics data structure, abstract
5. Formulate & use tree and graph algorithms to solve problems

UNIT-ISet Theory: Introduction, Size of sets and cardinals, Subsets, Power sets, Complement, Union and Intersection, Demorgan's law, Ordered pairs, and Set identities. **Relations & Functions:** Relations - Definition, Operations onrelations, Properties of relations, Equality of relations, Partial order relation. Functions - Definition, Classification of functions, Operations on functions, Recursively defined functions. **Notion of Proof:** Introduction, Mathematical Induction, Strong Induction, and Induction with Nonzero base cases.**Algebraic Structures:** Definition, Properties, Types: Semi Groups, Monoid, Groups, Abelian Groups.

UNIT– II:Lattices: Introduction, Partial order sets, Combination of partial order sets, Hasse diagram, Introduction of lattices, Properties of lattices – Bounded, Complemented, Modular and Complete lattice. Boolean Algebra: Introduction, Axioms, and Theorems of Boolean algebra, Boolean functions. Simplification of Boolean Functions, Karnaugh maps..

UNIT –III:Combinatorics: Multinomial theorem, the principle of inclusion-exclusion; Classification of recurrence relations, summation method, Linear homogeneous relations, characteristic root method, general solution for distinct and repeated roots, non-homogeneous relations, and examples, generating functions and their application to linear homogeneous recurrence relations

UNIT –IV: Graph Theory: Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments, trees; Minimum spanning tree, rooted trees, and binary trees, planar graphs, Euler's formula, statement of Kuratowski's theorem, dual of a planar graph, independence number, and clique number, chromatic number, statement of Four-color theorem, dominating sets and covering sets

UNIT –V:Logic: Propositional calculus propositions and connectives, syntax; semantics truth assignments and truth tables, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility,**Introduction to Predicate Calculus:** Syntax of first-order language; Semantics structures and interpretation; Formal deductibility; First-order theory, models of a first-order theory (definition only).

Essential Reading:

1. "Discrete Mathematics and Its Applications", K.H. Rosen, Tata McGraw Hill,8th edition, 2021.
2. "Discrete Mathematical Structure with Application to Computer Science", J. P. Trembley,1stedition, 2017.
3. "Elements of Discrete Mathematics A Computer Oriented Approach", C.L. Liu, D. P. Mohapatra,4th edition, 2017

Suggested Reading:

1. "Discrete Mathematics", C.V. Sastry, Wiley,1st edition, 2020.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – I)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-SEC-1201	Programming using C	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. To impart the concepts of programming.
2. To understand the concepts C& C++ programming language.

Course Learning Outcome:

Upon successful completion of the course, the students will be able to:

1. Construct flowchart and write algorithms for solving basic problems.
2. Write 'C' programs that incorporate the use of variables, operators, and expressions along with data types.
3. Write simple programs using basic elements like control statements, functions, arrays, and strings.
4. Write advanced programs using the concepts of pointers, structures, unions, and enumerated data types.

UNIT-I:Basics of programming: Approach to problem-solving , use of high level programming languge for systematic development of programs, Concept of algorithm & flowchart, concept and role of structure programming.**Basics of C:** History of C, Salient features of C, Structure of C Program, Compiling C Program, Link and Run C Program, Character set, Tokens, Keywords, Identifiers, Constants, Variables, Data types, Standard Input/Output, Operators and expressions.

UNIT– II: Conditional Statements:if, if-else, and nested if-else statements, Switch statements, Restriction of switch value, Use of break and default with switch, comparision of the switch and if-else.
Loops and Iteration: for, while, and do-while loops, Multiple loop variables, Nested loops, break and continue statement.
Functions: Introduction, Types, Declaration of a Function, Function calls, Defining functions, Function Prototypes, Passing arguments to a function, Return values and their types, Writing multifunction program,Calling a function by value, Recursive Functions.

UNIT –III: Array: Array notation and representation, Declaring one-dimentional array, Initializing array, accessing array elements, Manipulation array elements, Array of unknown or varying size, Two dimentional array, Multi-dimentional array.
Pointers: Introduction, Characterstic, * and &operatiors, Pointer type declaration and assignment, Pointer arithmetic, Call by reference, Passing pointer to function, the array of pointer, pointer to functions, pointer to pointer, Array of Pointer.
String: Initialization, Initializtion string, accessing string element, array of strings, passing string to functions, String function.

UNIT –IV: Structure: Introduction, Initializing, defining, and declaring structure, Accessing members, Operations on individual members, Operations on structures, Structure within structure, Array of structure, Pointer to structure
Union: Introduction, declaring union, Usage of unions, Operation of the unions, Enumerated data types. Stroage classes: Introduction, Types -automatic, register, static and extern

UNIT –V: Dynamic Memory Allocation: Introduction, Library functions – malloc, calloc, realloc and free.
File Handling: Basics, File types, File operations, File pointer, File opening modes, File handling function, file handling through command line arguments, Record I/O in files.
Graphics : Introduction, constant , data types and global variable used in graphics, Library functions used in drawing, Drawing and filling images, GUI interaction with program

Essential Reading:

1. "Schaum's Outlines- Programming in C", by Gottfried B., McGraw-Hill Publications,4th edition, 2018
2. "The C Programming Language", by Brian Kernighan and Dennis Ritchie, Prentice-Hall,2nd edition, 2015
3. "Let us C", by Kanektar. Y. BPB publication,15th edition, 2016

Suggested Reading:

1. "How to Solve it by Computer" by G Polya, Prentice-Hall,1st edition, 2020.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – I)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-SEC-1202	LabBased on C Programming	-	-	2	2	20	20	60	100

Course Learning Objectives:
To provide hands-on training in CProgramming to students to write programs

CourseLearning Outcomes: After completing this course students will be capable enough to implement programming concepts in the Clanguage.

The list of practicals will be decided by the course coordinator as per the theory paper of C Programming.

Any other as per teacher concern.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – II)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-2201	Database Management Systems	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. To know about the database system applications, data models, Database design, and ER
2. To construct the relational model and relational algebra.
3. To acquire the knowledge of query evaluation and designing database applications using normalization

Course Learning Outcome:

Upon successful completion of the course, students will be able to:

1. Familiar with the database theory use basics of SQL and construct queries using SQL.
2. Analyze the difference between the traditional file system and DBMS
3. Work with different database languages
4. Write relational algebra expressions for queries.

UNIT-I:Introduction to Database Management Systems: Database system Applications, Database system Vs File system, Data abstraction, Instances and Schemas,Database users, Database system concepts and architecture, data models schema and instances, data independence, and database language and interfaces. Database system structure, Database design, ER diagrams, ER Design - Entities, Attributes,Entity sets, Relationships, and Relationship sets

UNIT– II:RelationalModel: Integrity constraints over the relations, Enforcing integrity constraints (entity integrity, referential integrity, Keys constraints, Domain constraints). ER model to Relational model, Relation Algebra-selection, projection,renaming, join examples.

UNIT –III:SQL: Database Languages, DDL, DML, TCL,Characteristics of SQL, Advantages of SQL, the basic form of SQL query, Querying relational data, SQL data types, and literals, Types of SQL commands, SQL operators and their procedure, Tables, views and indexes Queries and subqueries, Aggregate functions, Insert, update and delete operations, Joints, Unions, Intersection, Minus, Cursors in SQL. PL/SQL, Triggers, and clusters

UNIT –IV: Normalization: Schema refinement – Problems Caused by redundancy – Decompositions – Problem-related to decomposition –reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless-join Decomposition,Dependency- preserving Decomposition – Schema Refinement in Database Design – Multi valuedDependencies – Fourth Normal Form and Fifth Normal form.

UNIT –V:Transaction Management and Concurrency Control: ACID properties, Transactions, and Schedules, Concurrent Execution of transactions, SerializabilityandRecoverability
Introduction to Lock Management: Lock Conversions, Dealing with Deadlocks, Concurrency without Locking. Performance Locking, Transaction Support in SQL Crash Recovery-Aries Recovery Algorithm

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Essential Reading:

1. "Database System Concepts" by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan - 7th edition (2020).
2. "Database Systems: Design, Implementation, and Management" by Carlos Coronel, 13th edition (2019)
3. "Modern Database Management" by Jeffrey A. Hoffer, Ramesh Venkataraman, 14th edition (2020).
4. "Database Management Systems" by Raghu Ramakrishnan and Johannes Gehrke - 3rd edition (2013).

Suggested Reading and links:

1. "Fundamentals of Database Systems" by Ramez Elmasri and Shamkant B. Navathe -: 7th edition (2017).
2. Database Management System, Avita Katal , 1st edition (2022).

.L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – II)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-2202	LabBased on DBMS	-	-	-	2	20	20	60	100

Course Learning Objectives: To provide hands-on training to students on creating and manipulating the database.

CourseLearning Outcomes: After completing this course students will be capable enough to manage the database.

Based on DBMS

The list of practicals will be decided by the course coordinator as per the syllabus of theory paper of DBMS.

Any other as per teacher concern.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester –II)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-2203	Data Communication & Computer Networks	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. Understand the modulation used in the data communication system
2. Know the classification of computer networks.
3. Aware of new technologies and protocols used for data communication

Course Learning Outcome:

Upon successful completion of the course, the students will be able to:

4. To understand the procedure of data communication and networking.
5. To learn the tools, techniques, protocols of establishing a communication network.
6. To be aware of problems generated during communication and their contents controls.
7.

UNIT-I:Introduction to computer network: Topology; Base Band & Broad Band Topology; Guided & Unguided Media. Overview of Data & Signal Bits. Baud & Bit Rate

UNIT– II: Basics of data communication: Modulation (AM, PM, FM); Multiplexing (TDM, FDM, STDM). Encoding (RZ, NRZ, BIPOLAR, MANCHESTER, DIFF. MANCHESTER). Digital To Analog – ASK, PSK, FSK, QPSK. Transmission methods – Synchronous & Asynchronous, Flow Control, Error Control, Error Detection methods. Goals of Layered protocols- Introduction to OSI, TCP/IP.

UNIT –III: Bit oriented (BSC) & Character oriented Protocol (SDLC, LAPB, LAPD, LLC) HDLC- frame format, station, states, configuration, access control

UNIT –IV: LAN Topology: Ethernet (IEEE 802.3), Token Bus (IEEE 802.4), Token Ring (IEEE 802.5)**Introduction to WAN:** DQDB (IEEE 802.6) & FDDI. **Switching Technologies:** Circuit, Message, and Packet. X.25, X.21.

UNIT –V: ISDN: D channel, B-Channel, International Standards, NT1, NT2, TA, TE Devices. Introduction to leased lines, DSL, Digital Carriers.
Bridging & Routing: Static & Dynamic. IP, IP addressing, ARP.RARP. Congestion Control, TCP, UDP. HTTP,FTP,Telnet,SMTP.

Essential Reading:

1. B. Forouzan, "Data Communication and Networking", Tata McGraw Hill,Fftht Edition, 2012
2. Tananbaum A.S., "Computer Networks", paperback edition, PHI, 2017.
3. Kurose, "Computer Networking 6 Edition, A Top-down approach", Pearson.,2017.

Suggested Reading and links:

1. "Networking Essentials: " by Jeffrey S. Beasley and PiyasatNilkaew -: 5th edition (2022).

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester –II)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-2204	Theory of Computation	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. Demonstrates models, Turing machine, regular expression, push down automaton.
2. Model, compare, and analyze different computational models.
3. Apply and prove properties of languages, grammars, and automata.
4. Apply knowledge of computing and mathematics to solve problems

Course Learning Outcome:

Upon successful completion of the course, the students will be able to:

1. Mathematical model of machines, formal language, and corresponding automaton.
2. The concept of ambiguity, derivations and parse tree in grammar.
3. FSA,DFA,NDFA, Turing machine, regular expression, push down automaton.
4. Learn and understand the properties of languages, grammar, and automata.

UNIT- I : Introduction to Theory of Computation: Basic Computational Constructs: Finite State Systems, Non-Deterministic Finite Automata (NDFA), Deterministic Finite Automata (DFA), Equivalence of DFA and NDFA, Finite Automata with ε -Moves, Limitations of FSM, Minimization of Finite Automata, Moore and Mealy Machines, Equivalence of Moore and Mealy Machines.

UNIT– II: Regular Sets, Closure Properties of Regular Sets, Pumping Lemma, Applications of Pumping Lemma. Regular Expression, Laws for Regular Expression, Equivalence of Finite Automata and Regular Expression, Introduction to Regular Grammar.

UNIT –III: Introduction to Context-Free and Context-Sensitive Grammar, Ambiguity, Parse Tree Representation of Derivations, Simplification of Context-Free Grammar, Normal Forms (Chomsky Normal Form (CNF) and Griebach Normal Form (GNF)).

UNIT –IV: Definition, Deterministic Push-Down Automaton (DPDA), Non-Equivalence of PDA& DPDA, Equivalence of CFG and PDA, Pumping Lemma for CFL's, Closure Properties of CFL, Non-CFL.

UNIT –V: Turing Machine: Introduction, Types of Turing Machine, Universal Turing Machine and Other Modifications, Construction of Tm for Simple Problems, Turing Machine as Enumerators, Relation Between Languages of Classes, Computational Complexity Theory. Computable Functions: Partial, Total, Constant Functions, Primitive Recursive Function, Regular Function, Recursive Functions.

Essential Reading:

1. "Introduction to the Theory of Computation" by Michael Sipser 3rd edition, Cengage Learning, 2014
2. Lewis & Papadimitriou Elements of the Theory of Computation. Second edition, 2015

Suggested Reading and links:

1. Peter Linz Introduction to Formal Languages and Automata, 6th edition,2016
2. "Theory of Computation: Formal Languages, Automata, and Complexity" by John E. Hopcroft, Rajeev Motwani, and Jeffrey D. Ullman - 2nd edition, Pearson, 2000

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – II)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-MDM-2201	Design and Analysis of Algorithm	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. Study different types of asymptotic notations that are used to analyze the running time of different algorithms and solve recurrences.
2. Analyze and derive the running time for different searching and sorting algorithms, study AVL trees and their construction, Red-Black trees, Overview of Divide and Conquer paradigm with examples.
3. Solve a variety of problems using different algorithm design paradigms like Dynamic Programming, Greedy Method, construction of Minimum Spanning Tree, a study of Shortest Path problem, and Maximum Network Flow problem.
4. Study of different String Matching algorithms, Backtracking method, example problems, and their backtracking solution using State Space Search Tree method, study of P , NP and NP comple problems

Course Learning Outcome:

Upon successful completion of the course, students will be able to:

1. To be able to analyze correctness and the running time of the basic algorithms for some classic problems in various domains and to be able to apply the algorithms and design techniques to advanced data structures.
2. To be able to analyze the running time complexity of different searching and sorting algorithms.
3. To learn different types of algorithm design techniques like divide and conquer, dynamic programming, greedy method, backtracking, branch and bound, and their applications in solving different practical problems
4. .To study different types of minimum cost spanning trees, shortest path algorithms, flow networks, string matching algorithms, NP-completeness, and reductions

UNIT-I :Performance Analysis of Algorithms: Algorithm Specification, Performance Analysis: Space and Time Complexity, Correctness of Algorithms, Growth of Functions, Asymptotic Notations and Types, Concept of Randomized Algorithms.**Recurrences:** Substitution, Iteration, Master, and Recurrence Tree method.

UNIT– II : Sorting and Searching Techniques: Selection Sort, Bubble Sort, Insertion Sort, Sequential Search, Binary Search, Depth First Search and Breadth-First Search, Balanced Search Trees, AVL Trees, Red-Black Trees, Heaps and Heap Sort, Divide and Conquer Paradigm of problem-solving, Complexity analysis and understanding of Merge Sort, Quick Sort, Binary Search Trees.**Sorting in linear time:** Counting Sort, Bucket Sort, and Radix Sort..

UNIT –III : Greedy Algorithms: General Concept, Applications, Activity Selection Problem, Fractional Knapsack problem, Job Sequencing with Deadlines, Huffman Coding, Prim's, Kruskal Algorithm and Dijkstra Algorithm.**DynamicProgramming:**General Concept, Matrix Multiplication Starsn's Matrix, Longest Common Subsequence Problem, Bellman-Ford Algorithm, Analysis and Correctness of Floyd-Warshall Algorithm, Optimal Binary Search Trees, 0/1 Knapsack Problem, NetworkFlow Problem.

UNIT –IV: String Matching Concept: Naive String-Matching Algorithm, Knuth Morris Pratt Algorithm, The Rabin-Karp Algorithm.**Backtracking:** n-Queen's problem, Hamiltonian Circuit problem, Subset-Sum problem, State Space Search Tree for these problems.

UNIT –V : Branch and Bound: Assignment Problem, Travelling Salesman Problem. Introduction to Computability, Polynomial-time Verification, NP-Completeness.**Complexity Classes:** Reducibility, NP-Completeness Proof, NP-Complete & NP-Hard, Problem Classification-P, NP, NPC, NP-Hard;

Essential Reading:

1. ""Introduction to Design Analysis of Algorithms" by K. K. Pandey: 2nd edition, Vikas Publishing House,: 2018.
2. .Algorithm Design and Applications" by Michael T. Goodrich and Roberto Tamassia - 1st edition,: Wiley, 2014.

Suggested Reading and links:

1. ""Data Structures and Algorithms Made Easy" by Narasimha Karumanchi,7th edition, 2018

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – II)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-SEC-2201	Java Programming	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. To learn the basic tools and techniques used inJava language.
2. To be aware of special and advanced features of Java language.
3. To develop the skill of writing Java program the for problem.

Course Learning Outcome:

Upon successful completion of the course, students will be able to:

1. Solve real-world problem java programming
2. Design practical GUI-based applications associated with the database.

UNIT- Principles of OOPs: Programming paradigms, OOPS concepts, benefits of OOP, applications of OOP, Features of Java; Java Magic: Byte Code.Java Virtual Machine, Why Java is important for Internet?, Programming concepts of Java, Identifiers and Keywords,Data types, Java coding conventions, Expressions in Java, Control structures, Decision makingstatements,Arrays

UNIT– II:Objects and Classes: Object fundamentals, Pass by value, Pass by reference, Overloading, Overriding, Constructors, Finalization, Subclasses(Inheritance), this, super, final with inheritance, Dynamic method dispatch, Scope rules, Static data, Static methods, Static blocks, class modifiers, String Handling, Command line arguments, Abstract Classes, Interfaces, Inner classes, Packages, Package access, Importing packages and classes, User define packages, Class-path.

UNIT –III:Exception Handling: Types of Exceptions, try, catch, finally, throw keywords, Handling User-defined Exceptions.**Multithreading:**processes and threads, Thread states, Thread life cycle, Creating threads, Interrupting threads, Thread priorities, Synchronizing threads, Inter thread communication, Thread groups, Daemon threads.**JAVA I/O:**Files and Streams, Stream classes, Reader-Writer classes, Utilities, Serialization, and Deserialization.

UNIT –IV: Applets: Types of Applets, Applet life cycle, Graphics, Parameter Passing
AWT: Abstract Window Toolkit, Components, and Graphics, Containers, Frames and Panels, Layout Managers, BorderLayout, Flow Layout, Grid Layout, Card Layout, Event delegation model, Event sources and Event handlers,Event categories, Event Listeners, Adapters classes, Anonymous classes

UNIT –V:Swings: Introduction, Handling Swing Controls like Icons, Buttons, Textboxes, Combo Boxes, TabbedPanes, Scroll Panes, JTree, JTable, Differences between AWT Controls & Swing Controls, developinghome page using Applets & Swings.**Event Handling:** Components of an Event; Event Classes; Event Listener; Event-Handling; Adapter Classes; Inner Classes; Anonymous Classes. JDBC: Database Management; Mechanism for connecting to a back-end database; Loading the ODBC driver.

Essential Reading:

1. Java: A Beginner's Guide" by Herbert Schildt ,8th edition, Publisher: McGraw-Hill Education, 2019.
2. "Java: The Complete Reference" by Herbert Schildt ,11th edition, McGraw-Hill Education, 2018
3. "Core Java Volume I -- Fundamentals" by Cay S. Horstmann and Gary Cornell: 11th edition, Pearson, 2018.

Suggested Reading and links:

1. "Effective Java" by Joshua Bloch - 3rd edition,Addison-Wesley Professional, Year: 2018
2. E. Balaguruswami "OOPs using c++ and Java"-TMH,6th edition,2017

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – II)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-SEC-2202	LabBased on Java Programming	-	-	2	2	20	20	60	100

Course Learning Objectives:
To train the students to implement concepts of Object-Oriented Programming in Java Language.

CourseLearning Outcomes: After completing this course students will be capable enough to relate and implement the real situation with various concepts of OOPs and Java.

Based onJava Programming

The list of practicals will be decided by the course coordinator as per the syllabus of theory paper of Java Programming.

Any other as per teacher concern.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester –III)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-3201	Web Application Design using PHP	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. To gain the ability to develop responsive web applications.
2. To explore different web extensions and web services standards.
3. To be familiarized with open source Frameworks for web development

Course Learning Outcome:

Upon successful completion of the course, students will be able to:

1. Develop web applications using PHP
2. Understanding MVC architecture to design web application based projects
3.

UNIT-IIntroduction: Introduction to PHP, Language Features. PHP Basics, PHP's Supported Data Types, Identifiers, Variables, Constants, Expressions, String Interpolation, Control Structures, Functions, Arrays, Strings, and Regular Expressions, Working with the File and Operating System.

UNIT– II:Object-Oriented PHP: Advantages of OOP, OOP Concepts, Constructors and Destructors, Static Class Members, The instance of Keyword. Advanced OOP Features - Object Cloning, Inheritance, Interfaces, Abstract Classes, Namespaces

UNIT –III: PEAR - Using the PEAR Package Manager, Introducing Pyrus. Date and Time - PHP's Date and Time Library, Date Fu. Error and Exception Handling – Error Logging, Exception Handling

UNIT –IV: Handling File Uploads - Uploading Files via HTTP, PHP. PHP and LDAP – Using LDAP from PHP. **Session Handlers** - Configuration Directives, Working with Sessions, Creating Custom Session Handlers. Working with HTML Forms – PHP and Web Forms, Validating Form Data

UNIT –VAuthenticating Your Users - HTTP Authentication Concepts, Authenticating Users with PHP. **Web Services** – XML – Loading and Parsing XML. Security - Hiding Configuration and Sensitive Data, Data Encryption. Introducing the Zend Framework - Introducing MVC, PHP, and Zend Framework. Using PHP with MySQL - Interacting with the Database.

Essential Reading:

1. "PHP and MySQL Web Development" by Luke Welling and Laura, Wesley Professional, 5th edition, 2016.
2. "PHP Objects, Patterns, and Practice" by Matt Zandstra - Latest edition: 5th edition,:Apress,: 2016.

Suggested Reading and links:

1. "HTML4 Complete" by E. Stephen Mask, Janan Platt BPB Publications.third edition, 2017

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester –III)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-3202	Lab Based on Web Application	-	-	2	2	20	20	60	100

Course Learning Objectives:
To train the students to implement the theory and concepts of Web Application development.

CourseLearning Outcomes: :After completing this course students will be capable enough to develop web-based applications.

Based onWeb Application Lab

The list of practicals will be decided by the course coordinator as per the theory paper of web application design using PHP.

Any other as per teacher concern.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – III)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-3203	Software Engineering	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. To impart the concepts of Software Engineering.
2. To understand the process of software implementation and maintenance.

Course Learning Outcome:

Upon successful completion of the course, Students will be able to:

1. demonstrate an understanding of software engineering layered technology and software process models that provide a basis for the software development lifecycle.
2. apply agile development methods for developing software.
3. describe software/system requirements and understand the processes involved in the discovery and documentation of these requirements, Software Testing using verification and validation, static analysis, reviews, inspections, and audits.

UNIT- I: Introduction: Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, PrototypeModel, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

UNIT– II: Software Requirement: Requirement Engineering Process: Elicitation,Analysis, Documentation, Review, and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model..

UNIT –III: Software Design: Basic Concept of Software Design, Architectural Design, Low-Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down, and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halstead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs

UNIT –IV:Software Testing: Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down, and Bottom-Up
Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards..

UNIT –V:Software Maintenance and Software Project Management: Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis, and Management.

Essential Reading:

1. "Software Engineering: A Practitioners Approach" by Roger Pressman McGraw Hill,9th edition, 2023.
2. "Software Engineering" by Ian Sommerville, Addison Wesley,10th edition, 2017.
3. "Introduction to Software Engineering Design" by Carl Erickson." first edition 2017

Suggested Reading and links:

1. "Software Product Management" by Samuel A. Fricker 1st edition,2018

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – III)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-DSM-3204	Cryptography and Network Security	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. learnvarious cryptographic algorithms including secret-key cryptography, hashes, and message digests, public-key algorithms.
2. Familiar in design issues and working principles of various authentication protocols and various secure communication standards including Kerberos, IPsec, and S/MIME

Course Learning Outcome:

Upon successful completion of the course, students will be able to:

1. Explain Basic Principles, different security threats, countermeasures, foundation course of cryptography mathematics, and Symmetric Encryption.
2. Classify the basic principles of Asymmetric key algorithms and operations of asymmetric key cryptography.
3. Design Cryptographic Hash Functions as SHA-3 and Digital Signatures as Elgamal
4. Explain the concept of Revise Key Management and Distribution and User Authentication
5. Determine the knowledge of Network and Internet Security Protocols such as S/MIME

UNIT-I:Basic Principles: Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography. **Symmetric Encryption:** Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard

UNIT– II: Asymmetric Encryption: Mathematics of Asymmetric Key Cryptography-Primes, primality Testing, Factorization, Asymmetric Key Cryptography-RSA Cryptosystem, Rabin Cryptosystem, ElGamal Cryptosystem, Elliptic Curye Cryptosystem.

UNIT –III: Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions Requirements and Security Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3.

UNIT –IV: Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates. **Digital Signatures:** Elgamal Digital Signature Scheme, Schnorr Digital Signature, NIST Digital Signature Algorithm

UNIT – V Electronic Mail Security: Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security, S/MIME. **IP Security:** IP Security Policy, Encapsulating Security Payload, Combining Security Associations Internet Key Exchange, Authentication

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Essential Reading:

1. "Cryptography and Network Security" by Behrouz A Forouzan, McGraw Hill,3rd edition,2015.
2. "Cryptography and Network Security" by William Stallings, Pearson.8th edition,2020

Suggested Reading and links:

1. "Cryptography, Network Security, and Cyber Laws" by Bernard Menges, Cengage Learning, 1st edition,2018.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – III)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-MDM-3201	AI & Machine Learning	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. Gain a historical perspective of AI and Machine Learning.
2. Become familiar with basic principles of AI toward problem-solving, inference, perception, knowledge representation, and learning.
3. Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks, and other machine learning models.
4. Explore the current scope, potential, limitations, and implications of intelligent systems.
5. Understand the basics of Machine Learning algorithms and their applications.

Course Learning Outcome:

Upon successful completion of the course, the students will be able to:

1. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligentagents
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.
3. Attain the capability to represent various real-life problem domains using logic-basedtechniques and use this to perform inference or planning.
4. understand basics of Machine learning including Supervised Learning, Unsupervised Learning, Ensemble Learning, Reinforcement Learning concepts, and use them in real-life problems.

UNIT- I :Introduction to Artificial Intelligence: Various definitions of AI, AI Applications and Techniques, Turing Test. Computer vision, Natural Language Possessing.Intelligent Agents: Introduction to Intelligent Agents, Rational Agent, their structure, reflex, model-based, goal-based, and utility-based agents.

UNIT– II:Problem Solving and Search Techniques: Problem Characteristics, Production Systems, Control Strategies, Breadth-First Search, Depth First Search, iterative deepening, uniform cost search, Hill climbing, genetic algorithm search. Heuristics Search Techniques: Best First Search, A* algorithm, AO* algorithm, Minmax & game trees, refining min-max, Alpha-Beta pruning, Constraint Satisfaction Problem

UNIT –III :Machine Learning: Introduction to Machine Learning and its applications. Supervised and unsupervised learning, Decision trees, Statistical learning models, Naive Bayes models, Learning with hidden data – EM algorithm, Reinforcement learning, ANN, Deep Learning.

UNIT –IV :Classification Techniques: Nearest Neighbour (NN) Rule,K-nearest Neighbour, Bayes Classifier, Support Vector Machine (SVM), K–means clustering, Hidden Markov Models (HMM), Bayesian Networks.

UNIT –V:Pattern Recognition: Introduction, Design principles of the pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA).

Essential Reading:

1. "Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th ed.). Pearson
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning* (1st ed.). MIT Press.
3. " Andriy Burkov. (2022). *Machine Learning Engineering* (1st ed.). MIT Press.

Suggested Reading and links:

1. Duda, R. O., Hart, P. E., & Stork, D. G. (2000). Pattern Classification (2nd ed.). Wiley-Interscience.
2. Suhas Pote . (2023). *Machine Learning in Production* (2nd ed.). MIT Press

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – III)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-SEC-3201	Programming with Python	04	-	-	04	20	20	60	100

Course Learning Objectives:

1. To acquire knowledge in Python programming.
2. To develop Python programs with conditionals and loops and data structures.
3. To learn how to design and program Python applications.
4. To learn how to build and package Python modules for reusability.

Course Learning Outcome:

Upon successful completion of the course, the students will be able to:

1. Understand the technique of simulation and different types of system models.
2. Understand the probability concepts in simulation and study different random number generator techniques along with standard tests for random numbers.
3. Study discrete system simulation like the simulation of a telephone system.
4. Study computer models of queueing, inventory and scheduling systems, Variance Reduction techniques, and analysis of simulation output.

UNIT-I: Basic Syntax, Data Types, Variables, Operators, Input/output, Flow of Control (Modules, Branching), If, If-else, Nested if-else, Looping, For, While, Nested loops, Control Structure, Break, Continue, Pass.**Strings and Tuples:** Accessing Strings, Basic Operations, String slices, Working with Lists, Introduction, Accessing list, Operations

UNIT– II:Function and Methods: Files, Modules, Dictionaries, Functions, and Functional Programming, Declaring and calling Functions, Declare, assign and retrieve values from Lists, Introducing Tuples, Accessing tuples. **Advanced Python:**Object-Oriented, OOPs concept, Class and object, Attributes, Inheritance, Overloading, Overriding, Data hiding, Operations Exception

UNIT –III:FileHandling: Introduction, File types, Creating, Opening, Closing, Renaming, Accessing and deleting files, Filepointers, File modes, Binary files**ExceptionHandling:**Introduction, Exception, Default exception handlers, Handling multiple errors, Raising exceptions, generators, Python Libraries

UNIT –IV:Database Interaction: SQL Database connection using python, creating and searching tables, Reading and storing config information on a database, Programming using database connections, Python Multithreading: Understanding threads, Forking threads, synchronizing the threads, Programming using multithreading.

UNIT –V: Introduction to Python packages like NUMPY, SCIPY, PANDAS, Scikit-learn, PyTorch& others

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Essential Reading:

1. Wesley J. Chun Core Python Application Programming Pearson Education Publication 2015
2. Eric Matthes Python crash course William pollock 2016

Suggested Reading and links :

1. Zed Shaw Learn Python the hard way Addition Wesley 2017
2. Mark Lutz Python pocket reference O'Reilly Media 2014 Pedagogy
3. https://www.codecademy.com/learn/learn-python-3
4. www.spoken-tutorial.org
5. https://docs.python.org/3/tutorial/index.htmlial — Python 3.12.0 documentation

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MCA (Semester –III)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-SEC-3202	Lab Based on Python Programming	-	-	2	2	20	20	60	100

Course Learning Objectives:
To provide hands-on training in Python Programming to students to write programs

CourseLearning Outcomes: After completing this course students will be capable enough to write programs in Python language.

Based onPython Programming Lab

The list of practicals will be decided by the course coordinator as per the theory paper of Python Programming.

Any other as per teacher concern.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – IV)

Elective/Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
Elective – 1 CSA-DSM-4201-A	Data Mining and Knowledge Discovery	03	-	-	03	20	20	60	100

Course Objective:

1. To introduce students to the basic concepts and techniques of Data Mining.
2. To develop skills in using recent data mining software for solving practical problems.
3. To gain experience in doing independent study and research.

Course Outcome:

Upon successful completion of the course, the students will be able to:

1. Apply data mining techniques in real life.
2. Implement various data mining techniques.

UNIT –I: Introduction: Introduction to data mining and knowledge discovery from databases. Scalability issues of data mining algorithms.**Introduction to Data warehousing:** General principles, needs for developing data Warehouse, Data warehouse systems, and its Components, Design of Data Warehouse, Dimension and Measures, Data Marts:-Dependent Data Marts, Independents Data Marts & Distributed Data Marts, Conceptual Modeling of Data Warehouses:-Star Schema, Snowflake Schema, Fact Constellations. Multidimensional Data Model & Aggregates.

UNIT –II: Datapreparation: Preprocessing - Data Cleaning, sub-sampling, feature selection, Data Integration, and Transformation. Data Reduction
Association Rule: Associations, dependence analysis, correlation, rule generation— a priori algorithm, FP Trees, etc., and evaluation.

UNIT –III:Classification and prediction: Bayes learning, discriminant analysis, decision trees, CART, C4.5,etc, neural learning, support vector machines, active learning. Combination of classifiers/ ensemble learning.

UNIT –IV:Cluster analysis and deviation detection: Partitioning algorithms, density-based algorithms, hierarchical algorithms, model-based algorithms, grid-based algorithms, graph-theoretic clustering, etc.
Temporal and spatial data mining: Mining complex types of data. Visualization of data mining results.

UNIT –V:Advanced topics: High-performance computing for data mining, distributed data mining, soft computing tools for data mining.Applications of data mining in bioinformatics, information retrieval, web mining, image and text mining.

Essential Reading:

1. " Introduction to Data Mining" by PANG-NING TAN 1st edition,2021
2. "Data Mining for business Analytics" by Galit Shmueli, MIT Press.,1st edition,2023
3. "Data Mining and Data Warehousing: Principles and Practical Techniques" by Prateek Bhatia. ,1stedition,2019

Suggested Reading:

1. "Data Warehousing & Data Mining & OLAP" by Berson, TMH.3rd edition,2017.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – IV)

Elective/Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
Elective - 1 CSA-DSM-4201-B	Cloud Computing	03	-	-	03	20	20	60	100

Course Objective:

1. To understand the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability, benefits, as well as current and future challenges.
2. To learn cloud-enabling technologies and get exposure to advanced clouds.
3. To explore cloud SOA technologies, relevant Workflow frameworks, and Virtualization technology.
4. To understand the cloud security threats and protective mechanisms for cloud computing and existing Cloud computing platforms and Technologies
5. To implement Task Scheduling algorithms, apply Map-Reduce concept to applications, build Private Cloud, and know the impact of engineering on legal and societal issues involved.

Course Outcome:

Upon successful completion of the course, students will be able to:

1. Compare the strengths and limitations of cloud computing.
2. Examine the economics, financial, and technological implications for selecting cloud computing for own organization
3. Identify the architecture, infrastructure, and delivery models of cloud computing.
4. Understand the role of SOA Technologies and the Workflow framework.
5. Apply a suitable virtualization concept.

UNIT –I: Virtualization concepts, Types of Virtualization & its benefits, Introduction to Various Virtualization OS, HA/DR using Virtualization, Moving VMs, Cloud Fundamentals, Cloud Building Blocks, Understanding Public & Private cloud environments, Private Cloud Environment, Public Cloud Environment, Managing Hybrid Cloud environment

UNIT –II: Build private cloud using open source tools, Understanding various cloud plugins, Setting up your own cloud environment, Auto-provisioning, Custom images, Integrating tools like Nagios, Integration of Public and Private cloud.

UNIT –III:Cloud Platform Architecture: Cloud Computing and service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms, InterCloud Resource Management, Cloud Security, and Trust Management. Service-Oriented Architecture, Message-Oriented Middleware.

UNIT –IV:Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel & Distributed Programming Paradigms, Programming Support of Google App EngineEmerging Cloud Software Environments. Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems,general parallel file systems. Google file system.

UNIT –V:Cloud Resource Management and Scheduling: Policies and Mechanisms for Resource Management Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two-Level Resource Allocation Architecture, Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds, Fair Queuing, Start Time Fair Queuing, Borrowed Virtual Time, Cloud Scheduling Subject to Deadlines.

Essential Reading:

1. "Distributed and Cloud Computing" by Kai Hwang, Geoffry C. Fox, Jack J. Dongarra, MK Elsevier,1st edition,2016
2. "Cloud Computing: Concepts, Technology & Architecture" by J. Sylvia Grace., 1st edition,2024
3. "Cloud Computing, A Hands-on approach" byArshadeepBahga, Vijay Madisetti, University Press,,1st edition,2017

Suggested Reading:

1. "Cloud and Distributed Computing" byRajivMishra,CRC Press.1st edition,2020.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – IV)

Elective/Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
Elective – 2 CSA-DSM-4201-C	InformationHiding Techniques	03	-	-	03	20	20	60	100

Course Objective:
Introduce the student to understand various information hiding techniques such as steganography and watermarking.

Course Outcome:
Upon successful completion of the course, the students will be able to:

1. implement algorithms for steganographic and watermarking operations.
2. Evaluate steganographic and watermarking algorithms for robustness.
3. Describe various finger printing techniques.

UNIT – I :Introduction: Information hiding: Introduction, Background, and Applications of Information hiding: Data hiding, applications of data hiding.

UNIT – II :Steganography: Frameworks of secret communication, Security of steganography systems, Information hiding in noisy data, Adaptive and non-adaptive algorithms, Active and malicious attackers, Information hiding in written text, Invisible communication.

UNIT – III :Data hiding in still images : LSB encoding, BPCS steganography, Lossless data hiding, Data hiding by quantification, Patchwork, Transform domain methods, Robust data hiding in JPEG images, frequency domain watermarking Detecting malicious tempering, Robust wavelet based watermarking, Kundur-Hatzinakos watermarking, Data hiding in binary images, Zhao-koch method, Wu-Lee method, CPT method, TP method, Data hiding in fax images.

UNIT – IV :Watermarking: Introduction, Watermarking principals, Applications, Requirements and algorithmic design issues, Evaluation and standards of watermarking.

UNIT – V :Fingerprinting: Introduction, Terminology and requirements, Classifications, Research history, fingerprinting schemes, Statistical fingerprinting, and Collusion-secure fingerprinting.

Essential Reading:

1"Introduction to Steganography and Watermarking" by Michael Arnold and Yiqun Lisa Yin, 1st edition,2015.
2. Fabien Petitcolas, Information Hiding, Artech House Publishers,1st edition,2015.

Suggested Reading:

1. "Practical Steganography: The Complete Guide to Hiding Data" by Ilya Evdokimov and Oleg Parashchenko, 1st edition,2016.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – IV)

Elective/Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
Elective -1 CSA-DSM-4201-D	Cyber Security	03	-	-	03	20	20	60	100

Course Objective:

1. To familiarize various types of cyber-attacks and cyber-crimes
2. To give an overview of the cyber laws
3. To study the defensive techniques against these attacks.

Course Outcome:

Upon successful completion of the course, the students will be able to:

1. understand cyber-attacks, types of cybercrimes, cyber laws, and also how to protect themself and ultimately the entire Internet community from such attacks

UNIT – I : Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT –II:Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT –III: Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT –IV :CyberSecurity: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security, and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations. Cybercrime and Cyber terrorism: Introduction, intellectual property in cyberspace, the ethical dimension of cybercrimes the psychology, mindset, and skills of hackers and other cybercriminals.

UNIT –V:Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Datalinking and profiling, privacy policies and their specifications, privacy policy languages, privacy indifferent domains-medical, financial, etc.

Essential Reading:

1. "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives" by Nina Godbole and Sunit Belpure, Wiley,1st edition,2017
2. "Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives" by B. B. Gupta, D. P. Agrawal, Haoxiang Wang, CRC Press.,1st edition,2020
3. "Cyber Security Essentials" by James Graham, Richard Howard, and Ryan Olson, CRC Press,1st edition,2015

Suggested Reading:

1. "Introduction to Cyber Security" by Chwan-Hwa (John) Wu,J. David Irwin, CRC Press,1st edition,2017.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – IV)

Elective/Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
Elective -1 CSA-DSM-4201-E	Big Data and Analytics	03	-	-	03	20	20	60	100

Course Objective:

1. To know the fundamental concepts of big data and analytics.
2. To explore tools and practices for working with big data
3. To learn about stream computing.
4. To know about the research that requires the integration of large amounts of data.

Course Outcome:

Upon successful completion of the course, the students will be able to:

1. Identify the need-based tools, viz., Pig and Hive and to handle and formulate an effective strategy to implement a successful Data analytics project
2. Organize the existing technologies and the need for distributed files systems to analyze the bigdata
3. Analyze the concepts of stream memory and spark models.
4. Explain the use of the NoSQL database in data analytics.

UNIT –I :Introduction to Big Data: Evolution of Big data, Best Practices for Big data Analytics, Big data characteristics, Validating, The Promotion of the Value of Big Data, Big Data Use Cases, Characteristics of Big Data Applications, Perception and Quantification of Value, Understanding Big Data Storage, A General Overview of High, Performance Architecture, HDFS, MapReduce and YARN, Map Reduce Programming Model.

UNIT – II: 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 ZooKeeper, IBM InfoSphere Big Insights and Streams.

UNIT – III :Clustering and Classification-Advanced Analytical Theory and Methods: Overview of Clustering, K-means, Use Cases - Overview of the Method, Determining the Number of Clusters, Diagnostics, Reasons to Choose and Cautions. Classification: Decision Trees, Overview of a Decision Tree, TheGeneral Algorithm, Decision Tree Algorithms, Evaluating a Decision Tree, Decision Trees in R, Naïve Bayes, Baye'sTheorem, Naïve Bayes Classifier.

UNIT – IV :Stream Memory and Spark- Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Introduction to Spark Concept, Spark Architecture, and components, spark installation, spark RDD(Resilient Distributed Dataset), spark RDD operations.

UNIT – V :NoSQL Data Management for Big Data and Visualization- NoSQL Databases: Schema-less Models: Increasing Flexibility for Data Manipulation, Key-Value Stores, Document Store, Tabular Stores, Object Data Stores, Graph Databases Hive, Sharding, Hbase, Analyzing big data with Twitter, Big data for ECommerce Big data for blogs, Review of Basic Data Analytic Methods using R.

Essential Reading:

1. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools,Techniques, NoSQL, and Graph", Morgan Kaufmann,1st edition,2015.
2. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding BigData: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw-Hill Publishing , 1st edition,2017.

Suggested Reading :

1. Subhashini Chellappan Seema Acharya, "Big Data Analytics", O'Reilly,2nd edition,2019.
2. BillFranks,"TamingtheBigDataTidalWave:FindingOpportunitiesinHugeData Streams withAdvanced Analytics", John Wiley& sons, 1st edition,2016.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – IV)

Elective/Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
Elective – 2 CSA-DSM-4202-A	Ad-Hoc and Sensor Networks	03	-	-	03	20	20	60	100

Course Learning Objectives:

1. Architect sensor networks for various application setups
2. Devise appropriate data dissemination protocols and model links cost
3. Understanding the fundamental concepts of wireless sensor networks and having a basic knowledge of the various protocols at various layers
4. Evaluate the performance of sensor networks and identify bottlenecks

Course Learning Outcome:

Upon successful completion of the course, the students will be able to:

1. Evaluate the principles and characteristics of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks
2. Determine the principles and characteristics of wireless sensor networks
3. Discuss the challenges in designing MAC, routing, and transport protocols for wireless ad-hoc sensor networks
4. Illustrate the various sensor network Platforms, tools, and applications

UNIT-I: Introduction: Fundamentals of Wireless Communication Technology, The Electromagnetic Spectrum, Radio propagation Mechanisms, Characteristics of the Wireless channel mobile ad hoc networks (MANETs).**Wireless Sensor Networks (WSNs):** concepts and architectures, Applications of Ad Hoc and Sensor Networks, Design Challenges in Ad hoc and Sensor Networks.

UNIT– II:MAC Protocols For Ad Hoc Wireless Networks: Issues in designing a MAC Protocol, Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks, Design Goals of a MAC Protocol for Ad Hoc Wireless Networks, .Classification of MAC Protocols, Contention based protocols, Contention based protocols with Reservation Mechanisms, Contention based protocols with Scheduling Mechanisms, Multi-channel MAC - IEEE 802.11.

UNIT –III:Routing Protocols And Transport Layer In Ad Hoc Wireless Networks: Routing Protocol: Issues in designing a routing protocol for Ad hoc networks, Classification, proactive routing, reactive routing (on demand), hybrid routing, Transport Layer protocol for Ad hoc networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer solutions-TCP over Ad hoc wireless, Network Security, Security in Ad Hoc Wireless Networks, Network Security Requirements.

UNIT –IV: Wireless Sensor Networks (WSNS) and Mac Protocols: Single node architecture - hardware and software components of a sensor node, WSN Network architecture: typical network architectures, data relaying and aggregation strategies, MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC -IEEE 802.15.4

UNIT –V: WSN Routing, Localization &Qos: Issues in WSN routing, OLSR, Localization, Indoor and Sensor Network Localization, absolute and relative localization, triangulation, QoS in WSN, Energy Efficient Design, Synchronization.

Essential Reading:

1. "Tedjo, R. (2018). *Wireless Sensor Networks: Principles, Design, and Applications* (2nd ed.). CRC Press..
2. Iyengar, S. R., Brooks, R. R., & Schultz, C. P. L. (2017). *Wireless Sensor Networks: Principles and Practice* (2nd ed.). Wiley-Interscience.

Suggested Reading and links:

3. "Cordeiro, C. de M., & Agrawal, D. P. (2013). Ad Hoc and Sensor Networks: Theory and Applications (2nd ed.). World Scientific Publishing Co. Pte. Ltd.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – IV)

Elective/Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
Elective – 2 CSA-DSM-4202-B	Natural Language Processing	03	-	-	03	20	20	60	100

Course Objective:

1. The learners will be able to develop expertise related to Natural Language Processing and its applications.
2. Apply conventional techniques in NLP
3. Design a TTS and ASR system.

Course Outcome:

Upon successful completion of the course, the students will be able to:

1. Relate to the existing NLP systems and determine the advantages and disadvantages of these systems.
2. Demonstrate the skills of solving specific NLP tasks, as well as running experiments on textual data.
3. Apply Natural Language Processing (NLP) knowledge to some of its applications.
4. Assess and apply the available tools of NLP on various case studies.

UNIT – I :Introduction: Understanding Language, NLP Overview, Definition, History and Challenges, NLP Applications, Language, as a rule, Artificial language (Logical language/programming language) vs. Natural Language, Language Modelling, Grammar-based Language Models, Statistical Language Models, Description of different branches of Linguistics: Statistical Linguistics, Psycholinguistics, Neurolinguistics, Computational Linguistics, Sociolinguistics.

UNIT – II :Language Models: Simple N-gram models. Estimating parameters and smoothing. Evaluating language models, Semantics, Discourse, Pragmatics, Part of Speech Tagging,Lexical syntax. Hidden Markov Models.

UNIT – III :Parsing and Analysis: Syntactic parsing, Semantic Analysis, Lexical semantics, and word-sense disambiguation.
Tools for NLP: Introduction to NLTK, NLP with Machine Learning and Deep Learning, Word2Vecmodels, Language modeling using Naive Bayes Maximum entropy classifiers and their application to document classification.

UNIT – IV :Meaning: Lexical knowledge networks, wordnet theory, Indian languages wordnet, multilingual dictionaries, semantic roles, word sense disambiguation, metaphors

UNIT – V :DeploymentModel:NLP Model Deployment Techniques using Flask, Information Extraction, MachineTranslation.
Web 2.0 Applications: Sentiment Analysis, text entailment, robust and scalable machine translation, question answering, multilingual setting, cross-lingual information retrieval.

Essential Reading:

1. Jurafsky& Martin, "Speech and Language Processing", Pearson Publication.,3rd edition 2020.
2. Tanveer & Tiwari, "Natural Language Processing and Information Retrieval", Oxford Press,1st edition 2018
3. Deepti Chopra, Jacob Perkins, and Nitin Hardeniya, "Natural Language Processing: Python and NLTK",1st revised edition 2017.

Suggested Reading:

1. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from Your Data", Apress,1st edition 2016.
2. Jacob Einstein, "Introduction to Natural Language Processing", MIT Press,1st edition 2019.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – IV)

Elective/Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
Elective – 2 CSA-DSM-4202-C	Information Retrieval & Web Mining	03	-	-	03	20	20	60	100

Course Objective:

1. Learn to write code for text indexing and retrieval.
2. Learn to evaluate information retrieval systems
3. Learn to analyze textual and semi-structured data sets
4. Learn to evaluate information retrieval systems
5. Learn about text similarity measure

Course Outcome:

Upon successful completion of the course, the students will be able to:

1. To Understand Document as Vector
2. Performance evolution metric for IR
3. To understand Search Engine functionality

UNIT – I : Introduction and Information Retrieval Models: Introduction to information storage and retrieval, IR models, functional view of a paradigm IR system, IR and other types of information systems.
IR evaluation: Measuring the effectiveness of IR system; Precision and recall, User-centered evaluation. Boolean model, Vector space model, Probabilistic model, non-classical models of IR – Information logic model, cluster model, LSI model; AI in IR – ANN model, genetic algorithm model, Knowledge-bases, Natural language processing; Query expansion.

UNIT – II : Data structures and algorithms related to IR: Data structures -inverted files and their implementation, Btrees and tries, signature files; algorithms – indexing and retrieval algorithms.

UNIT – III : Term and query operation: Tokenization, stop lists, stemming, different types of stemmers; thesaurus construction; query modification

UNIT – IV : Vector space model: Indexing - document and query representation; Term weighting; Similarity measures, ranking algorithms; Query expansion- Relevance feedback methodology Rocchio's and Ide's method, Evaluation of relevance feedback; clustering algorithms and its application.

UNIT – V: Further topics: Web information indexing; Web Information categorization and ranking; Web IR evaluation; Data fusion, Text mining; Semantic Web; Intelligent agents in IR.

Essential Reading:

1. "Modern Information Retrieval", Ricardo–Baeza Yates, B. Ribeiro-Neto, Addison Wesley.,3rd edition, 2019
2. Modern Information Retrieval: The Concepts and Technology behind Search" by Ricardo Baeza-Yates and Berthier Ribeiro-Neto,2nd edition, Addison-Wesley,:2017.
3. "Introduction to modern information retrieval", G. Salton, and M. J. McGill, McGraw-Hill,2nd edition 2018

Suggested Reading:

1. Information Retrieval: Algorithms and Heuristics" by David A. Grossman, Ophir Frieder, and Juergen J. Meinecke –2nd edition, 2016.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – IV)

Elective/Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
Elective – 2 CSA-DSM-4202-D	Digital Image Processing	03	-	-	03	20	20	60	100

Course Objective:

1. Introduce the student to analytical tools and methods which are currently used in digital image processing and computer vision as applied to image information for human viewing.
2. Apply these tools in the laboratory in image restoration, enhancement, segmentation, feature extraction, pattern recognition, compression, and other computer vision-related tasks.

Course Outcome:

Upon successful completion of the course, the students will be able to:

1. To understand how digital images are represented, manipulated, encoded, and processed, with emphasis on algorithm design, implementation, and performance evaluation.

UNIT – I: Introduction: Image acquisition process, Sampling & quantization, Pixel neighborhood properties (connectivity, path), Concept of matrices (Eigenvalues, diagonalization, etc.), Image transforms (Unitary Transform and properties, 2D Fourier Transform, 2D FFT, Discrete Fourier Transform (DFT), Properties of DFT, 2D DCT and properties, Walsh-Hadamard Transform, K-L Transform, Wavelet transform (Definition, Properties, Mathematical function, Mother wavelets).

UNIT –II: Image enhancement and restoration: Image Enhancements: Point processing functions, Piece-wise linear functions, Histogram based methods (histogram equalization, specification, and modification), Bit extraction, and other topics.Restoration (in the spatial domain): Image restoration and degradation model, Noise types (Gaussian, Rayleigh, Poisson, other) and their pdfs (Probability Distribution Functions), Averaging Filter (Mean Filters (Arithmetic, Geometric & Harmonic), Inverse filtering.

UNIT – III: Edge Detection: Mathematical concepts, Operators based on first-order derivative (Roberts, Prewitt, and Sobel), Laplacian (Second order derivative based edge detection),LOG. **Image Segmentation:** Thresholding based (Local, Global, Adaptive), Region-based (Region split & merge, Region growing), Cluster-based (K-means, Fuzzy c-means), Contour based (Snakes' method), Graph-based (book/literature)

UNIT – IV: Feature extraction: Spatial Features, Amplitude, Transform based features, Fourier Descriptors (FDs), Histogram based statistical features, Based on statistical moments (e.g., mean, variance, kurtosis, etc), Shape/geometry-based features & moment-based features(Radii, perimeter, area, compactness, max boundary rectangle, orientation, etc.), Texture features (GLCM and texture features, Gabor features), Color features

UNIT – V: Object representation and description: Boundary representation: Chain codes, Polygon approximations, Signatures, Boundary segments, Skeletons. Boundary Description: Shape numbers, FDs, Statistical moments Region representation: Data structures used for representing region (quadtree, RLE, projection). Region Description: Topological description. **Object recognition:** Patterns & pattern classification, Recognition based on decision-theoretic methods, Structural methods

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Essential Reading:

1. Digital Image Processing " by Rafael C. Gonzale, and Steven L. Eddins - 3rd edition, Gatesmark Publishing, 2019
2. "Digital Image Processing" by S. Jayaraman, S. Esakkirajan, and T. Veerakumar 3rd edition, McGraw Hill Education, 2017.

Suggested Reading:

1. "Handbook of Digital Image Processing and Analysis" by Richard C. Gonzalez and Paul Wintz - 2nd edition, CRC Press, 2018

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MCA (Semester – IV)

Elective/Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
Elective – 2 CSA-DSM-4202-E	Fundamental of Data Science	03	-	-	03	20	20	60	100

Course Objective:

1. Explore the fundamental concepts of data science
2. Understand data analysis techniques for applications handling large data
3. Understand various machine learning algorithms used in data science process
4. Visualize and present the inference using various tools.

Course Outcome:

Upon successful completion of the course, the students will be able to:

1. To Understand Concept of Big Data
2. To understand machine learning algorithms
3. Performance evolution metric for Macnine learning Models

UNIT – I: Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications, Mathematical Foundations for Data Science: linear algebra; Analytical and numerical solutions of linear equations; Mathematical structures, concepts and notations used in discrete mathematics. Introduction to Statistical Methods: basic and some advanced concepts of probability and statistics; Concepts of statistics in solving problems arising in data science.

UNIT – II : Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

UNIT – III : Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

UNIT – IV : Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings

UNIT – V : Applications of Data Science, Technologies for visualization, Bokeh (Python), recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science

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Essential Reading:

1. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 2015
2. Introducing Data Science, Davy Cielen, Amo D.B. Meysman, Mohamed Ali, Manning Publication Co, 1st edition, 2016

Suggested Reading:

1. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

MCA (Semester – IV)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-SEC-4201	Dissertation	-	-	-	20	20	20	60	100

Objective: The objective of a dissertation aims to demonstrate deep understanding of the subject matter and mastery of relevant concepts, theories, and methodologies. Enhance the student's ability to conduct independent research, including formulating research questions, designing studies, collecting and analyzing data, and interpreting results. Provide an opportunity to contribute original insights or findings to the academic field or area of study. Integrate and apply knowledge and skills acquired throughout the course to address a specific problem or question.
Improve Critical Thinking and Problem-Solving ability to solve complex problems.

Guidelines:

Overview: Every student should do a dissertation individually or in some cases, it may be in a group of two students. The type of dissertation can be either application-oriented with the latest technologies or research-based.

Supervisor: Any faculty appointed in the department of the Computer Science and Applications will be a supervisor for the dissertation work. A supervisor will be decided as per the guideline decided by the HoD.

Platform: The dissertation can be on any platform e.g., WINDOWS, UNIX, LINUX, Mac OS, etc. The dissertation can be done using any language or package learned within or outside the course such as C, C++, Java, .NET, Python, etc.

Venue: The dissertation can be done in the University itself or in aother outside organization/ITcompany.

Note: if student carried his/her dissertation outside Sagar they may be exempted from mandatory attendance in elective papers.

Evaluation of Mid-I, Internal Assessment& Final Examination: The progress of the dissertation will be evaluated as Mid-I, internal assessment& final examination through seminar/presentation, write-up/synopsis/ progress report and as per the guidelines of para 6 d of this syllabus.

L: Lecture, T: Tutorial, P: Practical. ME: Mid Examination, IA: Internal Assessment

Board of Studies Meeting held on 29th May, 2024
Approved MCA 1st to 4th Semesters Syllabus w.e.f. 2024-25

Prof. Vinay Rishiwal
(External Member)
MJP, Rohilkhand University, Bareily
(U.P.)

29/5/24
Prof. Ashish Verma
(Member)
Hod, Department of Physics
Dr. Harisingh Gour V.V., Sagar (M.P.)

29/5/24
Dr. Kavita Shrivastava
(Member)
Department of Mathematics and Statistics
Dr. Harisingh Gour V.V., Sagar (M.P.)

Mr. Kamal Kant Ahirwar
(Member)
Department of Computer Science and Applications
Dr. Harisingh Gour V.V., Sagar (M.P.)

Dr.Ranjit Rajak
(Special Invitee, Member)
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Dr. Harisingh Gour V.V., Sagar (M.P.)

Abansal 29.05.24.
Dr. Abhishek Bansal
(HoD & Chairman, BoS)
Department of Computer Science and Applications
Dr. Harisingh Gour V.V., Sagar (M.P.)

School Board Meeting held on 14th June, 2024

Approved MCA Syllabus 1st to 4th Semesters w.e.f. 2024-25

Prof. A.K. Saxena
External Member
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Online
Prof. K.S. Varsney
External Member
HoD Physics, D.S. College, Aligarh, UP

Prof. Narendra Pandey
External Member
Department of Physics, University of Lucknow (U.P.)

14/6/24
Prof. Diwakar Shukla
Member
HoD, Department of Mathematics & Statistics
Dr. Harisingh Gour V.V., Sagar (M.P.)

14/6/24
Prof. Ashish Verma
Member
HoD, Department of Physics
Dr. Harisingh Gour V.V., Sagar (M.P.)

Prof. R.K. Rawat
Member
Department of Applied Geology,
Dr. Harisingh Gour V.V., Sagar (M.P.)

Online
Prof. Ranveer Kumar
Member
Department of Physics
Dr. Harisingh Gour V.V., Sagar (M.P.)

Prof. U.K. Patil
Member
Department Pharmaceutical Science
Dr. Harisingh Gour V.V., Sagar (M.P.)

14/06/24
Dr. Abhishek Bansal
Member & Associate Professor
HoD, Department of Computer Science & Applications,
Dr. Harisingh Gour Vishwavidyalaya, Sagar (M.P.)

14.6.2024
Dr. U. K. Khedlekar
Member & Associate Professor
Department of Mathematics and Statistics
Dr. Harisingh Gour V.V., Sagar (M.P.)

14/6/24
Dr. Rekha Garg Soanki
Member & Associate Professor
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Dr. Harisingh Gour Vishwavidyalaya, Sagar (M.P.)

Mr. Kamal Kant Ahirwar
Member & Assistant Professor
Department of Comp. Sci. & Applications
Dr. Harisingh Gour V.V., Sagar(M.P.)

14.06.2024
Dr. Maheshwar Panda
Member & Assistant Professor
Department of Physics
Dr. Harisingh Gour V.V., Sagar (M.P.)

Dr. Mahesh Kumar Yadav
Member & Assistant Professor
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Dr. Harisingh Gour V.V., Sagar (M.P.)

14.06.24
Ms. Shivani Kahre
Member & Assistant Professor
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Dr. Harisingh Gour V.V., Sagar (M.P.)

14/06/24
Prof. R.K. Gangele
(Chairman, School Board & Dean, SMPS)
Dr. Harisingh Gour V.V., Sagar (M.P.)

Vedic Speedies