Department of Computer Science and Applications

School of Mathematical and Physical Sciences (SMPS)

Structure and Syllabus
Master of Computer Applications
(M.C.A.)

Academic Session: 2023-2024 & Onwards

(Approved by BoS: 07/12/2023)

Doctor Harisingh Gour Vishwavidyalaya, Sagar
(A Central University)

Sagar-Madhya Pradesh 470003

Chairman, BOS
Computer Science & Applications

Structure and Syllabus
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Curriculum Framework M.C.A.

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Regulations of Master of Computer Applications (MCA) Course

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	Core Course (CC) Credits	Elective Course (EC) Credits	Open Elective (OE) Credits	Skill Enhancement (SE) Credits	Total Credits
I	24	--	--	--	**24**
II	24	--	02	--	**26**
III	20	04	02	02	**28**
IV	10	12	--	--	**22**
TOTAL	**78**	**16**	**04**	**02**	**100**

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. If a student fails to secure 75% attendance in a course then he or she will not be allowed to appear in the End Semester Examination of the respective course. 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

   15 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

   Remaining 05 marks will be assigned for attendance. The marks for attendance shall be awarded as follows:

   i. 75% and below : 00 Mark
   ii. >75% and upto 80% : 01 Mark
   iii. > 80% and upto 85% : 02 Marks
   iv. > 85% and upto 90% : 03 Marks
   v. > 90% and upto 95% : 04 Marks
   vi. > 95% : 05 Marks

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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 of 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 committee consisting of the Chairman of BoS or his/her nominee and two faculty members of the department, one of them is the supervisor of the dissertation if the dissertationiscarried out under the supervision of the faculty member of the department.

Components III will be evaluated by a committee consisting of the Chairman of BoS or his/her nominee, two faculty members of the department, one of them is the supervisor of the dissertation if the dissertation is carried out under the supervision of the faculty member of the department, and 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.

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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 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.

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Course Structure:

Semester 1									
Course Code	**Course Title**	**Credit**	**L**	**T**	**P**	**Sessional**		**ESE**	**Total**
						ME	**IA**		
CSA-CC-1201	Computer Organization and Architecture	4	3	1	-	20	20	60	100
CSA-CC-1202	Programming using C	4	3	1	-	20	20	60	100
CSA-CC-1203	Data Structure	4	3	1	-	20	20	60	100
CSA-CC-1204	Discrete Mathematics	4	3	1	-	20	20	60	100
CSA-CC-1205	Operating System	4	3	1	-	20	20	60	100
CSA-CC-1206	C Programming Lab	2	-	-	4	20	20	60	100
CSA-CC-1207	Data Structure Lab	2	-	-	4	20	20	60	100
	Total Credits	**24**	**15**	**5**	**8**				**700**
Semester 2									
Course Code	**Course Title**	**Credit**	**L**	**T**	**P**	**Sessional**		**ESE**	**Total**
						ME	**IA**		
CSA-CC-2201	Java Programming	4	3	1	-	20	20	60	100
CSA-CC-2202	Database Management Systems	4	3	1	-	20	20	60	100
CSA-CC-2203	Design and Analysis of Algorithm	4	3	1	-	20	20	60	100
CSA-CC-2204	Theory of Computation	4	3	1	-	20	20	60	100
CSA-CC-2205	Data Communication & Computer Networks	4	3	1	-	20	20	60	100
CSA-CC-2206	Java Programming Lab	2	-	-	4	20	20	60	100
CSA-CC-2207	DBMS Lab	2	-	-	4	20	20	60	100
	Total Credits	**24**	**15**	**5**	**8**				**700**
Out Department Paper									
	Out Department	2	-	-	-	20	20	60	100
	Total Credits	**26**	**15**	**5**	**8**				**800**
Paper Offered for other department students									
CSA-OE-2201	Computer Education – I	2	2	-	-	20	20	60	100
Semester 3									
Course Code	**Course Title**	**Credit**	**L**	**T**	**P**	**Sessional**		**ESE**	**Total**
						ME	**IA**		
CSA-CC-3201	Software Engineering	4	3	1	-	20	20	60	100
CSA-CC-3202	Programming with Python	4	3	1	-	20	20	60	100
CSA-CC-3203	AI & Machine Learning	4	3	1	-	20	20	60	100
CSA-CC-3204	WEB Application Design using PHP	4	3	1	-	20	20	60	100
Elective 1 (Opt any one of the following)									
CSA-EC-3201	Cryptography and Network Security	4	3	1	-	20	20	60	100
CSA-EC-3202	Scientific Computing	4	3	1	-	20	20	60	100
CSA-EC-3203	Computer Graphics	4	3	-	1	20	20	60	100
CSA-EC-3204	Ad-Hoc and Sensor Networks	4	3	1	-	20	20	60	100
CSA-EC-3205	Simulation and Modeling	4	3	1	-	20	20	60	100
CSA-CC-3205	Python Programming Lab	2	-	-	4	20	20	60	100
CSA-CC-3206	Web Application Lab	2	-	-	4	20	20	60	100

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Out Department Paper									
	Out Department	2	-	-	-	20	20	60	100
Participation / Presentation / Industrial Visit									
CSA-SE-3201	Industrial Tour, Seminar Participation, Minor Project, training	2	-	-	-	20	20	60	100
	Total Credits	**28**	**15**	**5**	**8**				**900**
Paper Offered for other departments									
CSA-OE-3201	Computer Education -II	02	-	-	02	20	20	60	100

Semester 4									
Course Code	**Course Title**	**Credit**	**L**	**T**	**P**	**Sessional**		**ESE**	**Total**
						ME	**IA**		
Elective 2 (Opt any one of the following)									
CSA-EC-4201	**Data Mining and Knowledge Discovery**	4	3	1	-	20	20	60	100
CSA-EC-4202	Cloud Computing	4	3	1	-	20	20	60	100
CSA-EC-4203	Multimedia and Animation	4	3	-	1	20	20	60	100
CSA-EC-4204	Cyber Security	4	3	1	-	20	20	60	100
CSA-EC-4205	R Programming	4	3	-	1	20	20	60	100
Elective 3 (Opt any one of the following)									
CSA-EC-4206	Big Data and Analytics	4	3	1	-	20	20	60	100
CSA-EC-4207	Mobile Applications Design and Development	4	3	-	1	20	20	60	100
CSA-EC-4208	Parallel and Distributed Systems	4	3	1	-	20	20	60	100
CSA-EC-4209	Blockchain Technology	4	3	1	-	20	20	60	100
CSA-EC-4210	Microsoft .Net Technologies	4	3	-	1	20	20	60	100
Elective 4 (Opt any one of the following)									
CSA-EC-4211	Internet of Things	4	3	1	-	20	20	60	100
CSA-EC-4212	Natural Language Processing	4	3	1	-	20	20	60	100
CSA-EC-4213	Information Retrieval & Web Mining	4	3	1	-	20	20	60	100
CSA-EC-4214	Digital Image Processing & Computer Vision	4	3	1	-	20	20	60	100
CSA-EC-4215	Embedded System Design	4	3	1	-	20	20	60	100
CSA-CC-4201	Dissertation	10	-	-	-	20	20	60	100
	Total Credits	**22**	**9**	**3**	-				**400**

Summary				
Semester	1	2	3	4
Semester-wise Total Credits	24	26	28	22
Total Credits	100			

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

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MCA (Semester – I)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-1201	**Computer Organization and Architecture**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

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 Contents:

Unit	Topic	Proposed Lectures
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.	12
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.	12
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.	12
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.	12
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.	12

Suggested Reading:

1. Willam Stalling, "Computer Organization and Architecture" Pearson Education Asia
2. Mano Morris, "Computer System Architecture" PHI
3. Zaky and Hamacher, "Computer Organization: McGraw Hill
4. B. Ram, "Computer Fundamental Architecture and Organization" New Age
5. Tannenbaum, "Structured Computer Organization" PHI.
6. Hayes: Computer Architecture and Organization, Mc Graw Hill.
7. G.L. Jr.: Computer design, Computech Press Langdon.
8. Bywater: Hardware- Software Design of digital System

Course Outcome: Course students will be able to:

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

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

Approved by BOS Meeting on dated 07/12/2023

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MCA (Semester – I)

Course Code	Course Title	Credit	L	T	P	Sessional		ESE	Total
						ME	IA		
CSA-CC-1202	Programming Using C	4	3	1	-	20	20	60	100

Course Objective:

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

Course Contents:

Unit	Topic	Proposed Lectures
I	**Basics of programming:** Approaches to problem-solving, Use of high-level programming language for systematic development of programs, Concept of algorithm and flowchart, Concept and role of structured 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, Instructions, Data types, Standard Input/Output, Operators and expressions.	12
II	**Conditional Program Execution:** if, if-else, and nested if-else statements, Switch statements, Restrictions on switch values, Use of break and default with switch, Comparison of the switch, and if-else. **Loops and Iteration:** for, while, and do-while loops, Multiple loop variables, Nested loops, Assignment operators, 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.	12
III	**Arrays:** Array notation and representation, Declaring one-dimensional array, Initializing arrays, Accessing array elements, Manipulating array elements, Arrays of unknown or varying size, Two-dimensional arrays, Multidimensional arrays. **Pointers:** Introduction, Characteristics, * and & operators, Pointer type declaration and assignment, Pointer arithmetic, Call by reference, Passing pointers to functions, the arrayof pointers, Pointers to functions, Pointer to pointer, Array of pointers. **Strings:** Introduction, Initializing strings, Accessing string elements,Array of strings, Passing strings to functions, String functions.	12
IV	**Structure:** Introduction, Initializing, defining, and declaring structure, Accessing members, Operations on individual members, Operations on structures, Structure within the structure, Array of structure, Pointers to structure. **Union:** Introduction, Declaring union, Usage of unions, Operations on the union. Enumerated data types. **Storage classes:** Introduction, Types- automatic, register, static andexternal.	12
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 functions, File handling through command line argument, Record I/O in files. **Graphics:** Introduction, Constant, Data types and global variables used in graphics, Library functions used in drawing, Drawing and filling images, GUI interaction within the program.	12

Suggested Reading:

1. "Schaum's Outlines- Programming in C", by Gottfried B., McGraw-Hill Publications.
2. "The C Programming Language", by Brian Kernighan and Dennis Ritchie, Prentice-Hall.
3. "Problem Solving and Program Design in C", by Hanly J. R. and Koffman E. B., Pearson Education.
4. "How to Solve it by Computer" by R. G. Dromey, Prentice-Hall.
5. "Let Us C", by Kanetkar Y., BPB Publications.

Course Outcome: Course students will be able to:

- Construct flowchart and write algorithms for solving basic problems.
- Write 'C' programs that incorporate the use of variables, operators, and expressions along with data types.
- Write simple programs using basic elements like control statements, functions, arrays, and strings.
- Write advanced programs using the concepts of pointers, structures, unions, and enumerated data types.
- Apply pre-processor directives and basic file handling and graphics operations in advanced programming.

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

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MCA (Semester – I)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-1203	**Data Structure**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

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.
4. Ability to use standard libraries for data structures.

Course Contents:

Unit	Topic	Proposed Lectures
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, Introduction to Algorithms: Definition of Algorithms, Difference between algorithm and programs, properties of the algorithm, Algorithm Design Techniques, Performance Analysis of Algorithms, Complexity of various code structures, Order of Growth, Asymptotic Notations. **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.	12
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, Iteration and Recursion- Principles of recursion, Tail recursion, Removal of recursion Problem solving using iteration and recursion with examples such as binary search, Fibonacci numbers, and 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.	12
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, Comparison of Sorting Algorithms, Sorting in Linear Time: Counting Sort and Bucket Sort.	12
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, Connected Component. **Trees:** Basic terminology used with Tree, 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, and B Tree.	12
V	Divide and Conquer with Examples Such as Merge Sort, Quick Sort, Matrix Multiplication: Strassen's Algorithm Dynamic Programming: Dijkstra Algorithm, Bellman-Ford Algorithm, All Pairs Shortest Path: Warshal Algorithm, Longest Common Sub-sequence Greedy Programming: Prims and Kruskal algorithm.	12

Suggested Reading:

1. "Fundamentals of Computer Algorithms", Horowitz Ellis, Sahni Sartaj and Rajasekharan S., Universities Press.
2. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
3. "Theory and Problems of Data Structures", Lipschutz S., Schaum's Series.
4. "Data Structures With C - SIE – SOS", Lipschutz, McGraw Hill
5. "Classic Data Structures", Samanta D., Prentice Hall India.
6. Aho, Ullman, and Hopcroft, "Design and Analysis of Algorithms", Pearson Education.
7. Langsam, Yedidyah; Augenstein, Moshe J.; Tenenbaum, Aaron M. "Data structures using C and C++.

Course Outcome: At the end of the course students will be able to:

- Explain the concept of data structure, abstract data types, algorithms, and basic data organization schemes such as arrays and linked lists.
- Describe the applications of stacks and queues and implement various operations on them using arrays and linked lists.
- Describe the properties of graphs and trees and implement various operations such as searching and traversal on them.
- Compare incremental and divide-and-conquer approaches of designing algorithms for problems such as sorting and searching.

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

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MCA (Semester – I)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-1204	**Discrete Mathematics**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

1. Understand the basic concepts of discreet 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 Contents:

Unit	Topic	Proposed Lectures
I	**Set 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 on relations, Composite relations, 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.	12
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.	12
III	**Combinatorics:** Multinomial theorem, the principle of inclusion-exclusion; pigeonhole principle; Classification of recurrence relations, summation method, extension to asymptotic solutions from solutions for subsequences; 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.	12
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.	12
V	**Logic:** Propositional calculus propositions and connectives, syntax; semantics truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility, natural deduction system and axiom system; Soundness and completeness. **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).	12

Suggested Reading:

1. "Discrete Mathematics and Its Applications", K.H. Rosen, Tata McGraw Hill.
2. "Discrete Mathematical Structure with Application to Computer Science", J. P. Trembley, R. P. Manohar.
3. "Elements of Discrete Mathematics A Computer Oriented Approach", C.L. Liu, D. P. Mohapatra.
4. "Discrete Mathematics for Computer Scientists", J. L. Mott, A. Kandel, and T. P. Baker.
5. "Discrete Mathematics in Computer Science", D. F. Stanat and D. E. McAllister.
6. "Introductory Combinatorics", R. A. Brualdi.
7. "Graph Theory with Applications to Engineering and Computer Science", N. Deo.
8. "Introduction to Graph Theory", Douglas B. West.
9. "Introduction to Mathematical Logic", E. Mendelsohn.

Course Outcome: At the end of the course students will be able to:

- use mathematical and logical notation to define and formally reason about basic discrete structures such as Sets, Relations, and Functions
- Apply mathematical arguments using logical connectives and quantifiers to check the validity of an argument through truth tables and propositional and predicate logic
- Formulate and solve recurrences and recursive functions
- Apply the concept of combinatorics to solve basic problems in discrete mathematics Explain the concept of data structure, abstract data types, algorithms, and basic data organization
- Formulate & use tree and graph algorithms to solve problems
- Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra

MCA (Semester – I)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-1205	**Operating System**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective: Students will learn

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 Contents:

Unit	Topic	Proposed Lectures
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	12
II	**CPU Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Algorithm Evaluation.	12
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.	12
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.	12
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.	12

Suggested Reading:

1. Abraham Silberschatz and Peter Baer Galvin "Operating System Concepts"
2. Milan Milankovic, "Operating Systems, Concept and Design" McGraw Hill
3. R. C. Joshi "Operating System", Wiley dreamtech India Pvt. Ltd.
4. Harvey M Ddeital "Operating System" Addison Wesley.

Course Outcome: 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

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

Approved by BOS Meeting on dated 07/12/2023

Chairman, BOS
Computer Science & Applications

MCA (Semester – I)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-1206	**C Programming Lab**	**2**	**-**	**-**	**4**	**20**	**20**	**60**	**100**

Objectives: To provide hands-on training in C Programming to students to write programs

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The list of practicals will be decided by the course coordinator.

Learning Outcomes: After completing this course students will be capable enough to implement programming concepts in the C language.

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

MCA (Semester – I)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-1207	**Data Structure Lab**	**2**	-	-	**4**	**20**	**20**	**60**	**100**

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

The list of practicals will be decided by the course coordinator.

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

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

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Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-2201	Java Programming	4	3	1	-	20	20	60	100

Course Objective: Students will learn

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 Contents:

Unit	Topic	Proposed Lectures
I	**Principles of OOP:** 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.	12
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.	12
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.	12
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.	12
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.	12

Suggested Reading:

1. Herbert Scheldt, The complete reference Java, Seventh Edition, Tata McGraw Hill
2. Bill Verrens, Inside the Java Virtual Machine, Tata McGraw Hill
3. Sierra and Bates, Head First Java, O'Reilly
4. R Lafore "Object-Oriented Programming": Pearson
5. Horstmann, "CORE JAVA" Pearson Education
6. E. Balaguruswami "OOPs using Java"-TMH

Course Outcome: Course students will be able to:

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

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

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Computer Science & Applications

MCA (Semester – II)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-2202	**Database Management Systems**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective: Students will learn

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 Contents:

Unit	Topic	Proposed Lectures
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.	**12**
II	**Relational model:** 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.	**12**
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.	**12**
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.	**12**
V	**Transaction Management and Concurrency Control:** ACID properties, Transactions, and Schedules, Concurrent Execution of transactions, Serializability,andRecoverability Introduction to Lock Management: Lock Conversions, Dealing with Deadlocks, Concurrency without Locking. Performance Locking, Transaction Support in SQL Crash Recovery-Aries Recovery Algorithm.	12

Suggested Reading:

1. Date C.J. "An Introduction to Database System". Addison Wesley
2. Korth, Silbertz, Sudarshan, "Database Concepts" McGraw Hill
3. Elmasri, Navathe, "Fundamentals of Database Systems" Addison Wesley
4. Paul Beynon Davis, "Database Systems" Palgrave Macmillan
5. Bipin C. Desai, "An Introduction to Database Systems", Galgotia Pub
6. Beginning SQL: Paul Wilton, Wiley dreamtech

Course Outcome: Course students will be able to:

- familiar with the database theory use basics of SQL and construct queries using SQL.
- analyze the difference between the traditional file system and DBMS
- work with different database languages
- write relational algebra expressions for queries.

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

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Computer Science & Applications

MCA (Semester – II)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-2203	**Design and Analysis of Algorithm**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective: Students will learn

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.

Course Contents:

Unit	Topic	Proposed Lectures
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.	12
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.	12
III	**Greedy Algorithms:** General Concept, Applications, Activity Selection Problem, Fractional Knapsack problem, Job Sequencing with Deadlines, Huffman Coding, Analysis and Correctness of Prim's, Kruskal Algorithm and Dijkstra Algorithm.**Dynamic Programming:** General Concept, Matrix-Chain Multiplication Problem, Longest Common Subsequence Problem, Bellman-Ford Algorithm, Analysis and Correctness of Floyd-Warshall Algorithm, Optimal Binary Search Trees, 0/1 Knapsack Problem, NetworkFlow Problem.	12
IV	**String Matching Concept:** Naive String-Matching Algorithm, String Matching with Finite Automata, 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.	12
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; Circuit Satisfiability, 3SAT, Vertex Cover, Clique, Cook's Theorem.	12

Suggested Reading:

1. "The Design and Analysis of Computer Algorithms" by A.V.Aho,J.E.Hopcroft and J.D.Ullman, Pearson Education,
2. "Introduction to Algorithms" by T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein, PHI.
3. "Algorithms" by S. Dasgupta, C. Papadimitriou, and U.Vazirani, McGraw Hill.
4. "Algorithm Design" by J. Kleinberg and E. Tardos, Pearson Education.
5. "Fundamentals of Computer Algorithms" by S. Horowitz, University Press.
6. "Design and Analysis of Algorithms" by R. Panneerselvam, PHI.
7. "Algorithms Unlocked" by T. H. Cormen, MIT Press.
8. "Design and Analysis of Algorithms" by S. Sridhar, Oxford University Press.
9. "Foundations of Algorithms" by R. Neapolitan and K. Naimipour,", Jones & Bartlett Publishers.

Course Outcome: Course students will be able to:

- Study different types of asymptotic notations that are used to analyze the running time of different algorithms and solve recurrences.
- 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.
- 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.
- Study of different String Matching algorithms, Backtracking method, example problems, and their backtracking solution using State Space Search Tree method.
- Study of Branch and Bound technique, example problems and their solution using State Space Search Tree method, a study of P, NP and NP-Complete problems, Approximation algorithms and example problems.

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Computer Science & Applications

MCA (Semester – II)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-2204	**Theory of Computation**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective: Students will learn

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.

Course Contents:

Unit	Topic	Proposed Lectures
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.	12
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.	12
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)).	12
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.	12
V	**Turing Machine(TM)**: 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.	12

Suggested Reading:

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman. "Introduction to Automation Theory,Languages& Computation"
2. Mishra &Chandrasekaran-Theory of Computer Science.
3. Lewis & Papadimitriou Elements of the Theory of Computation.
4. John C. Martin -Introduction to Languages and Theory of Computation.
5. Bernard M. Moret Pearson -Henry of Computation ISBN-81-7808-550
6. Peter Linz Introduction to Formal Languages and Automata, 6/e
7. C.L.Liu-Elements of Diseretemaths-TMH ISBN-0-07-043476-X

Course Outcome: After completion Studentscan:

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

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

Chairman, BOS
Computer Science & Applications

Department of Computer Science and Applications, Dr. Harisingh Gour Vishwavidyalaya, Sagar (M.P.)

MCA (Semester – II)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-2205	**Data Communication & Computer Networks**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective: Students will learn

1. To understand the procedure of data communication and networking.
2. To learn the tools, techniques, protocols of establishing a communication network.
3. To be aware of problems generated during communication and their contents controls.

Course Contents:

Unit	Topic	Proposed Lectures
I	**Introduction to computer network:** Topology; Base Band & Broad Band Topology; Guided & Unguided Media. Overview of Data & Signal Bits. Baud & Bit Rate.	12
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.	12
III	Bit oriented (BSC) & Character oriented Protocol (SDLC, LAPB, LAPD, LLC) HDLC-frame format, station, states, configuration, access control.	12
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.	12
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.	12

Suggested Reading:

1. B. Forouzan, "Data Communication and Networking", First Edition, 1999, Tata McGraw Hill.
2. Stalling W, "Data & Computer Communications", 8th Edition, PHI
3. Tananbaum A.S., "Computer Networks", 3rd Ed, PHI, 1999.
4. Kurose, "Computer Networking 6 Edition, A Top-down approach", Pearson.
5. Dye, "Network Fundamental" CCNA Exploration", Pearson.
6. Cisco, "CCNA Exploration, Wan Accessing the Wan", Pearson

Course Outcome: Course students will be able to:

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

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

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MCA (Semester – II)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-2206	**Java Programming Lab**	**2**	**-**	**-**	**4**	**20**	**20**	**60**	**100**

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

The list of practicals will be decided by the course coordinator.

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

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

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MCA (Semester – II)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-2207	**DBMS Lab**	**2**	**-**	**-**	**4**	**20**	**20**	**60**	**100**

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

The list of practicals will be decided by the course coordinator.

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

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

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Computer Science & Applications

Department of Computer Science and Applications, Dr. Harisingh Gour Vishwavidyalaya, Sagar (M.P.)

MCA (Semester – II)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-OE-2201	**Computer Education-I**	**02**	**-**	**-**	**02**	**20**	**20**	**60**	**100**

Objectives : (1) To learn the basics of computer systems.
(2) To understand the basics of computer structure and organization.

Course Contents:

Unit	Topic	Proposed Lectures
I	Generations of Computer, Block Diagram of a Computer, Applications of Computers, Advantages and Disadvantage of Computer, CPU, Keyboard, mouse, joystick, trackball, light pen, Data Scanning devices image scanner, OCR, OMR, MICR, Bar code reader, card reader, Voice Recognition Device.	6
II	Monitor, Printer laser pointer, dot matrix printer, inkjet printer, Memory hierarchy, Cache Memory, Primary Memory RAM, DRAM and SRAM, ROM, Secondary Memories.	6
III	Application Software, System Software, Communication Software, Application Software, Programming Language Translators, Assembler, Compiler, Interpreter, Utility Programs, Computer Languages, Machine language, Assembly language, High-level language.	6
IV	Number System: Decimal Number System, Binary Number System, Octal Number System, and Hexadecimal Number System and their conversions.	6
V	First compliment & Second Compliment Logic Gates- AND, OR, NOT, Universal Logic Gates- NOR, NAND.	6

Learning Outcomes: After completing this course, students will be aware of the structure, functioning, and working procedure of a computer system.

Essential Reading:

1. Computer Fundamentals, Fourth Edition by P.K. Sinha and Priti Sinha.
2. Computer Fundamentals Architecture and Organization, Third Edition by B. Ram.

Suggested Reading and links :

1. Digital Principle and Applications, Six Edition by Donald P Leach, Albert Paul Malvino&GoutamSaha.
2. Fundamentals of Computers, Fourth Edition by V. Raja Raman

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

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MCA (Semester – III)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-3201	**Software Engineering**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

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

Course Contents:

Unit	Topic	Proposed Lectures
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.	12
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.	12
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.	12
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.	12
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.	12

Suggested Reading:

1. "Software Engineering: A Practitioners Approach" by R S Pressman McGraw Hill.
2. "Software Engineering" by Ian Sommerville, Addison Wesley.
3. "Software Engineering" by Pankaj Jalote, Wiley publication.
4. "Fundamentals of Software Engineering" by Rajib Mall, PHI Publication.
5. "Software Engineering" by K. K. Aggarwal and Yogesh Singh, New Age InternationalPublishers.
6. "Fundamentals of Software Engineering" by Ghezzi, M. Jarayeri, D. Manodrioli, PHIPublication.

Course Outcome: Course students will be able to:

- demonstrate an understanding of software engineering layered technology and software process models that provide a basis for the software development lifecycle.
- apply agile development methods for developing software.
- describe software/system requirements and understand the processes involved in the discovery and documentation of these requirements.
- practice system modeling techniques and object-oriented design for software development.
- test software using verification and validation, static analysis, reviews, inspections, and audits.
- appreciate software project management that includes project planning, project estimation techniques, risk management, quality management, and configuration management.
- work as an individual and/or in a team to develop and deliver quality software.

Chairman, BOS
Computer Science & Applications

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MCA (Semester – III)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-3202	**Programming with Python**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

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 Contents:

Unit	Topic	Proposed Lectures
I	**Introduction to Python**: 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	12
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.	12
III	**File Handling:** Introduction, File types, Creating, Opening, Closing, Renaming, Accessing and deleting files, Filepointers, File modes, Binary files**Exception Handling:** Introduction, Exception, Default exception handlers, Handling multiple errors, Raising exceptions, generators, Python Libraries.	12
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	12
V	Introduction to Machine learning packages like NUMPY, SCIPY, PANDAS, etc.	12

Suggested Reading:

1. "Exploring Python" by Budd T.A., McGraw Hill.
2. "Learn Python the Hard Way" by Shaw Z.A., Pearson.
3. "Python Programming –for the Absolute Beginner" by Dawson M., Cengage Learning.
4. "The Complete Reference Python" by Martin C. Brown, McGraw Hill.
5. "Programming and Problem Solving with Python" by Ashok Namdev Kamthane, Amit Ashok Kamthane, McGraw Hill.
6. "Think Python" by Allen B. Downey, SPD/O'Reilly.
7. "Introduction to Computation and Programming Using Python" by John V Guttag, MIT Press.

Course Outcome: Course students will be able to:

- Construct and execute basic programs in Python.
- Select the appropriate data structure of Python for solving a problem.
- Use external libraries and packages with Python
- Apply the features of Python language in various real applications.
- Design object-oriented programs using Python for solving real-world problems.

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

Approved by BOS Meeting on dated 07/12/2023

Chairman, BOS
Computer Science & Applications

Department of Computer Science and Applications, Dr. Harisingh Gour Vishwavidyalaya, Sagar (M.P.)

MCA (Semester – III)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-3203	**AI & Machine Learning**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

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.
6. Understand modern notions in Supervised Machine Learning and its concepts.

Course Contents:

Unit	Topic	Proposed Lectures
I	**Introduction:** 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.	12
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.	12
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	12
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.	12
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).	12

Suggested Reading:

1. "Artificial Intelligence: A New Synthesis" by N. J. Nilsson., Elsevier India.
2. "Principles of Artificial Intelligence" by N. J. Nilsson., Narosa Publishing House.
3. "Problem-Solving Methods in Artificial Intelligence N. J. Nilsson., McGrawHil.
4. "Artificial Intelligence and Modern Approach" by S. Russel, P. Norvig., Pearson Education.
5. "Artificial Intelligence" by Elaine Rich, Kevin Knight.
6. "The Elements of Statistical Learning" by T. Hastie, R. Tibshirani, J. Friedman.
7. "Pattern Recognition and Machine Learning" by Christopher Bishop
8. "Introduction to Machine Learning" by Ethem Alpaydin.
9. "Machine Learning: An Algorithmic Perspective" by Stephen Marsland.

Course Outcome: Course students will be able to:

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

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MCA (Semester – III)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-3204	**WEB Application Design using PHP**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

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 Contents:

Unit	Topic	Proposed Lectures
I	**Introduction:** 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.	12
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.	12
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.	12
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.	12
V	**Authenticating 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.	12

Suggested Reading:

1. "Beginning PHP and MySQL" by W. Jason Gilmore, Apress.
2. "PHP6 and MySQL" by Steve Suehring, Tim Converse and Joyce Park, Wiley Publication.
3. "HTML4 Complete" by E. Stephen Mask, Janan Platt BPB Publications.

Course Outcome: Course students will be able to:

- develop web applications using PHP

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Computer Science & Applications

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MCA (Semester – III)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-3201	**Cryptography and Network Security**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

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 Contents:

Unit	Topic	Proposed Lectures
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.	12
II	**Asymmetric Encryption:** Mathematics of Asymmetric Key Cryptography-Primes, primality Testing, Factorization, Asymmetric Key Cryptography-RSA Cryptosystem, Rabin Cryptosystem, ElGamal Cryptosystem, Elliptic Curve Cryptosystem	12
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. **Digital Signatures:** Elgamal Digital Signature Scheme, Schnorr Digital Signature, NIST Digital Signature Algorithm	12
IV	**Key Management and Distribution:** Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates. **User Authentication:** User Authentication, Remote User-Authentication Principle, Remote User-Authentication Using Symmetric Encryption, Kerberos, Remote User-Authentication Using Asymmetric Encryption	12
V	**Network and Internet Security 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.	12

Suggested Reading:

1. "Cryptography and Network Security" by Behrouz A Forouzan, Deb deep Mukhopadhyay, McGraw Hill.
2. "Cryptography and Network Security" by William Stallings, Pearson.
3. "Network Security and Cryptography" by Bernard Menges, Cengage Learning

Course Outcome: Course students will be able to:

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

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CSA-EC-3202	**Scientific Computing**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

1. about the floating-point representation of the number, the error, and its occurrence in numerical computation.
2. what interpolating is and how to construct various interpolating polynomials to perform interpolation and extrapolation.
3. iterative methods to find the solution of polynomial and transcendental equations.
4. to find the solution of linear equations using matrices.

Course Contents:

Unit	Topic	Proposed Lectures
I	**Number System and Errors:** Representation on integers and floating-point numbers, Errors in computation, loss of significance. **Solutions of Equations in one variable**: Bisection Method, Newton Raphson Method, Fixed Point iteration, Error Analysis, Accelerating Convergence, Polynomial Evaluation – Horner's rule, Zeros of polynomials, and Muller's Method	12
II	**Systems of Linear Equations:** Gaussian Elimination, Triangular decomposition, Pivoting strategies, Error analysis and Operations count, Ill-conditioning and condition number of system, Evaluation of determinants.	12
III	Eigenvalue Computations, Diagonalization of the system of ODE, Power Method, Gerschgorin theorem, Jacobi's Method, Given's and Householder's methods for Tridiagonalization, Method of Sturm sequences for tridiagonal matrix, Lanczos Method, QR Factorization.	12
IV	**Curve fitting and Approximation**: Lagrange's interpolation, Polynomial wiggle problem, Spline interpolation, Least Square Method – line and other curves, Orthogonal Polynomials, Tchebyshev interpolation, Fourier approximation, and Fast Fourier, Transforms (FFT) algorithm	12
V	**Numerical Differentiation and Integration**: Numerical Differentiation – Richardson Extrapolation method, Numerical Integration – Newton Cotes quadrature for equidistant points, Gaussian Quadrature, Integration using Chebyshev Polynomials	12

Suggested Reading:

1. Numerical Methods for Mathematics, Science and Engineering John H. Mathews.
2. Numerical Analysis (7th Edition) Richard and J. Douglas Faires
3. Numerical Analysis C. E. Froberg
4. Numerical Analysis – A practical Approach Maron M.J.
5. A First Course in Numerical Analysis Ralston and Rabinowitz.

Course Outcome: Course students will be able to:

- understand numerical problems,
- can solve real-world problems using scientific computing.

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MCA (Semester – III)

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CSA-EC-3203	**Computer Graphics**	**4**	**3**	**-**	**1**	**20**	**20**	**60**	**100**

Course Objective:

1. Basic building blocks and core concepts of computer graphics.
2. Theoretical, mathematical foundation, and practical aspects of different graphics algorithms.

Course Contents:

Unit	Topic	Proposed Lectures
I	**Introduction:** Computer Graphics and its Applications, Overview of Graphics Systems – Video display devices, Raster-Scan Systems, Random-Scan Systems, Graphics Software.**Graphical User Interfaces and Interactive Input Methods:** The User Dialogue, Windows and Icons, Input of Graphical Data, Input Functions.	12
II	**Output Primitives:** Line Attributes, Color and GrayScale levels, Area Fill Attributes, Character Attributes, Bundled Attributes, Antialiasing.**Transformations:** Two-Dimensional and Three-Dimensional Geometric Transformations: Translation, Scaling, Rotation, Reflection, Shearing, Homogeneous Coordinates, Composite Transformations,.	12
III	**Clipping:** Point Clipping, Line Clipping, Line Clipping Algorithms: Cohen Sutherland Algorithm and Cyrus-Beck, Polygon Clipping, Polygon Clipping Algorithms: Sutherland Hodgeman Clipping.**Window to Viewport:** Windowing, Clipping, 2D-Viewing Pipeline, Computing Location of Viewport, Window to Viewport Transformation.	12
IV	Hidden Surface Removal: Z-buffer algorithm, scan line algorithm, algorithm for oct-tres, algorithm for curve surfaces, visible surfaces ray-tracing, recursive ray tracing.	12
V	.**Illumination and Shading Models:** Object Rendering, Light Modelling Techniques: Ambient, Diffuse, Specular Reflection, Ray Tracing, Shading Models: Flat-Shading, Gouraud Shading, Phong Shading, Coloring: Color models – RGB, CMY, HSV, and HSL Models.	12

Suggested Reading:

1. "Computer Graphics: Principles and Practice" by Foley et al.
2. "Computer Graphics with OpenGL" by Donald Hearn and M. Pauline Baker, Pearson.
3. "Procedural elements in Computer Graphics: by David F. Rogers
4. "Mathematical Elements for Computer Graphics" by David F. Rogers and J. A. Adams.
5. "Computer Graphics: Principles and Practice" by Foley James D.
6. "The Complete Guide to Blender Graphics: Computer Modeling & Animation" by John M. Blain.

Course Outcome: Course students will be able to:

- Demonstrate graphics drawings concerning graphics primitives.
- Explain the mathematical concepts of different graphics algorithms.
- Apply 2D & 3D transformation concepts to represent images with different dimensions and shapes.
- Analyze and evaluate the concepts of projections and shading methods to obtain realistic images.
- Develop scenes with different clipping methods and transform themintothe graphics display device.

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MCA (Semester – III)

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CSA-EC-3204	**Ad-Hoc and Sensor Networks**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

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 Contents:

Unit	Topic	Proposed Lectures
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.	12
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.	12
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.	12
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.	12
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.	12

Suggested Reading:

1. "Ad Hoc Wireless Networks: Architectures and Protocols ", C. Siva Ram Murthy, and B. S. Manoj, Pearson Education.
2. "Wireless Adhoc and Sensor Networks", Labiod. H, Wiley,
3. "Wireless ad -hoc and sensor networks: theory and applications", Li, X, Cambridge University Press.
4. "Ad Hoc & Sensor Networks: Theory and Applications", 2nd edition, Carlos De Morais Cordeiro, Dharma Prakash Agrawal,World Scientific Publishing Company.
5. "Wireless Sensor Networks", Feng Zhao and Leonides Guibas, Elsevier Publication.
6. "Protocols and Architectures for Wireless Sensor Networks", Holger Karl and Andreas Willig,Wiley.
7. "Wireless Sensor Networks Technology, Protocols, and Applications", KazemSohraby, Daniel Minoli, &TaiebZnati, John Wiley.

Course Outcome: Course students will be able to:

- Evaluate the principles and characteristics of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks
- Determine the principles and characteristics of wireless sensor networks
- Discuss the challenges in designing MAC, routing, and transport protocols for wireless ad-hoc sensor networks
- Illustrate the various sensor network Platforms, tools, and applications
- Demonstrate the issues and challenges in security provisioning and also familiar with the mechanisms for implementing security and trust mechanisms in MANETs and WSNs

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MCA (Semester – III)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-3205	**Simulation and Modeling**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

1. To understand the technique of simulation and study different system models.
2. To study continuous system simulation and CSMP-III language.
3. To study probability concepts in simulation and different types of random number generators along with standard tests for random numbers.
4. To study Discrete Event System Simulation and GPSS language.
5. To study computer models of Queueing, Inventory, and Scheduling systems and about the design of simulation experiments and analysis of simulation output.

Course Contents:

Unit	Topic	Proposed Lectures
I	**Inventory Concept:** The technique of Simulation, Major application areas, concept of a System, Environment, Continuous and Discrete Systems, System Modeling, Types of models, Progress of a Simulation Study, Monte Carlo Method, Comparison of Simulation and Analytical Methods. Numerical Computation Technique for discrete and continuous models, Continuous System Simulation.	12
II	**Probability Concepts in Simulation:** Stochastic variables, Discrete and Continuous Probability Functions, Numerical evaluation of continuous probability functions, continuous uniformly distributed random numbers, Random Number Generators – Linear Congruential Generator, Additive, and Multiplicative Congruential Generators, Mid Square Method, Rejection Method, Testing of random numbers, Generation of Stochastic Variates, Arrival Patterns, Service Times.	12
III	**Discrete System Simulation:** Discrete Events, Representation of Time, Generation of Arrival Patterns, Fixed Time Step versus Next Event Simulation, Simulation of a Telephone System, Delayed Calls.	12
IV	**Introduction to GPSS:** Creating and moving transactions, queues, facilities, and storages, gathering statistics, conditional transfers, program control statements, priorities and parameters, standard numerical attributes, functions, gates, logic switches and tests, Variables, Select and Count, Example GPSS problems.	12
V	**Simulation Languages and Practical Systems:** Continuous and Discrete Systems Languages, Factors in the selection of Discrete Systems Simulation Language, Computer Model of Queuing, Inventory and Scheduling Systems. **Design and Evaluation of Simulation Experiments**: Length of Simulation Runs, Validation, Variance Reduction Techniques, Experimental Layout, Analysis of Simulation Output, Recent Trends, and Developments.	12

Suggested Reading:

1. "System Simulation", Geoffrey Gordon, PHI Publication.
2. "System Simulation with Digital computer", Narsingh Deo, PHI Publication.
3. "Discrete Event System Simulation", Jerry Banks and John S.Carson, Barry L. Nelson, David M.Nicol, Prentice Hall Publication.
4. "Systems simulation, The art, and science", R.E, Shannon Prentice Hall.
5. "Simulation using GPSS", Thomas J. Schriber, John Wiley Publication.

Course Outcome: Course students will be able to:

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

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MCA (Semester – III)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-3205	**Python Programming Lab**	**2**	**-**	**-**	**4**	**20**	**20**	**60**	**100**

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

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The list of practicals will be decided by the course coordinator.

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

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MCA (Semester – III)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-CC-3206	**Web Application Lab**	**2**	**-**	**-**	**4**	**20**	**20**	**60**	**100**

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

The list of practicals will be decided by the course coordinator.

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

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MCA (Semester – III)

Course Code	Course Title	Credit	L	T	P	Sessional		ESE	Total
						ME	IA		
CSA-SE-3201	**Industrial Tour, Seminar Participation, Minor Project, training**	2	-	-	-	20	20	60	100

Objectives:

1. To encourage students for collecting knowledge on recent topics.
2. To develop presentation and discussion skills among students.
3. To provide an opportunity to students for the latest update, short training minor-project, etc.

This is an activity & participation-based course:

Note:

1. Students have to participate in some of the activities Seminar, Poster Presentation, Group Discussion, training program, a minor project as decided by the course coordinator.
2. The course coordinator will arrange the activities for ME, IA, ESE.
3. A summary of the academic content of the activity will have to be submitted by students to the course coordinator for mid-term & internal evaluation.
4. There may be participation by students in three different (or some similar) activities relating to mid-exam, internal assessment, and End Sem. evaluation.
5. There will be individual (or paired) participation of students in activities. In some cases group may be considered.

Learning Outcomes: After completion of this course, the student will improve the skill of communication and presentation through discussion, training, etc.

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MCA (Semester – III)

Course Code	Course Title	L	T	P	C	Sessional		ESE	Total
						ME	IA		
CSA-OE-3201	**Computer Education – II**	**02**	**-**	**-**	**02**	**20**	**20**	**60**	**100**

Objectives :

1. To provide general awareness knowledge about the fundamentals of computers.
2. To provide a basic idea of computer programming and database.

Unit	Topic	Proposed Lectures
I	Introduction of Computer Networks: Characteristics of a Computer Network, Benefits of Networks, Types of Computer Networks, Network Cables, Network Topologies.	**6**
II	Operating System: Introduction, Functions of Operating System, Type of OS, basic scheduling FIFO, Round Robin.	**6**
III	Programming Language: Introduction of C, data types, operators, statements Input & Output statements, control statements, simple programming using C.	**6**
IV	Cyber Crime: Types of Cyber Crime, Hackers, Intrusion, Virus, **Denial of Service (DOS Attack), Network Security, crime detection and control.**	**6**
V	DBMS: Introduction keys and creation tables, File System, Database security, Database architecture and updation, Basic SQL Query, DDL, DML, DCL.	**6**

Essential Reading:

1. Computer Fundamentals, Fourth Edition by P.K. Sinha and Priti Sinha
2. Digital Principle and Applications, Six Editions by Donald P Leach, Albert Paul Malvino, and Goutam Saha.
3. Fundamentals of Computers, Fourth Edition by V. Raja Raman.
4. Database System Concept, Fifth Edition, by Abraham Silberschatz and S. Sudarshan, Mc Graw Hill.

Suggested Reading and links :

1. Computer Fundamentals Architecture and Organization, Third Edition by B. Ram.
2. Fundamentals of Database Systems, Fifth Edition by Ramez Elmasri and Shamkant B. Navathe.

Learning Outcomes: After completion of this course, students will be able to know the basic part of computer networking, operating system, Database management, and cybercrime.

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MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4201	**Data Mining and Knowledge Discovery**	**4**	**3**	**1**	**-**	**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 Contents:

Unit	Topic	Proposed Lectures
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.	12
II	**Data preparation:** 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.	12
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.	12
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.	12
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.	12

Suggested Reading:

1. "Data Mining: Concepts and Techniques" by J. Han, M. Kamber: Morgan Kaufmann.
2. "Principles of Data Mining" by D. J. Hand, H. Mannila and P. Smyth MIT Press.
3. "Mastering Data Mining" by M. Berry and G. Linoff, John Wiley & Sons.
4. "Data Warehousing & Data Mining & OLAP" by Berson, TMH.

Course Outcome: Course students will be able to:

- Apply data mining techniques in real life.
- Implement various data mining techniques.

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MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
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CSA-EC-4202	**Cloud Computing**	**4**	**3**	**1**	**-**	**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 Contents:

Unit	Topic	Proposed Lectures
I	**Systems modeling, Clustering, and Virtualization:** Scalable Computing over the Internet, Technologies for Network-based systems, System models for Distributed and Cloud Computing, Software environments for distributed systems and clouds, Performance, Security, and Energy Efficiency.	12
II	**Virtual Machines and Virtualization of Clusters and Data Centers:** Implementation Levels of Virtualization, Virtualization Structures/ Tools and mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data Centre Automation.	12
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.	12
IV	**Cloud Programming and Software Environments:** Features of Cloud and Grid Platforms, Parallel & Distributed Programming Paradigms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging 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, Apache Hadoop, BigTable, Megastore, Amazon Simple Storage Service(S3).	12
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, Feedback Control Based on Dynamic Thresholds. 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, Scheduling MapReduce Applications Subject to Deadlines.	12

Suggested Reading:

1. "Distributed and Cloud Computing" by Kai Hwang, Geoffry C. Fox, Jack J. Dongarra, MK Elsevier.
2. "Cloud Computing, Theory and Practice" by Dan C Marinescu, MK Elsevier.
3. "Cloud Computing, A Hands-on approach" byArshadeepBahga, Vijay Madisetti, University Press
4. "Cloud Computing: A Practical Approach" by Anthony T.Velte. Toby J.VeFte, Robert Elsenpeter, Tata McGraw Hill.
5. "Enterprise Cloud Computing" by Gautam Shroff, Cambridge University.
6. "Cloud Computing: Implementation, Management and Security" by, John W. Rittinouse, James FRansome,CRC Press.
7. "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" by Tim Mather,SubraKtriaraswamy, Shahid Latif.

Course Outcome: Course students will be able to:

- Compare the strengths and limitations of cloud computing.
- Examine the economics, financial, and technological implications for selecting cloud computing for own organization
- Identify the architecture, infrastructure, and delivery models of cloud computing.
- Understand the role of SOA Technologies and the Workflow framework.
- Apply a suitable virtualization concept.
- Choose the appropriate Cloud application, Programming Model, and approach based on security and threats.

Note: The students shall register in any of the Clouds like AWS/Azure, etc, and learn about cloudservices.

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

Chairman, BOS
Computer Science & Applications

Department of Computer Science and Applications, Dr. Harisingh Gour Vishwavidyalaya, Sagar (M.P.)

MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4203	**Multimedia and Animation**	**4**	**3**	**-**	**1**	**20**	**20**	**60**	**100**

Course Objective:

1. Identify a range of concepts, techniques, and tools for creating and editing interactive multimedia applications.
2. Identify the current and future issues related to multimedia technology.
3. Identify both theoretical and practical aspects in designing multimedia systems surrounding the emergence of multimedia technologies using contemporary hardware and software technologies.
4. To acquire knowledge to develop animations.

Course Contents:

Unit	Topic	Proposed Lectures
I	**Introductory Concepts:** Multimedia – Definitions, CD-ROM Technology and the Multimedia Highway, Applications of Multimedia, Introduction to Multimedia Projects – The Stages of Project, Requirements to make Good Multimedia, Multimedia Skills, and Training, Introduction to Virtual Reality, Challenges in Multimedia Technologies.**Multimedia-Hardware and Software:** Multimedia Hardware – Macintosh and Windows Production Platforms, Memory and Storage Devices.**Exposure of Multimedia Software and Tools:** Basic Tools, Making Instant Multimedia, Authoring Tools, Modelling, Rendering, Texture Shading, Different File Formats.**Multimedia Building Blocks:** Text, Sound, Images, Animation, and Video, Image Color Schemes, Digitization of Audio and Video objects.Assembling and Delivering a Project: Planning and Costing, Designing and Producing, Content and Talent, Delivering.	12
II	**Compression Fundamentals:** Need for Compression, Lossless and Lossy Compression, Taxonomy of Compression Algorithms, Basics of Information Theory.**Text Compression:** Huffman Coding, Dynamic Huffman Coding, Arithmetic Technique.**Entropy Encoding:** Run-Length Coding, Lempel-Ziv-Welch (LZW) Algorithm.**Source Coding:** Transform Coding- JPEG, MPEG, Audio Compression-MP3, Statistical Coding-Pattern Substitution.	12
III	**Animation:** Introduction, Basic Animation Techniques, Motion Graphics-2D & 3D Animation - Cell Animation, Computer Animation, Tweening& Morphing, Dynamics, Kinematics, Reverse Kinematics.**Video and Animation:** Video Basics, How Video works, Analog Video, Digital Video, Video Recording, and Tape Formats, Shooting and Editing Videos.	12
IV	**Photoshop:**Introduction to Photoshop; Digital Image Editingusing Photoshop. **Computer Animation:** Creating Your First Flash Animation – how to create a new blank movie file in Flash MX– and the tools and steps involved in making your first simple animation using motion twining – basic shapes –Flash Animation 2 - Shape Twining – pick up at the end of where we left off – Shape twining in Flash MX.**CharacterModeling & Animation:** Polygonal Modeling – Using primitives - Converting 5-,6-,7-,8-,9-,-SidedPolys to Quads – Creating Linear Templates – Working With Poly Editing Tools: Making Simple Hand – Sub divProxy Modeling – Splitting Polygons – Creating Areas of Details on a Poly Mesh(Surface); Character Animation –Skeletons – Clusters and Lattices Forward and Inverse Kinematics – Using the IKRP Solver, IKSC Solver, IKSpine handle Solver, IK Spring Solver, Human IK Solver – Switching between FK and IK – The AnimationProcess: Posing, Timing, and Refining.	12
V	**Multimedia Communication and Applications:** Multimedia Information Representation, Multimedia Networks, Integrated Services, RSVP- Differentiated Services, Multimedia on 4G/5G Networks, Standards for Multimedia Communications – Interpersonal Communication, Multimedia Conferencing, Interactive Application over the Internet, Entertainment Applications and Interactive Television.**Multimedia and Internet:** IP Datagram, Fragmentation, and Reassembly, QoS Support, IPv4/IPv6 Interoperability, Designing for WWW- Audio, Video.**Digital Communication:** Transmission Mode, Asynchronous, Synchronous, and Isochronous Transmission Modes.**Streaming:** Stored Audio and Video, Best-Effort Service, Protocols for Real-Time Interactive Applications, Scheduling and Policing Mechanism.	12

Suggested Reading:

1. John Vince, "Virtual Reality Systems", Pearson Education.
2. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols andStandards", Pearson.
3. Tay Vaughan, "Multimedia-Making it Works", McGraw-Hill.
4. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, "Fundamentals of Multimedia", Springer.
5. Ralf Steinmetz and Klara Nahrstedt, "Multimedia: Computing, Communications &Applications", Pearson.
6. K. Andleigh and K. Thakkar, "Multimedia System Design", PHI.
7. Keyes, "Multimedia Handbook", TMH.
8. Khalid Sayood, "Introduction to Data Compression", Elsevier.

Course Outcome: Course students will be able to:

- Explain the technical aspects of multimedia systems and animation.
- Apply various file formats of audio, video, and text media in different applications.
- Analyze the QoS parameters of various multimedia applications through the internet.
- Evaluate different types of multimedia compression methods.
- Design interactive multimedia software applications using animations.
- Develop real-time multimedia and animation applications using different multimedia components.

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MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4204	Cyber Security	4	3	1	-	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 Contents:

Unit	Topic	Proposed Lectures
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.	12
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.	12
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.	12
IV	**Cyber Security:** 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.	12
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.	12

Suggested Reading:

1. "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives" by Nina Godbole and Sunit Belpure, Wiley.
2. "Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives" by B. B. Gupta, D. P. Agrawal, Haoxiang Wang, CRC Press.
3. "Cyber Security Essentials" by James Graham, Richard Howard, and Ryan Olson, CRC Press.
4. "Introduction to Cyber Security" by Chwan-Hwa (John) Wu,J. David Irwin, CRC Press.

Course Outcome: Course students will be able to:

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

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

Approved by BOS Meeting on dated 07/12/2023

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Computer Science & Applications

MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4205	**R Programming**	**4**	**3**	**-**	**1**	**20**	**20**	**60**	**100**

Course Objective:

1. To acquire knowledge in R programming.
2. To develop R programs with conditionals and loops and data structures.
3. Understand storage, retrieval, and presentation of data
4. To learn how to design and program Python applications.

Course Contents:

Unit	Topic	Proposed Lectures
I	**Introduction**: Introduction to R, How to run R, R Sessions, and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.	12
II	**R Programming Structures**: Control Statements, Loops, - Looping Over Nonvector Sets, If-Else, Arithmetic, and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation Extended Example: A Binary Search Tree.	12
III	**Math and Simulation in R**: Math Function, Extended Example Calculating Probability-Cumulative Sums and Products-Minima and Maxima- Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product- Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /output, Accessing the Keyboard and Monitor, Reading and writer Files.	12
IV	**Graphics**: Creating Graphs, The Workhorse of R Base Graphics, the plot () Function – Customizing Graphs, Saving Graphs to Files.	12
V	**Statistics in R:** Probability Distributions, Normal Distribution- Binomial Distribution-Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests, ANOVA. Linear Models, Simple Linear Regression, -Multiple Regression Generalized. Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models-Survival Analysis, Nonlinear Models, Spines- Decision- Random Forests.	12

Suggested Reading:

1. "R Programming for Beginners" by Sandip Rakshit.
2. "Programming Skills for Data Science: Start Writing Code to Wrangle, Analyze, and Visualize Data with R" by Michael Freeman and Joel Ross.
3. "Hands-On Programming with R: Write Your Own Functions and Simulations" by Garrett Grolemund.
4. "Data Analytics Using R" by Seema Acharya. "Schaum's Outlines- Programming in C", by Gottfried B., McGraw-Hill Publications.

Course Outcome: Course students will be able to:

- construct and execute basic programs in R using elementary programming techniques
- write programs in R-language and can use different packages available in R.
- performthedifferent non-parametric tests on different types of data. To impart the concepts of programming.
- use external R-packages in statistics and graphics.

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Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4206	**Big Data and Analytics**	**4**	**3**	**1**	**-**	**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 Contents:

Unit	Topic	Proposed Lectures
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.	12
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.	12
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, The General Algorithm, Decision Tree Algorithms, Evaluating a Decision Tree, Decision Trees in R, Naïve Bayes, Baye'sTheorem, Naïve Bayes Classifier.	12
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.	12
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.	12

Suggested Reading:

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools,Techniques, NoSQL, and Graph", Morgan Kaufmann.
3. MichaelBerthold,DavidJ.Hand,"IntelligentDataAnalysis",Springer,2007.
4. TomWhite"Hadoop:TheDefinitiveGuide"ThirdEdition,O'ReillyMedia.
5. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding BigData: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw-Hill Publishing.
6. BillFranks,"TamingtheBigDataTidalWave:FindingOpportunitiesinHugeData Streams withAdvanced Analytics", John Wiley& sons.
7. GlennJ.Myatt,"MakingSenseofData",JohnWiley&Sons.
8. Pete Warden, "Big Data Glossary", O'Reilly,2011.
9. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Elsevier.

Course Outcome: Course students will be able to:

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

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

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MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4207	**Mobile Applications Design and Development**	**4**	**3**	**-**	**1**	**20**	**20**	**60**	**100**

Course Objective:

1. To demonstrate the introduction and characteristics of mobile applications
2. Application models of mobile application frameworks. Managing application data and User-interface design for mobile applications
3. Integrating networking, the OS, and hardware into mobile-applications
4. Addressing enterprise requirements in mobile applications – performance, scalability, modifiability, availability, and security
5. Testing methodologies for mobile applications– Publishing, deployment, maintenance, and management. To demonstrate their skills in using Android software development tools

Course Contents:

Unit	Topic	Proposed Lectures
I	**Introduction to mobile devices:** Introduction to Mobile Computing, Introduction to Android Development Environment, Mobile devices vs. desktop devices, ARM and Intel architectures, Screen resolution, Touch interfaces, Application deployment, App Store, Google Play, Windows Store.**Development environments:**XCode, Eclipse, VS2012, PhoneGap, etc.; Native vs. web applications. Factors in Developing Mobile Applications: Mobile Software Engineering, Frameworks, and Tools, Generic UI Development, Android User.	12
II	**Android User Interface:** Measurements – Device and pixel density independent measuring units User Interface (UI) Components – Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities.	12
III	Back Ground Running Process, Networking and Telephony Services: Services: Introduction to services – local service, remote service and binding the service, the communication between service and activity, Intent Service.**MultiThreading:** Handlers, AsyncTask. **Broadcast receivers:** Local Broadcast Manager, Dynamic broadcast receiver, System Broadcast. Pending Intent, Notifications.	12
IV	**Android:** Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server-side applications – Using Google Maps, GPS and Wifi – Integration with social media applications. Android network programming: Http Url Connection, Connecting to REST-based and SOAP-based Web services.	12
V	**Advanced Topics:** Power Management: Wake locks and assertions, Low-level OS support, Writing power-smart applications. **Augmented Reality via GPS and other sensors:** GPS, Accelerometer, Camera. **Mobile device security in-depth:** Mobile malware, Device protections, iOS "Jailbreaking", Android "rooting" and Windows' "defenestration"; Security and Hacking: Active Transactions, More on Security, Hacking Android.	12

Suggested Reading:

1. "Android Programming: The Big Nerd Ranch Guide" by Bill Phillips, Chris Stewart, Brian Hardy, and Kristin Marsicano.
2. "Mobile Applications: Architecture, Design, and Development" by Valentino Lee, Heather Schneider, and Robbie Schell, Prentice-Hall.
3. "Professional Android 4 Application Development" by Reto Meier, Wiley.
4. "Android Application Development for Java Programmers" by James C Sheusi, Cengage Learning.
5. "Head First: Android Development" by Dawn Griffiths, David Griffiths, OReilly.
6. "Professional Mobile Application Development" by Jeff McWherter and Scott Gowell.
7. "Beginning Android 4 Application Development" by Wei-Meng Lee, Wiley.
8. "Sketching and Prototyping iPhone Apps" Addison-Wesley Professional, 2010.

Course Outcome: Course students will be able to:

- Install and configure Android application development tools
- Design and develop user interfaces for the Android platform
- Save state information across important operating system events
- Apply Java programming concepts to Android application development

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

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MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4208	**Parallel and Distributed Systems**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

1. To introduce concepts related to parallel and distributed computing systems.
2. To focus on performance and flexibility issues related to systems design decisions
3. To expose students to current literature in distributed systems.
4. To prepare students for a real-world distributed application design.

Course Contents:

Unit	Topic	Proposed Lectures
I	**Basic Concepts:** Introduction to parallel processing, parallel processing terminology, decomposition, complexity, throughout, speedup, measures, data dependence, resource dependence, Bernstein's conditions levels of parallelism in programs. Program flow-control flow, data flow, Distributed systems – Introduction, advantages, and tightly-coupled loosely-coupled systems. Hardware and software requirements, design issues.	12
II	**Parallel Processing**: Structure & Organization: Taxonomy of parallel processes: granularity, basic architectures, multiprocessors, vector processors, pipeline:-both linear as well as nonlinear pipeline,optimal design, Arithmetic pipeline, Instruction pipeline, Pipeline hazards and their solution, reservation table, scheduling.	12
III	**Distributed Computing**: introduction, definition, its history;Distributed Computing system definition and its evolution, reasonsfor its popularity, Strength and weaknesses of distributed computing,Different forms of Computing: Minicomputer model, workstationmodel, workstation server model, Processor pool Model; Cluster:-definitions, reasons for its popularity cluster computer systemarchitecture, Windows cluster, Solaris cluster, Linux cluster; Usingcluster, distributed Computing System models: Distributed operatingsystem, Introduction to DCE, the architecture of Distributed Applications.	12
IV	**Clock:** Types of Clock, Synchronization of clocks, types of Clocksynchronization algorithms, Lamport timestamps, Message passing:- introduction, desirable features of a good message passing system,Issues in IPC by Message passing, synchronization, Buffering, Multidatagram messages, Encoding and decoding of message data, Processaddressing, Failure handling, IPC, Distributed Election, types ofelection algorithms.	12
V	**Parallel & Distributed Programming:** Parallel Programmingenvironments, models, synchronous asynchronous programming,Modula-2, Occam, FORTRAN, DAP FORTRAN, C-Linda, Actus,data flow programming, VAL,etc, MPI, Open MP.	12

Suggested Reading:

1. Michael J. Quinn, "Parallel Computing – Theory and Practice", McGraw Hill.
2. Kai Hwang, "Advanced Computer Architecture – Parallelism, Scalability, Programmability", McGraw Hill.
3. Wilkinson, "Parallel Programming using networked computer", Pearson Education.
4. S. G. Akl, "The Design and Analysis of parallel algorithms", Englewood Cliffs, NJ.
5. S. Tanenbaum, "Modern Operating System", PHI, 1996.
6. R. H. Perrott, "Parallel Programming", Addison Wesley, 1987.
7. T. G. Lewie and H. Ele-Revini, "Introduction to ParallelComputing", PHI.
8. S. Lakshmivardhan and S.K. Dhall, "Analysis and design ofparallel algorithm – arithmetic and matrix problems", McGrawHill.
9. J. M. Crichlow, "An introduction to distributed and parallelcomputing", PHI.

Course Outcome: Course students will be able to:

- Study software components of distributed and parallel computing systems.
- Know about the communication and interconnection architecture of multiple computer systems.
- Recognize the inherent difficulties that arise due to the distributedness of computing resources.
- understand basic problems in distributed computing, especially concerning concurrency, parallelism, synchronization, deadlocks, safety, and liveness properties

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

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Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4209	Blockchain Technology	4	3	1	-	20	20	60	100

Course Objective:

1. Impart a strong technical understanding of Blockchain technologies
2. Develop familiarity with current technologies, tools, and implementation strategies
3. Introduce application areas, current practices, and research activity.

Course Contents:

Unit	Topic	Proposed Lectures
I	The consensus problem, Asynchronous Byzantine Agreement, AAP protocol and its analysis, Nakamoto Consensus on the permission-less, nameless, peer-to-peer network, Abstract Models for BLOCKCHAIN,GARAY model, RLA Model, Proof of Work (PoW) as a random oracle, formal treatment of consistency, liveness, and fairness - Proof of Stake (PoS) based Chains, Hybrid models (PoW + PoS).	12
II	Cryptographic basics for cryptocurrency, A short overview of Hashing, signature schemes, encryption schemes, and elliptic curve cryptography	12
III	Bitcoin, Wallet, Blocks, Merkley Tree, hardness of mining, transaction verifiability, anonymity, forks, double spending, mathematical analysis of properties of Bitcoin.	12
IV	**Ethereum:** Ethereum Virtual Machine (EVM),Wallets for Ethereum, Solidity, Smart Contracts, someattacks on smart contracts	12
V	**Trends and Topics:** Zero-Knowledge proofs and protocols in Blockchain, Succinct non-interactive argument for Knowledge (SNARK), pairing on Elliptic curves, Zcash.	12

Suggested Reading:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder "Bitcoin and cryptocurrency technologies: a comprehensive introduction", Princeton University Press.
2. Joseph Bonneau et al, SoK: "Research perspectives and challenges for Bitcoin and cryptocurrency", IEEE Symposium on Security and Privacy.
3. J.A.Garay et al, "The bitcoin backbone protocol - analysis and applications" EUROCRYPT.
4. R.Pass et al, "Analysis of Blockchain protocol in Asynchronous network".

Course Outcome: Course students will be able to:

- Demonstrate the foundation of Blockchain technology and understand the processes inpayment and funding.
- Identify the risks involved in building Blockchain applications.
- Review of legal implications using smart contracts.
- Choose the present landscape of Blockchain implementations and Understand Cryptocurrencymarkets.
- Examine how to profit from trading cryptocurrencies.

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

Chairman, BOS
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MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4210	**Microsoft .Net Technologies**	**4**	**3**	**-**	**1**	**20**	**20**	**60**	**100**

Course Objective:

1. Understand the Visual Programming environment
2. To design and develop both Windows and Web-based applications.
3. To learn the .Net Framework and create ASP.Net web applications using standard .net controls.
4. Develop database applications using ADO.Net Connect to data sources and manage them.
5. Develop a data-driven web application.
6. Use Web Services and develop simple and complex applications using the .Net framework.

Course Contents:

Unit	Topic	Proposed Lectures
I	**The .Net framework:** Desktop Computing vs. Internet Computing, The Origin of .Net Technology, Features of .NET, Internet computing infrastructure, Client-side scripting vs. Server Side Scripting technologies, Web Server basics and configuration: IIS, Apache, etc., Web site hosting basics, Web Publishing, HTML, Common Language Runtime (CLR), Common Type System (CTS), Common Language Specification (CLS).	12
II	**.NET technologies languages**: C#.NET,VB.NET, basics of ASP.NET page framework, Visual studio .NET IDE, Page Life Cycle, PostBack, Viewstate, Page directives, ASP.Net page execution cycle, HTTP Pipeline, HTTP Application, HTTP Request, HTTP Response classes, HTTP Modules and HTTP Handlers, State Management, Role of Global.asax, Application configuration using web.config file.	12
III	ASP.NET Control hierarchy, HTML Server Controls, Web Server Controls, User and Server Controls, Validation Controls, List bound controls: dropdown lists, list boxes, Repeater, DataList, Data Grid, DataGridView, FormsView controls, Data binding to List Bound Controls, Templating and Styling of ASP.NET server controls Web Page Designing principles, CSS anatomy, Anatomy of Master Pages, nesting master pages, Site map file, Web site Navigation controls, properties: TreeView, Sitemap Path, Menu, Other Navigation methods: Response.Redirect(), Server.Transfer().	12
IV	Personalization through Profiles, Themes/Skins, Web Site security basics: authentication modes: Windows, Forms, passport, authorization, roles/Membership, access rules, login controls, Web services: working, anatomy, hosting.Database technology: ADO.NET, Anatomy/architecture of ADO.NET, working with Connection, Command, Data Adaptor, DataReader, DataSet, DataTable objects, Editing data in Data Tables, concurrency control. Introduction to MVC, Data Reports	12
V	**C-Sharp Language (C#):** Introduction, Data Types, Identifiers, Variables, Constants, Literals, Array and Strings, Object and Classes, Inheritance and Polymorphism, Operator Overloading, Interfaces, Delegates and Events. C# Using Libraries: Namespace-System, Input-Output, Multi-Threading, Networking and sockets, Managing Console I/O Operations, Windows Forms, Error Handling.	12

Suggested Reading:

1. "Professional Visual Basic 2010 and.NET4" by Bill Sheldon, Kent Sharkey, Jonathan Merbutt, Rob Windsor, Gatson C Hiller, Wiley publishing.
2. "Visual Basic .NET Programming Black Book" by Steven Holzner,
3. "VB.NET Programming Developer's Guide" by Cameron Wakefield, Henk-Evert Sonder, Wei Meng Lee.
4. "Beginning ASP.NET 4: in C# and VB", by Imar Spaanjaars, Wiley Publishing.
5. "Professional ASP .NET 3.5 in C# and VB" by Bill Evjen, Scott Hanselman, Devin Rader, Wiley Publishing.

Course Outcome: Course students will be able to:

- Design Web applications / Websites using ASP.NET.
- Use ASP.NET controls in web applications
- Debug and deploy ASP.NET web applications.
- Create database-driven ASP.NET web applications and web services.

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

Chairman, BOS
Computer Science & Applications

MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4211	**Internet of Things**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

1. Understand the IoT Terminology, Technology, architecture, and its implementation procedure.
2. Learn the Network and Communication protocols for IoT.
3. Identify the role of controllers and sensors in IoT.
4. Apply the Programming Concepts for IoT.

Course Contents:

Unit	Topic	Proposed Lectures
I	**Getting Familiar with the Internet of Things (IoT):** Definition, Characteristics, History, and Evolution of IoT. **Physical Design of IoT:** Things in IoT, IoT Protocols. **Logical Design of IoT:** Functional block, Communication Models and APIs, IoT Stack. **Enabling Technologies:** Sensors, Cloud Computing, Big Data analytics, Embedded Computing Boards, Communication Protocols, IoT Challenges, IoT Levels, Overview of Domain-Specific IoTs applications Like Smart Cities, Smart Agriculture, and Industrial IoT Applications. **The IoT Paradigm:** Comparison with User interface related Technologies like SCADA, M2M, SDN. IoT Design Methodology: IoT Components.	12
II	Internet Vs Internet of Things: IoT Layers, IoT Messaging Protocols: MQTT, CoAP. IoT Transport Protocols: BLE, LiFi, Network Protocol: 6LoWPAN. **Physical Design of IoT:** Functional Block, Cloud Storage Models, Communication Models, and Communication APIs: REST-based, Web Socket Based, Cloud for IoT: Challenges, Fog Computing.	12
III	**Business Models**: Business models for Business Processes in the Internet of Things,IoT/M2M systems LAYERS AND designs standardizations,Modified OSI Stack for the IoT/M2M Systems,ETSI M2M domains and High-level capabilities, Communication Technologies, Data Enrichment, and Consolidation and Device Management Gateway Ease of designing and affordability.	12
IV	**Physical Devices and Endpoints:** Arduino Pin diagram, Arduino Architecture, Arduino Programming, Raspberry Pi Pin diagram, Raspberry Pi Architecture. **Sensors and Interfacing:** Types of Sensors. Integrating Sensors: HDT (Humidity and Temperature Sensor), Gas Detector, HC-05 (Bluetooth Module), Ultrasonic Sensor, ESP8266 (Wi-Fi Module).	12
V	**Logical Design of IoT:** Revisiting Python Programming for IoT (Data types, Operators,Control Structures, List, Tuples, Dictionaries, Functions, Modules, and File Handling).Python Packages for connecting IoT Devices: Bluetooth, Sockets, Time, Requests, Sys,Adafruit Python DHT, paho-mqtt, Python JSON, Python pip.	12

Suggested Reading:

1. S. K. Vasudevan, A. S. Nagarajan, RMD Sundaram, "Internet of Things", Wiley.
2. G. C. Hillar, "Internet of Things with Python", PACKT Publications.
3. V. Madisetti, A. Bahga, "Internet of Things: A Hands-on Approach".
4. J. C. Shovic, "Raspberry Pi IoT Projects: Prototyping Experiments for Makers", Apress.
5. M. Schwartz, "Internet of things with the Arduino Yun", Packt Publishing.
6. O. Hersent, D. Boswarthick, O. Elloumi, "The Internet of Things: Key Applications and Protocols", John Wiley & Sons.
7. C. Dierbach, "Introduction to Computer Science Using Python: A Computational Problem-Solving Focus", Wiley Publishing.

Course Outcome: Course students will be able to:

- Explain the architecture of the Internet of Things
- Demonstrate the different enabling technologies for IoTs
- Apply Python Programming skills to develop IoT application
- Analyze the architecture of Arduino and Raspberry Pi.
- Create Small IoT Applications using Sensors

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

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Computer Science & Applications

MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4212	**Natural Language Processing**	**4**	**3**	**1**	**-**	**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 Contents:

Unit	Topic	Proposed Lectures
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.	12
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.	12
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.	12
IV	**Meaning:** Lexical knowledge networks, wordnet theory, Indian languages wordnet, multilingual dictionaries, semantic roles, word sense disambiguation, metaphors	12
V	**Deployment Model:**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.	12

Suggested Reading:

1. Jurafsky& Martin, "Speech and Language Processing", Pearson Publication.
2. Tanveer & Tiwari, "Natural Language Processing and Information Retrieval", Oxford Press.
3. Christopher Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", MIT Press.
4. Deepti Chopra, Jacob Perkins, and Nitin Hardeniya, "Natural Language Processing: Python and NLTK".
5. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from Your Data", Apress
6. Jacob Einstein, "Introduction to Natural Language Processing", MIT Press.
7. Nitin Indurkhya and Fred Damerau, "Hand Book of Natural Language Processing", CRC Press.

Course Outcome: Course students will be able to:

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

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Computer Science & Applications

MCA (Semester – IV)

Course Code	Course Title	Credit	L	T	P	Sessional ME	Sessional IA	ESE	Total
CSA-EC-4213	**Information Retrieval & Web Mining**	4	3	1	-	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 Contents:

Unit	Topic	Proposed Lectures
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.	12
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.	12
III	**Term and query operation:** Tokenization, stop lists, stemming, different types of stemmers; thesaurus construction; query modification	12
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.	12
V	**Further topics:** Web information indexing; Web Information categorization and ranking; Web IR evaluation; Data fusion, Text mining; Semantic Web; Intelligent agents in IR.	12

Suggested Reading:

1. "Modern Information Retrieval", Ricardo–Baeza Yates, B. Ribeiro-Neto, Addison Wesley.
2. "Information Retrieval", C. J. van Rijsbergen.
3. "Introduction to modern information retrieval", G. Salton, and M. J. McGill, McGraw-Hill
4. "Information Retrieval: Data Structures and algorithms", W. Frakes and R. Baeza-Yates (Eds.). Prentice-Hall.
5. "Speech and language processing: an introduction to natural language processing, computational linguistics, and speech recognition", D. Jufrasky, and J. H. Martin, Pearson.
6. "Introduction to Information Retrieval" C. Manning, P. Raghavan, and H. Schütze.

Course Outcome: Course students will be able to:

- To Understand Document as Vector
- Performance evolution metric for IR
- To understand Search Engine functionality

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Computer Science & Applications

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4214	**Digital Image Processing & Computer Vision**	**4**	**3**	**1**	**-**	**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.ions and loops and data structures.

Course Contents:

Unit	Topic	Proposed Lectures
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, Principal Component Analysis (PCA), Wavelet transform (Definition, Properties, Mathematical function, Mother wavelets).	12
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, Weiner Filter, Tikhonov Regularization, LMMSE filters, constrained least-squares filters, Other related optimization problems.	12
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)	12
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 **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, Texture, Moments, Principal components	12
V	**Object recognition:** Patterns & pattern classification, Recognition based on decision-theoretic methods, Structural methods **A framework of a computer vision**	12

Suggested Reading:

1. "Fundamental of image processing by" R.C. Gonzalez
2. "Digital image processing" by A.K. Jain
3. "Image Processing and Analysis" by Milan Sonka

Course Outcome: Course students will be able to:

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

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MCA (Semester – IV)

Course Code	Course Title	Credit				Sessional		ESE	Total
			L	T	P	ME	IA		
CSA-EC-4215	**Embedded System Design**	**4**	**3**	**1**	**-**	**20**	**20**	**60**	**100**

Course Objective:

1. To impart the concepts and architecture of embedded systems and to make the students capable of designing embedded systems.
2. The course examines contemporary issues and problems in the design, development, and test of contemporary real-time embedded systems while emphasizing solid design practices to ensure safety and reliability.

Course Contents:

Unit	Topic	Proposed Lectures
I	**Introduction:** Embedded Systems and general-purpose computer systems, history, classifications, applications, and purpose of embedded systems. **Core of Embedded Systems:** Microprocessors and microcontrollers, RISC and CISC controllers, Big-endian and Little-endian processors, Application-specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, other system components, PCB and passive components.	12
II	**Characteristics and quality attributes of embedded systems:** Characteristics, Operational and nonoperational quality attributes, application-specific embedded system - washing machine, domain-specific - automotive. **Embedded hardware:** Memory map, i/o map, interrupt map, processor family, external peripherals, memory - RAM, ROM, types of RAM and ROM, memory testing, CRC, Flash memory.	12
III	**Programming Embedded Systems:** Structure of embedded program, infinite loop, compiling, linking and locating, downloading, and debugging.	12
IV	**Peripherals:** Control and Status Registers, Device Driver, Timer Driver-Watchdog Timers, Embedded Operating System, Real-Time Characteristics, Selection Process.	12
V	**Design and Development:** Embedded System development environment - IDE, Types of files generated on a cross-compilation, disassembler/decompiler, simulator, emulator and debugging, embedded product development life-cycle, trends in the embedded industry.	12

Suggested Reading:

1. "Programming Embedded Systems in C and C++", Michael Barr, O' Reilly
2. "Introduction to embedded systems", Shibu K V Tata McGraw-Hill.
3. "Embedded Systems", Rajkamal, TataMcGraw-Hill.
4. "Embedded Systems Architecture Programming and Design" by Raj Kamal, Tata MC Graw-Hill.
5. "Designing Embedded Systems with PIC Microcontrollers: principles and applications" by Tim Wilmshurst, Elsevier.
6. "Embedded Systems Design" by Steve Heath, Newnes publications
7. "An embedded software primer" by David E. Simon, Pearson Education.
8. "Microcontrollers Architecture Programming Interfacing And System Design" by Raj Kamal, Pearson Education.

Course Outcome: Course students will be able to:

- Understand the concepts of Embedded Systems
- Understand interfacing of IO devices and other peripherals.
- Device driver programming & interrupt service mechanisms
- Understand Inter-process Communication and Synchronization of processes, Threads and Tasks.
- Learn OS functions and Real-Time Operating System

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MCA (Semester – IV)

Course Code	Course Title	Credit	L	T	P	Sessional		ESE	Total
						ME	IA		
CSA-CC-4201	**Dissertation**	**10**	**-**	**-**	**-**	**20**	**20**	**60**	**100**

Objective: TheDissertation work provides an opportunity to the students to demonstrate independence and originality in thought and application. The objective of the dissertation work is to consolidate the concepts and practices that were learned during the course and to serve as a record of competence. It should enable a student to apply concretely in a small package the concepts gained from Software Engineering. Students will select topics from the field of computer application and based on a thorough review of literature on that topic, they will identify the problems and decide on plans of research for the dissertation.

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 on mutual understanding between students and faculty.

If the dissertation is to be done in a reputed organization, a supervisor from that organization is worked as a principal supervisor and a faculty member from the department as Co-Supervisor.

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 a reputed organization/ITcompany.

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

Mid-I and Internal Assessment: The progress of the dissertation will be evaluated as Mid-I and internal assessment through seminar/presentation, write-up/synopsis/ progress report.

Final Examination: For the final external evaluation a brief summary of the project in the form of hard and soft copy report along with the developed codes, output, results, software, hardware (as applicable) etc. should be submitted to the university at least one week prior to the date of the examination for the benefit of the external examiner.

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

Chairman, BOS
Computer Science & Applications

Approved by BOS Meeting on dated 07/12/2023

Board of Studies Meeting held on 07th December, 2023

Approved MCA: 1st to 4th Semesters Syllabus for Academic Session 2023-24 and onwards

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

Prof. R. K. Shrivastava
(External Member)
Dr. Shakuntala Mishra National Rehabilitation University, Lucknow
(U.P.)

Dr. Kavita Rohit
(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)
Department of Computer Science and Applications,
Dr. Harisingh Gour V.V., Sagar (M.P.)

Prof. Ashish Verma
(HoD& Chairman, BoS)
Department of Computer Science and Applications,
Dr. Harisingh Gour V.V., Sagar (M.P.)

Chairman, BOS
Computer Science & Applications

School Board of Studies Meeting held on 13th December, 2023

Approved MCA: 1st to 4th Semesters Syllabus for Academic Session 2023-24 and onwards

13.12.23
Prof. A.K. Saxena,
(External Member)
Department of Mathematics, Maharaja Chhatrasal University, Chhatarpur, MP

online concerted
Prof. K.S. Varsney,
(External Member)
HoD Physics, D.S. College, Aligarh, UP

online concerted
Prof. Narendra Pandey,
(External Member)
Department of Physics, University of Lucknow, UP

DShukla 13/12/23
Prof. Diwakar Shukla
(Member)
Department of Mathematics & Statistics, Dr. Harisingh Gour V.V., Sagar

13/12/23
Prof. R.K. Gangele
(Member)
Department of Mathematics & Statistics, Dr. Harisingh Gour V.V., Sagar

13/12/23
Prof. Ranveer Kumar,
(Member)
Department of Physics, Dr. Harisingh Gour V.V., Sagar

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

13/12/2023
Prof. R.K. Rawat
(Member)
Department of Applied Geology, Dr. Harisingh Gour V.V., Sagar

13.12.23
Dr. Mahesh Kumar Yadav
(Member)
Department of Mathematics & Statistics, Dr. Harisingh Gour V.V., Sagar

on leave
Dr. Maheshwar Panda
(Member)
Department of Physics, Dr. Harisingh Gour V.V., Sagar

Mr. Kamal Kant Ahirwar
(Member)
Department of Comp. Sci. & Application, Dr. Harisingh Gour V.V., Sagar

13/12/23
Prof. Ashish Verma
(Dean, SMPS & Chairman, School Board)
Dr. Harisingh Gour V.V., Sagar (M.P.)

13/12/23

विभागाध्यक्ष / Head
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