KHWAJA MOINUDDIN CHISHTI LANGUAGE UNIVERSITY
UTTAR PRADESH, LUCKNOW

MCA Evaluation Scheme and Course Structure

Regulations 2021

As Per

National Education Policy 2020

(Effective from the Session: 2021-22)

Introduction

The Program's thrust is to provide the students a thorough and sound background in theoretical and skill-oriented courses relevant for productive careers in software industry, corporate sector, Govt. organizations and academia. The program emphasizesproviding skill-based environment for teaching and research in the core and emerging areas of software technology to solve mathematical, computing, communications/networking and commercial problems.

This Master's Degree Program has been designed with a semester approach in mind. The first-year courses are aimed at skills development in computers using various technologies while the second year is more focused on core courses providing conceptual frame work and the third year provides the specialization and the project work.

A two-year degree (six-semesters) in Computer Applications will get skills and information not only about Computer and Information Technology but also in communication, organization and management. One also gets to learn programming languages such as C, C++, Java, SQL, Php, Python, front-end and back-end design etc. Information about various computer applications and latest developments in IT and communication systems is also provided. The Master of Computer Application Programme has been designed to supply trained manpower it ever growing IT and IT Enabled industry.

1. Applicability

These regulations shall apply to the Master of Computer Application (MCA) programme from the session 2021-22.

2. Minimum Eligibility for Admission

Passed BCA/ Bachelor Degree in Computer Science Engineering or equivalent Degree.

OR

Passed B.Sc./ B.Com./ B.A. with Mathematics at 10+2 Level or at Graduation Level (with additional bridge Courses as per the norms of the concerned University).

Obtained at least 50% marks (45% marks in case of candidates belonging to reserved category) in the qualifying Examination.

3. Programme Objectives

The MCA Programme is designed to enhance employability by preparing students for careers in computer science and leadership in both the private and public sectors. Students acquire a comprehensive foundation in the fundamentals of computer applications, the environment in which they will function, the analytical tools for intelligent decision-making and problem solving. Specifically:

- Produce knowledgeable and skilled human resources which are employable in IT and ITES.
- Impart knowledge required for planning, designing and building complex Application Software Systems as well as provide support to automated systems or application.
- Produce entrepreneurs who can develop customized solutions for small to large Enterprises.

- To 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.
- To develop students to become globally competent.
- To inculcate Entrepreneurial skills among students

4. Programme Outcomes (POs)

Upon completion of the MCA Programme, the students will be able to:

- PO1. To produce knowledgeable and skilled human resources which are employable in IT industry.
- PO2. To impart knowledge required for planning, designing and building complex Application Software Systems as well as provide support to automated systems or applications.
- PO3. To produce entrepreneurs who can develop customized solutions for small to large enterprises.
- PO4. To develop competent and professionally motivated personnel, equipped with objective, critical thinking, right moral and ethical values that foster the scientific temper with a sense of social responsibility.
- PO5. To train students to become globally competent and employable.

5. Programme Specific Outcomes (PSOs)

After completing the program students will be capable of:

- PSO1. Understanding to apply knowledge of computing and technological advances appropriate to the programme.
- PSO2. Analysing, identifying and defining problems for logical modelling and its solutions.
- PSO3. Understanding a sense of professional, ethical, legal, security and social issues and responsibilities.
- PSO4. Analysing the local and global impact of business solutions on individuals, organizations, and society.

6. Course Structure

The course structure of the Master of ComputerApplication (MCA) programme shall be as under:

Semester-wise Course Structure / Titles of the Papers

(as **per** National Education Policy-2020)

Post Graduate Diploma in Computer Application (PGDCA) (One Year) / Master of Computer Application (Two Years)

Year	Semester	Subject	Course Code	Paper Title	Theory/ Practical	Credits	{Cumulative Minimum Credits} Required for Awards of PGDCA/Degree
1	I	Core Compulsory 1	MCACC 101	Fundamental of Computers & Emerging Technologies	Theory	4	{48 Credits} Post Graduate Diploma in Computer Application (PGDCA)
		Core Compulsory 2	MCACC 102	Problem Solving using C	Theory	4	
		Core Compulsory 3	MCACC 103	Computer Organization & Architecture	Theory	4	
		Core Compulsory 4	MCACC 104	Data Structures	Theory	4	
		Value Added Course (Credited)	MCAVC 105	Discrete Mathematics	Theory	4	
		Core Compulsory	MCACC 106	Lab: Problem Solving using C	Practical	2	
		Core Compulsory	MCACC 107	Lab: Data Structures	Practical	2	
						24	
1	II	Core Compulsory 5	MCACC 201	Object Oriented Programming using Java	Theory	4	
		Core Compulsory 6	MCACC 202	Operating System	Theory	4	
		Core Compulsory 7	MCACC 203	Database Management System	Theory	4	

		Core Compulsory 8	MCACC 204	Automata Theory and Formal Languages	Theory	4	
		Core Compulsory 9	MCACC 205	Computer Network	Theory	4	
		Value Added Course (Non Credited)	MCAVNC 206	Cyber Security	Theory	0	
		Core Compulsory	MCACC 207	Lab: OOP using Java	Practical	2	
		Core Compulsory	MCACC 208	Lab: DBMS	Practical	2	
						24	
2	III	Core Compulsory 10	MCACC 301	Python Programming	Theory	4	**{96 Credits} Master of Computer Application**
		Core Compulsory 11	MCACC 302	Software Engineering	Theory	4	
		Core Compulsory 12	MCAE-I	Elective-I (Select any one from the list)	Theory	4	
		Core Compulsory 13	MCAE-II	Elective-II (Select any one from the list)	Theory	4	
		Inter-departmental Course	MCAIER 303	E-Commerce	Theory	4	
		Core Course	MCACC 304	Lab: Python Programming	Practical	2	
		Core Course	MCACC 305	Lab-Minor Project	Practical	2	
						24	
2	IV	Core Compulsory 14	MCACC 401	Design and Analysis of Algorithms	Theory	4	
		Core Compulsory 15	MCAE-III	Elective-III (Select any one from the list)	Theory	4	
		Core Compulsory 16	MCAE-IV	Elective-IV (Select any one from the list)	Theory	4	
		Core Compulsory 17	MCAIRA 402	Office Automation (For other department students) MCA students may opt from other	Practical	4	

				departments offering Intra-departmental course			
		Master's Thesis	MCAPD 403	Dissertation (Project)	Theory	4	
		Viva-Voce	MCAPV 404	Project- Viva-Voce	Theory	4	
						24	
				GRAND TOTAL		**96**	

MCACC – Core Course
MCAVC – Value Added Course (Credited)
MCAVNC – Value Added Course (Non-Credited)
MCAE – Elective Course
MCAIER – Inter-Departmental Course
MCAIRA – Intra-Departmental Course
MOOC – Massive Open Online Course

- IA: Internal Assessment, ESE: End Semester Examination.
- Students are required to select one course from each set of electives (Elective-I to Elective-IV) offered by the department.
- ESE=70, IA=30, P=70 (30 Marks for Practical Problems, 30 Marks for Viva-Voce, 10 Marks for Lab Record)
- The weight age of Internal Assessment and External Assessment will be in the ratio of 30% and 70% of total marks in all theory, practical papers & projects.

Elective Papers

Semester-III

Elective-I

1. MCAE11- Cryptography & Network Security
2. MCAE12- Blockchain Fundamentals
3. MCAE13- Privacy & Security in Online Social Media
4. MCAE14- Mobile Computing
5. MOOC01 – MOOCs (any course of same credit)

Elective-II

1. MCAE21- Cloud Computing
2. MCAE22- Internet of Things (IoT)
3. MCAE23- Soft Computing
4. MCAE24- Software Testing and Quality Assurance

Semester-IV

Elective-III

1. MCAE31- Machine Learning
2. MCAE32- Neural Network
3. MCAE33- Artificial Intelligence
4. MCAE34- Pattern Recognition
5. MOOC02 – MOOCs (any course of same credit)

Elective-IV

1. MCAE41- Data Warehousing & Data Mining
2. MCAE42- Big Data Analytics
3. MCAE43- Advanced Database Management System
4. MCAE44- Compiler Design

Master of Computer Application (Two Year Course)
Study and Evaluation Scheme

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Khwaja Moinuddin Chishti Language University, Lucknow, Uttar Pradesh (India)
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Course	Course Code	Title of the Paper	Maximum Marks			Credits Allotted				Teaching Hours
Semester I										
			Internal	**ESE**	**Total**	**Lecture**	**Tutorial**	**Practical**	**Total Credits**	
Core Course	MCACC 101	Fundamental of Computers & Emerging Technologies	30	70	100	**3**	**1**	**0**	**4**	**04**
Core Course	MCACC 102	Problem Solving using C	30	70	100	**3**	**1**	**0**	**4**	**04**
Core Course	MCACC 103	Computer Organization & Architecture	30	70	100	**3**	**1**	**0**	**4**	**04**
Core Course	MCACC 104	Data Structures	30	70	100	**3**	**1**	**0**	**4**	**04**
Value Added Course (Credited)	MCAVC 105	Discrete Mathematics	30	70	100	**3**	**1**	**0**	**4**	**04**
Practical										
Core Course	MCACC 106	Lab: Problem Solving using C	30	70	100	**0**	**0**	**4**	**2**	**04**
Core Course	MCACC 107	Lab: Data Structures	30	70	100	**0**	**0**	**4**	**2**	**04**
Semester Total			**210**	**490**	**700**	**15**	**5**	**8**	**24**	**28 Hours**

Course	Subject Code	Title of the Paper	Maximum Marks			Credits Allotted				Teaching Hours
	Semester II									
			Internal	**ESE**	**Total**	**Lecture**	**Tutorial**	**Practical**	**Total Credits**	
Core Course	MCACC 201	Object Oriented Programming using Java	30	70	100	**3**	**1**	**0**	**4**	**04**
Core Course	MCACC 202	Operating System	30	70	100	**3**	**1**	**0**	**4**	**04**
Core Course	MCACC 203	Database Management System	30	70	100	**3**	**1**	**0**	**4**	**04**
Core Course	MCACC 204	Automata Theory and Formal Languages	30	70	100	**3**	**1**	**0**	**4**	**04**
Core Course	MCACC 205	Computer Network	30	70	100	**3**	**1**	**0**	**4**	**04**
Value Added Course (Non Credited)	MCAVNC 206	Cyber Security	30	70		**3**	**1**	**0**	**0**	**04**
Practical										
Core Course	MCACC 207	Lab: OOP using Java	30	70	100	**0**	**0**	**4**	**2**	**04**
Core Course	MCACC 208	Lab: DBMS	30	70	100	**0**	**0**	**4**	**2**	**04**
Semester Total			**240**	**490**	**700**	**18**	**6**	**8**	**24**	**32 Hours**

Course	Subject Code	Title of the Paper	Maximum Marks			Credits Allotted				Teaching Hours
	Semester III									
			Internal	**ESE**	**Total**	**Lecture**	**Tutorial**	**Practical**	**Total Credits**	
Core	MCACC 301	Python Programming	30	70	100	**3**	**1**	**0**	**4**	**04**

Master of Computer Application (Two Year Course)
Study and Evaluation Scheme

Course										
Core Course	MCACC 302	Software Engineering	30	70	100	**3**	**1**	**0**	**4**	**04**
Elective I/ MOOC	MCAE-I	Elective-I (Select any one from the list)	30	70	100	**3**	**1**	**0**	**4**	**04**
Elective II	MCAE-II	Elective-II (Select any one from the list)	30	70	100	**3**	**1**	**0**	**4**	**04**
Inter-departmental Course	MCAIER 303	E-Commerce	30	70	100	**3**	**1**	**0**	**4**	**04**
Practical										
Core Course	MCACC 304	Lab: Python Programming	30	70	100	**0**	**0**	**4**	**2**	**04**
Core Course	MCACC 305	Lab-Minor Project	30	70	100	**0**	**0**	**4**	**2**	**04**
		Semester Total	**210**	**490**	**700**	**15**	**5**	**8**	**24**	**28 Hours**

Course	**Subject Code**	**Title of the Paper**	**Maximum Marks**				**Credits Allotted**			**Teaching Hours**
	Semester IV									
			Internal	**ESE**	**Total**	**Lecture**	**Tutorial**	**Practical**	**Total Credits**	
Core Course	MCACC 401	Design and Analysis of Algorithms	30	70	100	**3**	**1**	**0**	**4**	**04**
Elective-III/ MOOC	MCAE-III	Elective-III (Select any one from the list)	30	70	100	**3**	**1**	**0**	**4**	**04**
Elective-IV	MCAE-IV	Elective-IV (Select any one from the list)	30	70	100	**3**	**1**	**0**	**4**	**04**
Intra-departmental Course	MCAIRA 402	Office Automation (For other department students) MCA students may choose from other departments offering Intradepartmental course from KMCL University	30	70	100	**3**	**1**	**0**	**4**	**04**
Master's Thesis	MCAPD 403	Dissertation (Project)	30	70	100			**8**	**4**	**08**
Viva-Voce	MCAPV 404	Project- Viva-Voce	30	70	100				**4**	
		Semester Total	**180**	**420**	**600**	**12**	**4**	**8**	**24**	**24 Hours**
		GRAND TOTAL	**810**	**1890**	**2700**	**60**	**20**	**32**	**96**	**112 Hours**

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Elective Papers

Semester-III

Elective-I

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2. MCAE12- Blockchain Fundamentals
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Elective-II

1. MCAE21- Cloud Computing
2. MCAE22- Internet of Things (IoT)
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Semester-IV

Elective-III

1. MCAE31- Machine Learning
2. MCAE32- Neural Network
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Elective-IV

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3. MCAE43- Advanced Database Management System
4. MCAE44- Compiler Design

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MCA Semester I
MCACC 101 - Fundamental of Computers & Emerging Technologies

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorial: 15 Hours

OBJECTIVES OF THE COURSE:

1. To demonstrate the knowledge of the basic structure, components, features and generations of computers.
2. To describe the concept of computer languages, language translators and construct algorithms to solve problems using programming concepts.
3. To Compare and contrast features, functioning & types of operating system and computer networks.
4. To demonstrate architecture, functioning & services of the Internet and basics ofmultimedia.
5. To illustrate the emerging trends and technologies in the field of Information Technology.

UNIT-I **Lectures: 09**

Introduction to Computer: Definition, Computer Hardware & Computer Software
Components: Hardware – Introduction, Input devices, Output devices, Central Processing Unit, Memory- Primary and Secondary. Software - Introduction, Types– System and Application.
Computer Languages: Introduction, Concept of Compiler, Interpreter & Assembler
Problem solving concept: Algorithms – Introduction, Definition, Characteristics, Limitations, Conditions in pseudo-code, Loops in pseudo code.

UNIT-II **Lectures: 09**

Operating system: Definition, Functions, Types, Classification, Elements of command based and GUI based operating system.
Computer Network: Overview, Types (LAN, WAN and MAN), Data communication, Topologies.

UNIT-III **Lectures: 09**

Internet : Overview, Architecture, Functioning, Basic services like WWW, FTP, Telnet, Gopher etc., Search engines, E-mail, Web Browsers.
Internet of Things (IoT): Definition, Sensors, their types and features, Smart Cities, Industrial Internet of Things.

UNIT-IV **Lectures: 09**

Block chain: Introduction, overview, features, limitations and application areas fundamentals of Block Chain.

Crypto Currencies: Introduction, Applications and use cases
Cloud Computing: It nature and benefits, AWS, Google, Microsoft & IBM Services.

UNIT-V **Lectures: 09**

Emerging Technologies: Introduction, overview, features, limitations andapplication areas of Augmented Reality , Virtual Reality, Grid computing, Greencomputing, Big data analytics, Quantum Computing and Brain Computer Interface.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Demonstrate the knowledge of the basic structure, components, features andgenerations of computers.	K1,K2
2	CO2. Describe the concept of computer languages, language translators and construct algorithms to solve problems using programming concepts.	K2, K3
3	CO3. Compare and contrast features, functioning & types of operating system and computer networks.	K4
4	CO4. Demonstrate architecture, functioning & services of the Internet and basics of multimedia.	K2
5	CO5. Illustrate the emerging trends and technologies in the field of Information Technology.	K1,K2

Suggested Readings:

1. Rajaraman V., "Fundamentals of Computers", Prentice-Hall of India.
2. Norton P., "Introduction to Computers", McGraw Hill Education.
3. Goel A., "Computer Fundamentals", Pearson.
4. Balagurusamy E., " Fundamentals of Computers", McGraw Hill
5. Thareja R., "Fundamentals of Computers", Oxford University Press.
6. Bindra J., "The Tech Whisperer- on Digital Transformation and the Technologies that Enable it ", Penguin.

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MCA Semester I
MCACC 102: Problem Solving using C

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To describe & understand the problem solving techniques.
2. To understand the concept of basic terminology used in C programming.
3. To develop programs in C language by writing, compiling and debugging.
4. To develop programs involving simple statements, conditional statements, iterative statements, array, strings, functions, recursion, structure and union.
5. To differentiate between call by value and call by reference, acquire skills of using dynamic memory allocations, use of pointers and basic operations on a file.

UNIT-I **Lectures: 09**

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.

UNIT-II **Lectures: 10**

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 switch and if-else.

Loops and Iteration: for, while and do-while loops, Multiple loop variables, Nested loops, break and continue statement.

Functions: Introduction, Types, Declaration of a Function, Function calls, Defining unctions, Function Prototypes, Passing arguments to a function Return values and their types, Writing multifunction program, Calling function by value, Recursive functions.

UNIT-III **Lectures: 09**

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, array of 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.

UNIT-IV **Lectures: 09**

Structure: Introduction, Initializing, defining and declaring structure, Accessing members, Operations on individual members, Operations on structures, Structure within structure, Array of structure, Pointers to structure. **Union:** Introduction, Declaring union, Usage of unions, Operations on union. Enumerated data types. **Storage classes**: Introduction, Types- automatic, register, static and external.

UNIT-V **Lectures: 08**

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.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Describe the functional components and fundamental concepts of a digital computer system including number systems.	K1,K2
2	CO2. Construct flowchart and write algorithms for solving basic problems.	K2,K3
3	CO3. Write 'C' programs that incorporate use of variables, operators and expressions along with data types.	K2,K3
4	CO4. Write simple programs using the basic elements like control statements, functions, arrays and strings.	K2, K3
5	CO5. Write advanced programs using the concepts of pointers, structures, unions and enumerated data types.	K2,K3
6	CO6. Apply pre-processor directives and basic file handling.	K2, K3

Suggested Readings:

1. Kanetkar Y., "Let Us C", BPB Publications.
2. E. Balagurusamy, Computer Concepts and Programming in C, *McGraw Hill*.
3. Yashwant Kanetkar, "Working with C", BPB Publications.
4. E. Balagurusamy, "Programming in ANSI C", TMH.
5. Reema Thareja, Computer Fundamentals and Programming in C, Oxford Publication.
6. Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, Pearson Education.
7. Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Computer Science- A Structured Programming Approach Using C, Cengage Learning.
8. Schildt H., "C- The Complete Reference", McGraw-Hill.
9. Goyal K. K. and Pandey H.M., Trouble Free C", University Science Press
10. Gottfried B., "Schaum's Outlines- Programming in C", McGraw-Hill Publications.

11. Kochan S.G., "Programming in C", Addison-Wesley.
12. Dey P. and Ghosh M., "Computer Fundamentals and Programming in C", Oxford University Press.
13. Goyal K. K., Sharma M. K. and Thapliyal M. P. "Concept of Computer and C Programming", University Science Press.

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MCA Semester I
MCACC 103: Computer Organization & Architecture

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To study functional units of digital system and how arithmetic and logical operations are performed by computers
2. To understand the operations of control unit and sequence of instructions for carrying out simple operation using various addressing modes.
3. To design various types of memory and its organization.
4. To study the various modes in which IO devices communicate with CPU and memory.
5. To analyze various types of flip flops used for designing registers and counters.
6. To understand the criteria for classification of parallel computer.
7. To learn various architectural schemes..

UNIT-I **Lectures: 09**

Introduction: Functional units of digital system and their interconnections, buses, bus architecture, types of buses and bus arbitration. Register, bus and memory transfer. **Processor organization:** general registers organization, stack organization and addressing modes.

UNIT-II **Lectures: 09**

Arithmetic and logic unit: Look ahead carries adders. Multiplication: Signed operand multiplication, Booths algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation, Arithmetic & logic unit design. IEEE Standard for Floating Point Numbers.

UNIT-III **Lectures: 09**

Control Unit: Instruction types, formats, instruction cycles and sub cycles (fetch and execute etc), micro operations, execution of a complete instruction. Program Control, Reduced Instruction Set Computer, Pipelining. Hardwire and micro programmed control: micro-program sequencing, concept of horizontal and vertical microprogramming.

UNIT-IV **Lectures: 09**

Memory: Basic concept and hierarchy, semiconductor RAM memories, 2D & 2 1/2D memory organization. ROM memories. Cache memories: concept and design issues & performance, address mapping and replacement Auxiliary memories: magnetic disk, magnetic tape and optical disks Virtual memory: concept implementation.

UNIT-V **Lectures: 09**

Input / Output: Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Modes of Data Transfer: Programmed I/O, interrupt initiated I/O

and Direct Memory Access., I/O channels and processors. Serial Communication: Synchronous & asynchronous communication, standard communication interfaces.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Describe functional units of digital system and explain how arithmetic and logical operations are performed by computers	K2, K3
2	CO2. Describe the operations of control unit and write sequence of instructions for carrying out simple operation using various addressing modes.	K2, K4
3	CO3. Design various types of memory and its organization.	K3
4	CO4. Describe the various modes in which IO devices communicate with CPU and memory.	K2, K3
5	CO5. List the criteria for classification of parallel computer and describe various architectural schemes.	K1, K2

Suggested Readings:

1. John P. Hayes, "Computer Architecture and Organization", McGraw Hill.
2. William Stallings, "Computer Organization and Architecture-Designing for Performance", Pearson
Education.
3. M. Morris Mano, "Computer System Architecture", PHI.
4. Carl Hamacher, ZvonkoVranesic, SafwatZaky, "Computer Organization", McGraw-Hill.
5. BehroozParahami, "Computer Architecture", Oxford University Press.
6. David A. Patterson and John L. Hennessy, "Computer Architecture-A Quantitative Approach",
Elsevier Pub.
7. Tannenbaum, "Structured Computer Organization", PHI.

ख़्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
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MCA Semester I
MCACC 104: Data Structures

Credit: 03, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To develop the understanding of data structures, their types and applications.
2. To familiarize with concepts of algorithm and complexity.
3. To implement, analyze various data-structures as array, linked-list, stack, queue, tree, graph, etc. in detail and utilization of data structure techniques in problem solving.
4. To develop the understanding of various sorting and searching techniques.
5. To implement them using C programming language.

UNIT-I **Lectures: 08**

Introduction to data structure: Basic Terminology, Elementary Data Organization, Definition of Data structures, Types of Data Structures: Linear and Non-Linear Data Structure, Abstract data type, Data Structure operations, Time-Space trade-off.

Introduction to Algorithms: Definition ofAlgorithms, Algorithm Design Techniques, Performance Analysis of Algorithms, Complexity of various code structures, Order of Growth, Asymptotic Notations.

UNIT-II **Lectures: 09**

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: Representation and Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation, Generalized linked list.

UNIT-III **Lectures: 09**

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- Problem solving using iteration and recursion with examples.

Queues: Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue.

UNIT-IV **Lectures: 10**

Trees: Basic terminology used with Tree, Binary Trees, Binary Tree Representation: Representation and Implementation(Pointer), Types of Binary Tree:Complete Binary Tree, Extended Binary Trees, Threaded Binary trees,Tree Traversal algorithms: In-order, Pre-order and Post-order,Binary Search Tree,Operation of Insertion, Deletion, Searching & Modification

of data in Binary Search Tree, Constructing Binary Tree from given Tree Traversal, AVL Tree andB Tree.

Graphs: Terminology used with Graph, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List. Graph Traversal: Depth First Search and Breadth First Search,Spanning Trees, Minimum Spanning Trees,Single Source and All Pair Shortest Path Algorithms.

UNIT-V **Lectures: 09**

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.

Divide and Conquer with Examples: Merge Sort, Quick Sort, Matrix Multiplication: Strassen's Algorithm

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Explain the concept of data structure, abstract data types, algorithms and analysis of algorithms.	K1, K2
2	CO2. Describe basic data organization schemes such as arrays and linked lists, implementation of linked lists, operations on linked-list,	K2, K3
3	CO3. Describe stacks and queues, their applications and implement various operations on them using arrays and linked lists.	K2, K3
4	CO4. Describe the properties of trees and graphs and implement various operations such as searching and traversal on them.	K2, K3
5	CO5. Apply, compare and analyze various searching and sorting algorithms, incremental and divide-and-conquer approaches of designing algorithms for problems.	K3, K4

Suggested Readings:

1. Y. Langsam, M. Augenstin and A. Tannenbaum, Data Structures using C and C++, Pearson Education Asia.
2. Ellis Horowitz, S. Sahni, D. Mehta Fundamentals of Data Structures in C++, Galgotia Book Source, New Delhi.
3. S. Lipschutz, Data Structures Mc-Graw Hill International.
4. Data Structures: A Pseudocode Approach with C, Second Edition, Richard F. Gilberg, Behrouz A. Forouzan

5. Jean-Paul Tremblay, Paul. G. Soresan, An introduction to Data Structures with Applications, Tata Mc-Graw Hill International Edition.
6. A. Michael Berman, Data structures via C++, Oxford University Press.
7. Thomas H. Cormen, Introduction to Algorithms, 3rd Edition (The MIT Press).
8. M. Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education.
9. Tremblay & Sorenson, An Introduction to Data Structures with Applications, Mcgraw Hill.
10. R.S. Salaria, Data Structures and Applications using C, Khanna Book Publishing.
11. Samanta D., "Classic Data Structures", Prentice Hall India.
12. Aho, Ullman and Hopcroft, "Design and Analysis of algorithms", Pearson Education.
13. R. Neapolitan and K. Naimipour, "Foundations of Algorithms", Jones an Bartlett, Student edition.
14. Reema Thareja, Data Structures using C, Oxford Univ. Press

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MCA Semester I
MCAVC 105: Discrete Mathematics

Credit: 03, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To perform operations on **discrete structures** such as sets, functions, relations.
2. To apply mathematical arguments using logical connectives and quantifiers.
3. To identify and prove properties of Algebraic Structures.
4. To formulate and solve recurrences and recursive functions.
5. To apply the concept of combinatorics to solve basic problems in discrete mathematics.

UNIT-I **Lectures: 09**

Set Theory: Introduction, Size of sets and Cardinals, Venn diagrams, Combination of sets, Multisets, Ordered pairs and Set Identities. **Relation:** 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.

UNIT-II **Lectures: 09**

Posets, Hasse Diagram and Lattices: Introduction, Partial ordered sets, Combination of Partial ordered 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, Logic gates.

UNIT-III **Lectures: 09**

Propositional: Propositions, Truth tables, Tautology, Contradiction, Algebra of Propositions, Theory of Inference and Natural Detection. **Predicate Logic:** Theory of Predicates, First order predicate, Predicate formulas, Quantifiers, Inference theory of predicate logic.

UNIT-IV **Lectures: 09**

Algebraic Structures: Introduction to algebraic Structures and properties. Types of algebraic structures: Semi group, Monoid, Group, Abelian group and Properties of group. Subgroup, Cyclic group, Cosets, Permutation groups, Homomorphism and Isomorphism of groups. **Rings and Fields:** Definition and elementary properties of Rings and Fields.

UNIT-V **Lectures: 09**

Natural Numbers: Introduction, Piano's axioms, Mathematical Induction, Strong
Induction and Induction with Nonzero Base cases. **Recurrence Relation & Generating functions:** Introduction and properties of Generating Functions. Simple Recurrence relation with constant coefficients and Linear recurrence relation without constant coefficients. Methods of

solving recurrences. **Combinatorics:** Introduction, Counting techniques and Pigeonhole principle,Polya's Counting theorem.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Use mathematical and logical notation to define and formally reason about basic discrete structures such as Sets, Relations and Functions	K1, K2
2	CO2. Apply mathematical arguments using logical connectives and quantifiers to check the validity of an argument through truth tables and propositional and predicate logic	K2, K3
3	CO3. Identify and prove properties of Algebraic Structures like Groups, Rings and Fields	K3, K4
4	CO4. Formulate and solve recurrences and recursive functions	K3, K4
5	CO5. Apply the concept of combinatorics to solve basic problems in discrete mathematics	K1, K3

Suggested Readings:

1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", McGraw Hill.
2. B. Kolman, R.C Busby and S.C Ross, "Discrete Mathematics Structures", Prentice Hall.
3. R.P Girimaldi, "Discrete and Combinatorial Mathematics", Addison Wesley.
4. Y.N. Singh, "Discrete Mathematical Structures", Wiley- India.
5. Swapankumar Sarkar, "A Textbook of Discrete Mathematics", S. Chand & Company PVT. LTD.V.
6. Krishnamurthy, "Combinatorics Theory & Application", East-West Press Pvt. Ltd., New Delhi.
7. Liptschutz, Seymour, "Discrete Mathematics", McGraw Hill.
8. J.P. Trembely&R.Manohar, "Discrete Mathematical Structure with application to Computer Science",
McGraw Hill.

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MCACC 106: Lab: Problem Solving using C

Credit: 02, IA Marks: 30, ESE Marks: 70

OBJECTIVES OF THE COURSE:

1. To write, compile, debug and execute programs in a C programming environment.
2. To learn programs that incorporate use of variables, operators and expressions along with data types.
3. To learn programs for solving problems involving use of decision control structures and loops.
4. To learn programs that involve the use of arrays, structures and user defined functions.
5. To Write programs using file handling operations.

- Program to implement conditional statements in C language.
- Program to implement switch-case statement in C language
- Program to implement looping constructs inC language.
- Program to perform basic input-output operations in C language.
- Program to implement user defined functions in C language.
- Program to implement recursive functions in C language.
- Program to implement one-dimensional arrays in C language.
- Program to implement two-dimensional arrays in C language.
- Program to perform various operations on two-dimensional arrays in C language.
- Program to implement multi-dimensional arrays in C language.
- Program to implement string manipulation functions in C language.
- Program to implement structure in C language.
- Program to implement union in C language.
- Program to perform file handling operations in C language.

Note: The Instructor may add/delete/modifyexperiments, wherever he/she feels in a justified manner.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Write, compile, debug and execute programs in a C programming environment.	K3
2	CO2. Write programs that incorporate use of variables, operators and expressions along with data types.	K3
3	CO3. Write programs for solving problems involving use of decision control structures and loops.	K3
4	CO4. Write programs that involve the use of arrays, structures and user defined functions.	K3
5	CO5. Write programs using file handling operations.	K3

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MCACC 107: Lab: Data Structures

Credit: 02, IA Marks: 30, ESE Marks: 70

OBJECTIVES OF THE COURSE:

1. To learn implementation of various Data Structures.
2. To applying data structures in solving real life problems using C.
3. To learn implementation of various Data Structures.

Program in C for following:

- To implement addition and multiplication of two 2D arrays.
- To transpose a 2D array.
- To implement stack using array
- To implement queue using array.
- To implement circular queue using array.
- To implement stack using linked list.
- To implement queue using linked list.
- To implement BFS using linked list.
- To implement DFS using linked list.
- To implement Linear Search.
- To implement Binary Search.
- To implement Bubble Sorting.
- To implement Selection Sorting.
- To implement Insertion Sorting.
- To implement Merge Sorting.
- To implement Heap Sorting.
- To implement Matrix Multiplication by Strassen's algorithm
- Find Minimum Spanning Tree using Kruskal's Algorithm

Note: The Instructor may add/delete/modify experiments, wherever he/she feels in a justified manner.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Write and execute programs to implement different searching algorithms.	K3
2	CO2. Write and execute programs to implement various sorting algorithms	K3
3	CO3. Write and execute programs to implement various operations on two-dimensional arrays.	K3
4	CO4. Implement various operations of Stacks and Queues using both arrays and linked lists data structures.	K3
5	CO5. Implement graph algorithm to solve the problem of spanning tree	K3

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MCA Semester II
MCACC 201: Object Oriented Programming using Java

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To understand Object Oriented Concepts using Java Language.
2. To develop, debug and document programs in Java using OOP paradigms.
3. Describe the meaning of the object-oriented paradigm and implement real-world entities like inheritance, hiding, polymorphism in programming using the object-oriented design process.
4. To understand and implement core Java concepts as interface, package, exception handling, etc.
5. To understand and develop GUI components using Applets.
6. To understand and develop applications using Servlets/JSPs with database handling.

UNIT-I **Lectures: 09**

Introduction: Object Oriented Programming: objects, classes, Abstraction, Encapsulation, Inheritance, Polymorphism, OOP in Java, Characteristics of Java, The Java Environment, Java Virtual Machine, Comparison to other languages as C++,Java Source File Structure, and Compilation. Fundamental Programming Structures in Java: Defining classes in Java, constructors, methods, access specifiers, static members, Comments, Data Types, Variables, Operators, Control Flow, Arrays.

UNIT-II **Lectures: 09**

Inheritance, Interfaces and Packages: Inheritance: Super classes, sub classes, Protected members, method overloading, constructor overloading, use of this and super keyword, Object class, abstract classes and methods. Interfaces: defining an interface, implementing interface, differences between classes and interfaces and extending interfaces. Packages: Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages, importing and naming convention for Packages, Networking java.net package. Access control: private access, public access, protected access and package access.

UNIT-III **Lectures: 09**

Exception Handling, I/O, Multithreading: Exceptions: exception hierarchy, checked and unchecked exceptions, throwing and catching exceptions, finally clause, built-in exceptions, creating own exceptions, Stack Trace Elements, catching exceptions. Input / Output Basics: Byte streams and Character streams, Reading and Writing, Console Reading and Writing Files. Multi-threading overview.

UNIT- IV **Lectures: 09**

Applets and Graphics: Why applets, HTML Applet Tag, A simple applet, graphical shapes, colors, fonts, drawing complex shapes, reading text input inside applet. AWT: introduction, labels, buttons, check boxes, events etc; Layout manager: flow layout, border layout, grid layout, card layout; Menus: Dialog boxes, File dialog; Applet classes, Applet life cycle. Introduction of Java Swing.

UNIT- V **Lectures: 09**

Database Handling with JDBC, Servlets and JSP: An Overview of DBMS – JDBC Architecture – Working with JDBC, DriverManager and Connectivity, Statement and PreparedStatement, ResultSet. Servlets and JSP: Introduction to Servlet, The Servlet Lifecycle, Retrieving/ Sending Information using Servlets, HttpServlet: Request and responseJSP: overview, JSP elements/ directives/ implicit objects, standard action tags.
Multitier Applications using JDBC with Servlet-JSP.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1 To understand Object Oriented Concepts using Java and understand/implement Java programming basics as data types, variable, constants, operators, control statements, arrays, etc.	K1, K2, K3
2	CO2. To understand and implement concepts of inheritance, hiding, polymorphism,interfaces and packages etc. in Java programming.	K2, K3
3	CO3. To handle exceptions in programs and gain practical experience on using I/O, multithreading, etc.	K2, K3
4	CO4. Explain and implementation approaches for GUI design using Applets.	K2, K3
5	CO5.Design and implement interactive applications using Servlets-JSP and database handling	K2, K3

Suggested Readings:

1. Herbert Schildt, "Java The Complete reference", McGraw Hill Education, 8th Edition, 2011.
2. Khalid Mughal, "A Programmer's Guide to Java SE 8 Oracle Certified Associate (OCA)", AddisonWesley.
3. Cay S. Horstmann, Gary Cornell, "Core Java Volume –I Fundamentals", Prentice Hall, 9th Edition,2013.
4. Steven Holzner, "Java Black Book", Dreamtech.
5. Balagurusamy E, "Programming in Java", McGraw Hill.
6. Naughton, Schildt, "The Complete reference java2", McGraw Hill.
7. Deitel and Deitel, Java, How to Program, Prentice-Hall.
8. Naughton, Schildt, "The Complete reference java2", McGraw Hill

9. Cay Horstmann, Java Concepts, John Wiley & Sons, Inc.
10. Cay Horstmann, Big Java John Wiley & Sons, Inc.
11. David Flanagan, Java in a Nutshell, O'Reilly.
12. Liang, “Introduction to Java Programming, Comprehensive Version”, Pearson Education.
13. A.R.Venugopal, Rajkumar, T. Ravishanker “Mastering C++”, TMH.
14. R.Lafore, “Object Oriented Programming using C++”, Galgotia Publications.
15. E. Balagurusamy, “Object Oriented Programming with C++”, TMH.

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MCA Semester II
MCACC 202: Operating System

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorial: 15 Hours

OBJECTIVES OF THE COURSE:

1. To develop the understanding of the structure and functioning of Operating System.
2. To learn about Processes, Threads and Scheduling algorithms.
3. To understand the principles of concurrency and Deadlock.
4. To learn various memory management schemes.
5. To study I/O management and File systems.

UNIT-I **Lectures: 09**

INTRODUCTION Evolution of Operating System, Operating System Structure, types of Operating System: Batch Processing, Multiprogramming, Timesharing, Distributed System, Real Time System. Process: Concepts, Process control blocks, concurrency, mutual exclusion, semaphores, Interprocess Communication, Process Synchronization.

UNIT-II **Lectures: 09**

Processor management techniques; Threads, Process Scheduling, Scheduling Criteria types of scheduling, scheduling algorithms, Deadlocks, Deadlocks Prevention, Deadlocks Avoidance, Deadlocks Detection.

UNIT-III **Lectures: 09**

Memory Management: Real storage, Contiguous vs. Non-Contiguous storage allocation, Static and Dynamic Partitioned memory allocation; Virtual memory, management of virtual memory, Paging, Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Cache memory organization, Locality of reference. Segmentation with Paging, Protection schemes, Paged segmentation.

UNIT-IV **Lectures: 09**

I/O Management: Disk Organization, disk space management, disk scheduling, Files types and operations, File access and security, File storage Management, File Organization. RAID: File System: File concept, File organization and access mechanism, File directories, and File sharing, File system implementation issues, File system protection and security.

UNIT-V **Lectures: 09**

Advanced Operating System : Basics of Network Operating System, Server Operating System and Real Time Operating. UNIX: Essential commands and utilities, Unix files, directory structure, file security, Bourne shell programming features, systems calls classification and basics, Linux: System components, Networking software layers, Case Study of UNIX/LINUXOS.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Explain main components, services, types and structure of Operating Systems.	K2
2	CO2. Apply the various algorithms and techniques to handle the various concurrency control issues.	K3
3	CO3. Compare and apply various CPU scheduling algorithms for process execution.	K2,K4
4	CO4. Identify occurrence of deadlock and describe ways to handle it.	K3
5	CO5.Explain and apply various memory, I/O and disk management techniques.	K5

Suggested Readings:

1. Abraham Siberschatz and Peter Baer Galvin, "Operating System Concepts", Addision-Wesley
2. Milan Milankovic, "Operating Systems, Concepts and Design", Tata McGraw-Hill.
3. Harvey M Deital, "Operating Systems", Addison Wesley
4. Richard Peterson, "Linux: The Complete Reference", Osborne Tata McGraw-Hill.
5. SibsankarHalder and Alex A Aravind, "Operating Systems", Pearson Education
6. D M Dhamdhere, "Operating Systems : A Concept basedApproach", McGraw Hill.
7. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education".
8. Stuart E. Madnick& John J. Donovan.Operating Systems.McGraw Hill.
9. A. S. Tanenbaum, "Modern Operating Systems", PHI.
10. William Stallings, "Operating Systems – internals and design principles", PHI.

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MCA Semester II
MCACC 203: Database Management System

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorial: 15 Hour

OBJECTIVES OF THE COURSE:

1. To learn the features of a database system and its application and compare various types of data models.
2. To construct an ER Model for a given problem and transform it into a relation database schema.
3. To formulate solution to a query problem using SQL Commands, relational algebra, tuple calculus and domain calculus.
4. To understand the need of normalization and normalize a given relation to the desired normal form.
5. To understand different approaches of transaction processing and concurrency control.

UNIT-I **Lectures: 09**

Introduction: Overview, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure. Data Modeling Using the Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.

UNIT-II **Lectures: 09**

Relational data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. Introduction to SQL: Characteristics of SQL, Advantage of SQL. SQL Data Type and Literals. Types of SQL Commands.SQL Operators and their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL

UNIT-III **Lectures: 09**

Data Base Design & Normalization: Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design

UNIT-IV **Lectures: 09**

Transaction Processing Concept: Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from

Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling. Distributed Database: Distributed Data Storage, Concurrency Control, Directory System.

UNIT-V **Lectures: 09**

Concurrency Control Techniques: Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction, Case Study of Oracle.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Describe the features of a database system and its application and compare various types of data models.	K2
2	CO2. Construct an ER Model for a given problem and transform it into a relation database schema.	K5, K6
3	CO3. Formulate solution to a query problem using SQL Commands, relational algebra, tuple calculus and domain calculus.	K5, K6
4	CO4. Explain the need of normalization and normalize a given relation to the desired normal form.	K2, K3
5	CO5. Explain different approaches of transaction processing and concurrency control.	K2

Suggested Readings:

1. Date, C.J.,"An Introduction to Database Systems", Narosa Publishing House, New Delhi.
2. Korth, Silbertz, Sudarshan, "Database Concepts", Tata Mcgraw-hill Education (India).
3. Elmasri, Navathe, "Fundamentals Of Database Systems", Pearson Education New Delhi India.
4. G.K. Gupta, "Database Management System", Tata Mcgraw-hill Education (India) Pvt. Ltd.
5. Bipin C. Desai, "An introduction to Database Systems", Galgotia Publication.
6. Majumdar& Bhattacharya, "Database Management System", Tata Mcgraw-hill Education.
7. Ramakrishnan, Gehrke, "Database Management System", McGraw Hill (India) Pvt Ltd.
8. Chakravarti, "Advanced Database Mnagement System" Wiley Dreamtech Publications.
9. Ullman, J.D.,"Principles of Database Systems", Galgotia Publications, New Delhi.
10. James Mortin- Principles of Database Management Object Oriented Modeling & Design.

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MCA Semester II
MCACC 204: Automata Theory and Formal Languages

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorial: 15 Hour

OBJECTIVES OF THE COURSE:

1. Introduce concepts in automata theory and theory of computation.
2. Identify different formal language classes and their relationships.
3. Design grammars and recognizers for different formal languages.
4. Prove or disprove theorems in automata theory using its properties.
5. Determine the decidability and intractability of computational problems.

UNIT-I **Lectures: 09**

Basic Concepts and Automata Theory: Introduction to Theory of Computation- Automata, Computability and Complexity, Alphabet, Symbol, String, Formal Languages, Deterministic Finite Automaton (DFA)- Definition, Representation, Acceptability of a String and Language, Non Deterministic Finite Automaton (NFA), Equivalence of DFA and NFA, NFA with ε-Transition, Equivalence of NFA's with and without ε-Transition, Finite Automata with output-Moore machine, Mealy Machine, Equivalence of Moore and Mealy Machine, Minimization of Finite Automata, Myhill-Nerode Theorem, Simulation of DFA and NFA.

UNIT-II **Lectures: 09**

Regular Expressions and Languages: Regular Expressions, Transition, Graph, Kleen's Theorem, Finite Automata and Regular Expression Arden's theorem, Algebraic Method Using Arden's Theorem, Regular and Non-Regular Languages- Closure properties of Regular Languages, Pigeonhole Principle, Pumping Lemma, Application of Pumping Lemma, Decidability- Decision properties, Finite Automata and Regular Languages, Regular Languages and Computers, Simulation of Transition Graph and Regular language.

UNIT-III **Lectures: 09**

Regular and Non-Regular Grammars: Context Free Grammar(CFG)-Definition, Derivations, Languages, Derivation Trees and Ambiguity, Regular Grammars-Right Linear and Left Linear grammars, Conversion of FA into CFG and Regular grammar into FA, Simplification of CFG, Normal Forms- Chomsky Normal Form(CNF), Greibach Normal Form (GNF),Chomsky Hierarchy, Programming problems based on the properties of CFGs.

UNIT-IV **Lectures: 09**

Push Down Automata and Properties of Context Free Languages: Nondeterministic Pushdown Automata (NPDA)- Definition, Moves, A Language Accepted by NPDA, Deterministic Pushdown Automata(DPDA) and Deterministic Context free Languages(DCFL),

Pushdown Automata for Context Free Languages, Context Free grammars for Pushdown Automata, Two stack Pushdown Automata, Pumping Lemma for CFL, Closure properties of CFL, Decision Problems of CFL, Programming problems based on the properties of CFLs.

UNIT-V **Lectures: 09**

Turing Machines and Recursive Function Theory : Basic Turing Machine Model, Representation of Turing Machines, Language Acceptability of Turing Machines, Techniques for Turing Machine Construction, Modifications of Turing Machine, Turing Machine as Computer of Integer Functions, Universal Turing machine, Linear Bounded Automata, Church's Thesis, Recursive and Recursively Enumerable language, Halting Problem, Post Correspondence Problem, Introduction to Recursive Function Theory.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Define various types of automata for different classes of formal languages and explain their working.	K1,K2
2	CO2. State and prove key properties of formal languages and automata.	K1, K3
3	CO3. Construct appropriate formal notations (such as grammars, acceptors, transducers and regular expressions) for given formal languages.	K3, K4
4	CO4 .Convert among equivalent notations for formal languages.	K3
5	CO5. Explain the significance of the Universal Turing machine, Church Turing thesis and concept of Un-decidability.	K2

Suggested Readings:

1. J.E. Hopcraft, R. Motwani, and Ullman, "Introduction to Automata theory, Languages and Computation", Pearson EducationAsia,2nd Edition.
2. J. Martin, "Introduction to languages and the theory of computation", McGraw Hill, 3rd Edition.
3. C. Papadimitrou and C. L. Lewis, "Elements and Theory of Computation", PHI.
4. K.L.P. Mishra and N. Chandrasekaran ,"Theory of Computer Science Automata Languages and Computation" , PHI.
5. Y.N. Singh, "Mathematical Foundation of Computer Science", New Age International.

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MCA Semester II
MCACC 205: Computer Network

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorial: 15 Hour

OBJECTIVES OF THE COURSE:

1. To understand the computer networks and concentrates on building a firm foundation
2. To provide the fundamental knowledge of the various aspects of computer networking
3. To understanding the OSI Reference Model and TCP/IP Model
4. To have a good knowledge of Reference Model Layers and associated protocols.
5. Analyze the requirements for a given organizational structure. Select the most appropriate networking architecture and technologies and appreciate recent developments in the area.

UNIT-I **Lectures: 09**

Introduction: Data Communication& Networking, Data communication Components, data representation and data flow, Network structure and architecture, Types of Connections, Topologies, Protocols and Standards, The OSI reference model and TCP/IP reference model, services, comparison of models, Physical Layer Transmission Media, Switching methods., Delaysand Performance of Network, Internetworking-Bridges, Switches, Routers and Gateways; Virtual. LANs.

UNIT-II **Lectures: 09**

Data Link Layer: Error Handling: Error Detection and Error Correction, Introduction–Block coding, Hamming Distance, CRC, Flow Control and Error control: Stop and Wait, Sliding Window protocols: Go-Back–N ARQ, Selective Repeat ARQ, Piggybacking, Medium Access sub layer, Channel Allocations, Multiple Access protocols, Random Access protocols: ALOHA CSMA, CSMA/CD,CDMA/CA protocols, Overview of IEEE standards.

UNIT-III **Lectures: 09**

Network Layer: Overview, Point-to-Pont Networks, IP addressing and subnetting, IPv4-IPv6 address, IP packet, Address mapping–ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols, Routing Algorithms: Distance Vector Routing; Link State Routing.

UNIT-IV **Lectures: 09**

Transport Layer: Process-to-Process Delivery, User Datagram Protocol(UDP), Transmission Control Protocol (TCP), SCTP, Congestion: Congestion Control techniques andpolicies, TCP

Congestion Control, TCP- Window Management, Quality of Service(QoS) concept, Techniques for achieving QoS.

UNIT-V **Lectures: 09**

Application Layer: Domain Name Space(DNS), TELNET-Virtual Terminals, Electronic-mail architecture and components, File transfer protocol (FTP), WWW-HTTP, SNMP, Electronic mail and other applications, Cryptography – Basic concepts.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand computer network basics, network architecture, TCP/IP and OSI reference models and other concepts.	K1,K2
2	CO2. Understand error handling concepts, data link protocols, flow-error control, multi-channel access protocols and Standards.	K1, K2
3	CO3. Describe network layer protocols, IP addressing, IPV4 addressing scheme, Routing algorithms, etc.	K1, K2
4	CO4.Describe functionality of Transport layer and related protocols; concept of QoS and techniques.	K1, K2
5	CO5. Define various application layer protocols such as DNS, Electronic Mail, FTP, HTTP, Telnet and understand network security	K2

Suggested Readings:

1. Forouzen, "Data Communication and Networking", TMH A.S.
2. Tanenbaum, Computer Networks, Pearson Education
3. W. Stallings, Data and Computer Communication, Macmillan Press
4. AnuranjanMisra, "Computer Networks", Acme Learning
5. G. Shanmugarathinam, "Essential of TCP/ IP", Firewall Media

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MCA Semester II
MCAVNC 206: Cyber Security

Credit: 00, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorial: 15 Hour

OBJECTIVES OF THE COURSE:

1. Exhibit knowledge to secure corrupted systems, protect personal data, and secure computer networks in an Organization.
2. Practice with an expertise in academics to design and implement security solutions.
3. Understand key terms and concepts in Cryptography, Governance and Compliance.
4. Develop cyber security strategies and policies
5. Understand principles of web security and to guarantee a secure network by monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools.

UNIT-I **Lectures: 09**

Introduction- Introduction to Information Systems, Types of Information Systems, Development of Information Systems, Introduction to Information Security and CIA triad, Need for Information Security, Threats to Information Systems, Information Assurance and Security Risk Analysis, Cyber Security.

UNIT-II **Lectures: 09**

Application Security- (Database, E-mail and Internet), Data Security Considerations-(Backups, Archival Storage and Disposal of Data), Security Technology-(Firewall , VPNs, Intrusion Detection System), Access Control. Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail Viruses, Macro Viruses, Malicious Software, Network and Denial of Services Attack.

UNIT-III **Lectures: 09**

Introduction to E-Commerce , Threats to E-Commerce, Electronic Payment System, e- Cash, Credit/Debit Cards. Digital Signature, Cryptography Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets - Access Control, CCTV, Backup Security Measures.

UNIT-IV **Lectures: 09**

Security Policies- Why policies should be developed, Policy Review Process, Publication and Notification Requirement of policies, Types of policies – WWW policies, Email Security policies, Corporate Policies, Sample Security Policies. Case Study – Corporate Security.

UNIT-V **Lectures: 09**

Information Security Standards-ISO, IT Act, Copyright Act, IPR. Cyber Crimes , Cyber Laws in India; IT Act 2000 Provisions, Intellectual Property Law, Copy Right Law , Semiconductor Law and Patent Law , Software Piracy and Software License.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1.Identify and analyze nature & inherent difficulties in the security of the Information System.	K3
2	CO2. Analyze various threats and attacks, corresponding counter measures and various vulnerability assessment and security techniques in an organization.	K3
3	CO3. Applications of cyber based policies and use of IPR and patent law for software-based design.	K1, K2
4	CO4 . Define E-commerce types and threats to E-commerce	K2
5	CO5. Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance	K2,K4

Suggested Readings:

1. William Stallings, "Cryptography and Network Security", Pearson Education/PHI, 2006.
2. V.K. Jain, "Cryptography and Network Security", Khanna Publishing House.
3. Gupta Sarika, "Information and Cyber Security", Khanna Publishing House, Delhi.
4. AtulKahate, "Cryptography and Network Security", McGraw Hill.
5. V.K. Pachghare, "Cryptography and Information Security", PHI Learning
6. Nina Godbole, "Information System Security", Wiley
7. Bothra Harsh, "Hacking", Khanna Publishing House, Delhi
8. The basic of Hacking and Penetration testing ,second edition on ethical hacking and penetration by Patrick Engebretson
9. The web application hackers handbook and LAB manual by Wiley

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MCA Semester II
MCACC 207: Lab-OOP using JAVA

Credit: 02, IA Marks: 30, Final Marks: 70

OBJECTIVES OF THE COURSE:

1. To learn and implement OOP concepts using Java programming language.
2. To apply object oriented techniques to analyze, design and develop a complete solution for a given problem.

Use Java compiler and eclipse platform to write and execute java program:

- Creating simple java programs,
- Understand OOP concepts and basics of Java programming.
- Create Java programs using inheritance and polymorphism.
- Understand the use of java packages.
- Implement error-handling techniques as exception handling, IO/file-handling, concept of multithreading.
- Develop GUI applications like a simple calculator using JavaApplets, swing components.
- Develop a Client Server networking application.
- Develop simple dynamic web-application using Servlets/JSP with database connectivity and perform basic CRUD operations.

Note: The Instructor may add/delete/modify experiments, wherever he/she feels in a justified manner.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1 Use Java compiler and eclipse platform to write and execute java program.	K3
2	CO2. Create Java programs using inheritance and polymorphism.	K3
3	CO3 Implement error-handling techniques using exception handling, IO/ file-handling techniques, multithreading.	K3
4	CO4. Develop a Client Server Application and develop GUI applications using Swing components.	K3
5	CO5. Develop interactive web application using Servlets/JSP and JDBC for database connectivity.	K3

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MCA Semester II
MCACC 208: Lab-DBMS

Credit: 02, IA Marks: 30, Final Marks: 70

OBJECTIVES OF THE COURSE:.

1. To write SQL commands to query a database.
2. To develop database and writing queries using MySQL, SQL Server.
3. To write, debug and implement SQL programs in MySQL, SQL Server.
4. To learn programming in SQL.

- Installing SQL Server/MYSQL.
- Creating Entity-Relationship Diagram using case tools.
- Writing basic SQL statements.
- Restricting and sorting data.
- Displaying data from multiple tables.
- Aggregating data using group function.
- Manipulating data.
- Creating and managing tables.
- Normalization.
- Creating procedure and functions etc.
- Design and implementation of Payroll processing system.
- Design and implementation of Library Information System.
- Design and implementation of Student Information System.
- Automatic Backup of Files and Recovery of Files.

Note: The Instructor may add/delete/modify experiments, wherever he/she feels in a justified manner.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1Creating Entity-Relationship Diagram using case tools.	K3
2	CO2. Write SQL commands to query a database and displaying data from multiple tables.	K3
3	CO3.Analyze front end tools to design forms, reports and menus.	K3
4	CO4.Aggregating data using group function. Manipulating data.	K3
5	CO5.Develop a Client Server Application.	K3

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MCA Semester III
MCACC 301 - Python Programming

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorial: 15 Hours

OBJECTIVES OF THE COURSE:

1. To acquire programming skills in core Python.
2. To explore the use of data structures, strings, text files, lists and dictionaries.
3. To acquire Object Oriented Skills in Python.
4. To understand to solve the problems with Python database, Python multithreading.
5. To work with Django framework, Numpy and other libraries.

UNIT-I **Lectures: 09**

Introduction, Problem solving: Planning a computer program, Problem solving techniques. History of Python, Need of Python Programming, Applications Basics of Python Programming. Getting started with Python programming- Running code in interactive shell. Input, processing and output. Editing, saving and running Python Scripts. Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT-II **Lectures: 09**

Data Types, Operators and Expressions: Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass.
Data Structures-Lists- Operations, Slicing, Methods, Tuples, Sets, Dictionaries, Sequences, Comprehensions.

UNIT-III **Lectures: 09**

Functions - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Scope of the Variables in a Function - Global and Local Variables
Object Oriented Design: Design with Classes, Programming types, Object Oriented Programming, Structuring classes with Inheritance and Polymorphism. Case study- request, analysis, design & implementation. Python Regular Expression. **Error and Exceptions:** Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User defined Exceptions.

UNIT-IV **Lectures: 09**

Python Database Interaction: SQL Database connection using Python. Creating and searching tables. Reading and storing config information on database. Programming using database connections.
Python Multithreading: Understanding threads, synchronizing the threads, programming using multithreading.

UNIT-V **Lectures: 09**

Logging in python, **Introduction to Django framework**: Creating a project and application, URLs, models, templates and views files, Introduction to web development, **Introduction to Pycharm**. **Numpy**: Main advantages of Numpy arrays over Python list, Creating arrays.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand and comprehend the Basics of Python programming.	K1,K2
2	CO2. Describe and explain the use of the built-in data structures list, sets, tuples and dictionary.	K2, K3
3	CO3. Make use of functions, modules and its applications.	K2, K3
4	CO4. Demonstrate the principles of OOPs and identify real-world applications using OOPs, files and exception handling provided by Python.	K2, K3
5	CO5. Implement Python Database handling and concepts of Python Multithreading.	K2, K3
6	CO6. Familiarize and be able to use Django framework, Pycharm IDE, Python standard libraries.	K2, K3

Suggested Readings:

1. Kenneth A. Lambert, Martin, Juneja "Fundamentals of Python", Cengage Learning.
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.
3. Learning Python, Mark Lutz, Orielly.
4. Harsh Bhasin, "Python for Beginners", New Age International.
5. Ashok Namdev Kamthane , Programming and Problem Solving with Python, TMH.
6. Allen Downey, Learning with Python, Dreamtech.

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MCA Semester III
MCACC 302: Software Engineering

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To understand the methodologies involved in the development and maintenance of software (i.e.) over the entire life cycle.
2. To learn about generic models of software development process.
3. To understand methods of capturing, specifying, visualizing and analyzing software requirements and analysis modeling.
4. To know basics of testing and understanding concept of software quality assurance and software configuration management process.
5. To understand the different design techniques and their implementation.
6. To learn various testing and maintenance measures.
7. To understand Project management and Quality Assurance plan and measures.

UNIT-I **Lectures: 09**

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, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

UNIT-II **Lectures: 09**

Software Requirement Specifications (SRS): 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 9000Models, SEI-CMM Model.

UNIT-III **Lectures: 09**

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: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

UNIT-IV **Lectures: 09**

Software Testing: Testing Objectives, UNIT Testing, Integration Testing, 8 Acceptance Testing, Regression Testing, Testing for functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.

UNIT-V **Lectures: 09**

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.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand and comprehend the nature of software development and software life cycle models.	K1,K2
2	CO2. Explain needs for software specifications, software requirements and their gathering techniques and their application.	K2,K3
3	CO3. Understand and comprehend software quality assurance techniques.	K1,K2
4	CO4. Learn and implement concepts of software design modeling and principles.	K1, K2
5	CO5. Compare, understand and learn different testing strategies and tactics.	K1,K2
6	CO6. Understand, compare and apply various software maintenance and management techniques.	K1, K2, K3

Suggested Readings:

1. R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
2. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
3. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
4. Pankaj Jalote, Software Engineering, Wiley.
5. Deepak Jain,"Software Engineering: Principles and Practices", Oxford University Press.
6. Munesh C. Trivedi, Software Engineering, Khanna Publishing House.
7. N.S. Gill, Software Engineering, Khanna Publishing House.

8. Jibitesh Mishra and Ashok Mohanty, Software Engineering: Pearson.
9. Sommerville, I., Software Engineering, Narosa.
10. Fairley, R.E., Software Engineering Concept, Mc-Graw Hill.
11. Shooman, M., Software Engineering, Mc-Graw Hill.
12. Robert N. Charett, Software Engineering Environments, McGraw Hill.

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MCA Semester III (Elective-I)
MCAE11: Cryptography & Network Security

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To understand the fundamentals of Cryptography, modular arithmetic, etc.
2. To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
3. To understand the various key distribution and management schemes, message authentication and hashing functions.
4. To understand how to deploy encryption techniques to secure data in transit across data networks.
5. To design security applications in the field of Information technology.

UNIT-I **Lectures: 10**

Introduction: to security attacks, services and mechanism, introduction to cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers.

Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, confidentiality using conventional encryption, traffic confidentiality, key distribution, random number generation.

UNIT-II **Lectures: 09**

Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.

UNIT-III **Lectures: 09**

Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm (SHA). Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

UNIT-IV **Lectures: 08**

Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security, pretty good privacy (PGP), S/MIME.

UNIT-V **Lectures: 09**

IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET). System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand and become familiar with basics of cryptography and mathematics behind it.	K1, K2
2	CO2. Explain, distinguish and apply various cryptographic techniques/ algorithms and its applications to network security.	K2, K4
3	CO3. Acquire knowledge about Message Authentication, Hashing and Digital Signature techniques.	K1, K2
4	CO4. Understand various authentication applications.	K1, K2
5	CO5. Understand, describe network security threats, security services and related protocols as IPSec, SSL, etc	K1, K2

Suggested Readings:

1. William Stallings, "Cryptography and Network Security: Principals and Practice", Pearson Education.
2. Behrouz A. Forouzan:: Cryptography and Network Security, Tata McGraw Hill
3. C K Shyamala, N Harini, Dr. T.R.Padmnabhan Cryptography and Security, Wiley
4. Bruce Schiener, "Applied Cryptography". John Wiley & Sons
5. V.K. Jain, Cryptography and Network Security, Khanna Publishing House
6. Bernard Menezes," Network Security and Cryptography", Cengage Learning.
7. Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill

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MCA Semester III (Elective-I)
MCAE12: Blockchain Fundamentals

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To provide the overview of the structure of Blockchain and cryptography behind it.
2. To understand the basics of Blockchain Consensus Mechanism.
3. To get overview of digital money and crypto-currencies as Bitcoin.
4. To understand Blockchain implementation platforms as Hyperledger fabric, Ethereum and their components.
5. To discuss and cover both the conceptual as well as application aspects of Blockchain.

UNIT-I **Lectures: 10**

Introduction: Introduction to Blockchain, Blockchain Data structure, Hash chain, distributed database, Index structure, Transactions, Blockchain Architecture and Design: Ledgers, Blocks, Chaining Blocks, Peer to peer systems, centralized and decentralized systems.

Cryptographic Primitives: Cryptographic hash functions – collision free, Hash tree- Merkle Tree, Public Key cryptography, Digital signatures. Use of hash functions and digital signatures in blockchain. Asymmetric-Key Cryptography, Addresses and Address Derivation, Private Key Storage.

UNIT-II **Lectures: 09**

Consensus and multiparty agreements: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols, Proof of Work, Proof of Stake, Delegated Proof of Stake, Deposit based consensus, Proof of importance.

Federated consensus or federated Byzantine consensus, Reputation-based mechanisms, Practical Byzantine Fault Tolerance. Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains

UNIT-III **Lectures: 08**

Blockchain implementation. Forking-Soft Fork, Hard Forks. Smart contract programming. Blockchain Platforms and Cryptocurrencies - Bitcoin, Litecoin, Ethereum, Ripple. Bitcoin: Basics (Structure of block, creation of coins), Double Spending.

UNIT-IV **Lectures: 09**

Blockchain Platforms: Hyperledger, Ethereum. Architecture. Decomposing the consensus process, Hyperledger fabric components, Chaincode Design and Implementation.

UNIT-V **Lectures: 09**

Blockchain applications and case-study: Blockchain in Financial Software and Systems: Settlements, KYC, Blockchain in trade/supply chain, Blockchain for Government: Digital identity, land records and other entities.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand and become familiar with concepts of public digital ledger to share information in a trustworthy and secure way.	K1, K2
2	CO2. Interpret the uses of cryptographic techniques in Blockchain.	K1, K2
3	CO3. Explain, distinguish and compare various consensus mechanisms and their concept.	K1, K2
4	CO4.Demonstrate the use of platforms as Hyperledger, Ethereum and its components for implementation.	K2, K3
5	CO5. Analyze the use of Blockchain technology in various domains	K1, K2

Suggested Readings:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, Princeton University Press
2. Mark Gates, Blockchain ultimate Guide to understanding Blockchain, Bitcoin, Cryptocurrencies, Smart Contracts and Future of money, Wise Fox Publishing
3. Andreas M. Antonopoulos, Mastering Bitcoin - Programming the Open Blockchain, O'Reilly Media, Inc., 2017
4. Imran Bashir, Mastering Blockchain, 2017.
5. Vikram Dhillon, David Metcalf, Max Hooper, Blockchain Enabled Applications, Apress, ISBN No.13:978-1-4842-3081-7.
6. Alex Leverington, Ethereum Programming, Packt Publishing Limited, 2017
7. Roger Wattenhofer, The Science of the Blockchain, CreateSpace Independent Publishing Platform, 2016.
8. Don Tapscott,Alex Tapscott, Blockchain Revolution, ISBN No. 9781101980132
9. Don Tapscott, "Block chain and Crypto currency", 2016. Draft NISTIR 8202, Blockchain Technology Overview - NIST CSRC, 2018.
10. Abhijit Das and VeniMadhavan, C. E., Public-Key Cryptography: Theory and Practice: Theory and Practice, Pearson Education India, 2009.
11. Melanie Swan, Blockchain Blueprint for a new economy, O'Reilly, First Edition, ISBN No.978-1-491-92049-7
12. Mayukh Mukhopadhyay, Ethereum Smart Contract Development, Packt publishing, First Edition, ISBN No.978-1-78847-304-0
13. Chris Dannen, Introducing Ethereum and Solidity, Apress, ISBN No.978-1-4842-2535-6
14. https://www.ibm.com/blockchain/in-en/hyperledger.html.

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MCA Semester III (Elective-I)
MCAE13: Privacy & Security in Online Social Media

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To study and understand the use of online social media and networks on the Internet with its exponential increase and is current need of society awareness.
2. To study, investigate and characterize Privacy and security of online social media from various perspectives (computational, cultural, psychological, etc.).
3. To familiarize students with how websites like Facebook, YouTube, LinkedIn, Twitter, Flickr, Instagram, Google+, Four Square, Pinterest, Tinder, and the likes have changed the way the Internet is being used.

UNIT-I **Lectures: 09**

Various privacy and security concerns (spam, phishing, fraud nodes, identity theft) on Online Social Media, Introduction to Social Media API, OSM APIs and tools for data collection, Facebook API. Trust and Credibility on Twitter API.

UNIT-II **Lectures: 09**

Data privacy in the context of social media, Social Tagging Information cascades and social Epidemics. Rumors and deception in social media, OSM Misinformation on Social Media, Privacy and Social Media. Internet safety, social networking apps. Trust, credibility, and reputations in social systems.

UNIT-III **Lectures: 09**

Crime Prevention - Crime and sense of security - Social control and crime prevention - .Community, Privacy in online data collection, email, searches, online marketing and advertising, social media threats, MySQL, Mongo DB, Crowd sourcing.

UNIT-IV **Lectures: 09**

Policingand Online social Media, Information privacy disclosure, revelation and its effects in OSM and online social networks, Phishing in OSM & Identifying fraudulent entities in online social networks.

UNIT-V **Lectures: 09**

E-Crime on Online Social Media, Social Network Analysis, Weblog analysis, Cyber laws: IT act 2000 overview.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand and become familiar with privacy and security concerns (spam, phishing, fraud nodes, identity theft) on Online Social Media	K1, K2
2	CO2. Acquire knowledge about Social Media API, OSM APIs and other tools for data collection	K1, K2
3	CO3. Acquire knowledge about data privacy on OSM, Internet safety and about trust, credibility, and reputations in social systems	K1, K2
4	CO4. Understand and learn about Policing and Online social Media, Information privacy disclosure and its effects in OSM, phishing in OSM & identifying fraudulent entities in online social networks.	K1, K2
5	CO5. Comprehend and explain about the nature of e-crime on Online Social Media, Cyber laws and Social Network and Weblog analysis,	K1, K2

Suggested Readings:

1. Toby Segaran, "Programming Collective Intelligence: Building Smart Web 2.0 Applications", O'Reilly.
2. Quentin Zervaas, "Practical Web 2.0 Applications with PHP", Apress.
3. Gavin Bell, "Building Social Web Applications: Establishing Community at the Heart of Your Site", O'Reilly.
4. DafyddStuttard, "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", Wiley.

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MCA Semester III (Elective-I)
MCAE14: Mobile Computing

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To develop and fostering interest in the mobility of systems, users, data and computing.
2. To understand the data management issues in mobile environments.
3. To understand the integration of wired and mobile, wireless systems.

UNIT-I **Lectures: 09**

Introduction, issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS.

UNIT-II **Lectures: 09**

Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.

UNIT-III **Lectures: 09**

Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, Disconnected operations.

UNIT-IV **Lectures: 09**

Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.

UNIT-V **Lectures: 09**

Adhoc networks, localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Ad Hoc Networks, applications.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand basics of mobile computing and identify its issues.	K1, K2
2	CO2. Understand and become familiar with wireless telephony concepts, GSM/CDMA and channel allocation, its structure and other details.	K1, K2
3	CO3. Understand and get brief overview of Wireless	K1, K2

	Networking, Wireless LAN concepts and protocols, WAP architecture and other concepts.	
4	CO4.Comprehend and understand data management issues for mobile computers, disconnected operations and adaptive clustering concepts for mobile networks.	K1, K2
5	CO5. Comprehend and understand data management issues for mobile computers, disconnected operations and adaptive clustering concepts for mobile networks.	K1, K2
6	CO6. Describe and comprehend working of Adhoc networks and related protocols.	K1, K2

Suggested Readings:

1. J. Schiller, Mobile Communications, Addison Wesley.
2. A. Mehrotra, GSM System Engineering.
3. M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House.
4. Charles Perkins, Mobile IP, Addison Wesley.
5. Charles Perkins, Ad hoc Networks, Addison Wesley.

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MCA Semester-III (Elective-II)
MCAE21- Cloud Computing

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To analyze the components of cloud computing and its services show how business agility in an organization can be created.
2. To compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.
3. To identify data management, resource management, security and privacy issues in cloud computing.
4. To understand the recent research trends in cloud computing.

UNIT-I **Lectures: 09**

Introduction to Cloud Computing

Overview of Computing, History and Evolution of Cloud Computing, Definition and Essential Characteristics of Cloud Computing, Key Cloud Service Providers and Their Services, Internet of Things in the Cloud, Artificial Intelligence on the Cloud, Blockchain and Analytics in the Cloud,Basics of Parallel and Distributed Computing, Overview of Cloud Delivery Models: Infrastructure as a Service(IaaS), Platform as a Service(PaaS),Software as a Service(SaaS); Overview of Cloud Deployment Models Deployment Models: Public, Private, Hybrid, Community; Cloud Applications,.

UNIT-II **Lectures: 09**

Virtualization and Data Management in Cloud

Virtualization: Virtualization, Benefits of Virtualization, Virtualization Models: Bare metal, Hosted hypervisor, Types of Virtualization: Processor Virtualization, Memory Virtualization, Full Virtualization, Para virtualization, Device virtualization, Virtual Machines (VM) and its types, VM Migrations.

Data Management: Benefits of Cloud Data Management, Key Capabilities for Cloud Data Management, Cloud data management for healthcare, finance, Data Management Strategy, Data-Vendor Lock-in

UNIT-III **Lectures: 09**

Resource Management (RM) in Cloud Computing

Service Level Agreements (SLAs), Cloud Economics, Resource Management Techniques in Cloud Computing, Energy aware RM Techniques, SLA-aware RM Techniques, Load-Balanced RM Techniques.

UNIT-IV **Lectures: 09**

Cloud Security

Basic Component of Security: Confidentiality, Integrity and Availability, Goals of Security, Security Stack, Data Security and Storage, Identity and Access Management, Cloud Encryption, Security Risk, Access Control, Trust, Reputation.

UNIT-V **Lectures: 09**

Case Study on Open Source and Commercial Clouds, Cloud Simulator, Research trend in Cloud Computing, Fog Computing.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Demonstrate the knowledge of the basic structure, components, features, and various cloud models of cloud.	K1,K2
2	CO2. Illustrate the concept of virtualization, virtual machine and data management in cloud computing.	K1, K2
3	CO3. Identify, compare and examine the several resource management techniques under various quality of service parameters (QoS).	K3,K4
4	CO4. Demonstrate the concept of security component, access control, and risk associated to the cloud computing.	K2
5	CO5. Illustrate the emerging recent research trends and technologies in the field of Cloud Computing.	K1,K2

Suggested Reading:

1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
2. Enterprise Cloud Computing - Technology, Architecture, Applications, GautamShroff, Cambridge University Press, 2010.
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media
5. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010
6. Smith, Jim, and Ravi Nair, "Virtual machines: versatile platforms for systems and processes", Elsevier.
7. Recent conference/journal papers as well as documentation from cloud providers.

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MCA Semester-III (Elective-II)
MCAE22- Internet of Things

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. Understand the vision of IoT from a global context.
2. Understand the application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints
3. Determine the Market perspective of IoT.
4. Use of Devices, Gateways and Data Management in IoT
5. Building state of the art architecture in IoT.Application of.

UNIT-I **Lectures: 09**

INTRODUCTION

Introduction to Internet of Things, Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT, IoT Protocols, IoT Enabled Technologies, Logical Design of IoT, IoT Communication Models, IoT Communication APIs, IoT Levels and Deployment Templates, Domain Specific IoTs: Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle.

UNIT-II **Lectures: 09**

IoT& M2M

Machine to Machine (M2M), Key Features of M2M, M2M vsIoT, M2M Protocols, Software Defined Networks (SDN), and its BussinesBanefit, Logical View of SDN, Network Function Virtualization (NFV) Architecture, SDN vs NFV, IoT System Management with NETCOZF, YANG- NETCONF, YANG, and SNMP.

UNIT-III **Lectures: 09**

IoT&WSN

Introduction of Wireless Sensor Networks (WSN), WSN Types, WSN Applications, Sensors and its Characteristics in WSN, Security Integration Challenges, Integration Approaches, TCP/IP Adaption, Problems and Solutions in WSN

UNIT-IV **Lectures: 09**

ENABLING TECHNOLOGIES, PROTOCOLS, AND APPLICATIONS

Market Opportunity, IOT Architecture, IoT Elements, IoTCommon Standards, QoS Criteria, IoTChallenges and Future Directions.

UNIT-V **Lectures: 09**

ENABLING TECHNOLOGIES, PROTOCOLS, AND APPLICATIONS

IoT Ethics and Privacy

Ethical Challenges of the Internet of Things, Importance of the Internet of Things (IoT) in Society, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, Data Aggregation for the IoT in Smart Cities

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy

1	CO1. Understand the Definitions, technology, various designs, applications and significance of the Internet of Things.	K1, K2
2	CO2. Illustrate the concept of M2M (machine to machine) with necessary protocols and relationship between IoT and M2M.	K2
3	CO3. Illustrate the constraints and opportunities of wireless and mobile networks for Internet of Things.	K2
4	CO4. Identify the need of IoT, deployment challenges and potential business opportunities of the IoT.	K3
5	CO5. Identify the ethical challenges and privacy requirement in implementing web based services for IoT.	K3

Suggested Reading:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)
3. Recent conference/journal papers.

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MCA Semester-III (Elective-II)
MCAE23- Soft Computing

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. Introduce and use the idea of Neural networks, fuzzy logic and use of heuristics based on human experience.
2. Understand the underlying principle of soft computing with its usage in various applications. .
3. Understand different soft computing tools to solve real life problems.
4. Introduce and use the concepts of Genetic algorithm and its applications to soft computing using some applications.

UNIT-I **Lectures: 09**

Artificial Intelligence

Artificial Intelligence: a Brief Review, Pitfalls of Traditional AI, Need for Computational Intelligence, Importance of Tolerance of Imprecision and Uncertainty, Constituent Techniques, Overview of Artificial Neural Networks, Fuzzy Logic and Evolutionary Computation.

UNIT–II **Lectures: 09**

Neural Network

Neural Network: Biological and Artificial Neuron, Neural Networks, Supervised and Unsupervised Learning. Single Layer Perceptron - Multilayer Perceptron – Backpropagation Learning.

UNIT-III **Lectures: 09**

Genetic Algorithm

Concept of GA, GA Operators: Encoding, Selection, Crossover, Mutation, Solving optimization problems using GA Algorithms

UNIT–IV **Lectures: 09**

Fuzzy Logic

Fuzzy Sets, Properties, Membership Functions, Fuzzy Operations, Fuzzy Logic and Fuzzy Inference System

UNIT-V

Evolutionary Computation **Lecture: 09**

Introduction to EC, Overview of other Bio-inspired Algorithms, Swarm Intelligence Algorithms, MOEA Approaches

Course Outcomes: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand theoretical and practical aspects of Artificial Intelligence	K1
2	CO2. Study and identify various issues related to the development of Artificial neural networks and its applications.	K2
3	CO3. Analyze the concept and significance of genetic algorithms and Solving optimization problems using GAs.	K3, K4

4	CO4. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.	K3
5	CO5. Solving multi-objective optimization problems using Evolutionary algorithms (MOEAs).	K3

Suggested Readings:

1. An Introduction to Genetic Algorithm,Melanic Mitchell (MIT Press)
2. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)
3. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
4. Neural Networks and Learning Machines Simon Haykin (PHI)
5. AmitKonar, “Artificial Intelligence and Soft Computing”, First Edition,CRC Press, 2000.
6. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley
7. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall
8. Simon Haykin, “Neural Networks: A Comprehensive Foundation”, Prentice Hall
9. Recent conference/journal papers.

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MCA Semester-III (Elective-II)
MCAE24- Software Testing and Quality Assurance

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. Building on previous exposure to the fundamentals of the software process
2. This course focuses on techniques for ensuring software quality.
3. quality assurance is viewed as an activity that runs through the entire development process
4. Understanding the needs of clients and users; analyzing and documenting requirements; verifying and validating solutions through testing.
5. To understand the methodologies involved in the development and maintenance of software (i.e.) over the entire life cycle.
6. To learn various testing and maintenance measures.
7. To understand Project management and Quality Assurance plan.

UNIT-I **Lecture -09**

SOFTWARE TESTING FUNDAMENTALS

Introduction; Software Testing Perspective Related Terminology; Myths; Purpose, Goal and Objectives; Challenges and Issues; Effective Software Testing; Types of Testing; Principles of Software Testing; Testing and Debugging, Testability Artifacts Testability Facilitators, Testability Analysis

UNIT-II **Lecture -09**

STATIC TESTING & TESTING STRATEGY

Introduction, Principles of Static Analysis, Static Testing Perspective, General Methodology, A Taxonomy of Static Testing, Manual Techniques, Walkthrough, Formal Reviews, Inspection, Automated Testing, Syntax Parser, Static Verification, Symbolic Execution, Static Vs Dynamic Testing, Strategic Issues Strategic Premises A Generic Testing Strategy Models for Software Testing

UNIT-III **Lecture -09**

BLACK BOX TESTING & WHITE BOX TESTING

Introduction, Black Box Techniques, Equivalence Partitioning, Scope and Prospects, Test Case Generation, Boundary Value Analysis, Robustness Testing, Syntax Testing, Finite State Testing White Box Technique White Box Modeling Basis Path Testing Control Structure Testing Mutation Testing

UNIT-IV **Lecture -09**

SOFTWARE AND QUALITY CONCEPT

Objectives, Quality: An Overview, Software Perspective, Software Quality Factors & Planning Software Quality Assurance, Software Quality Models, Software Quality Measurement and Metrics, Software Quality Assurance Software Quality Assurance Life Cycle Establishing Software Quality Assurance Program SQA Activities

UNIT-V **Lecture -09**

SQA PLANNING & STANDARDS

Building Blocks of Software Quality Assurance Plan, SQA Planning Assurance, Journey of Standards SQA Standards: Purpose and Role SQA Standards: Requirements and Activities ISO 9000 Quality Standard Series Software Metrics, Software Quality Metrics Framework, Software Quality Metrics Features, Developments of Software Quality Metrics, Selection of Software Quality Metrics, Quality Models: Hierarchical Models Quality Models: Non- Hierarchical Models, Capability Maturity Models, CMM Maturity Levels.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1Outline software testing and software quality assurance principles.	K2,K3
2	CO2. Prepare test case and test suites for completely testing all aspects of a system under test	K5, K6
3	CO3. Concept of quality assurance and quality control techniques and develop a QA plan and Test Plan	K5, K6
4	CO4. To carry out inspections and carry out testing in a production environment	K3
5	CO5.Compile findings of a quality assurance cycle.	K2,K6

Suggested Readings:

1. Software Quality: Concept and Practices, R A Khan, K Mustafa, S I Ahson
2. Software Quality Assurance: From Theory to Implementation, Daniel Galin
3. Metrics and Models in Software Quality Engineering, Stephen H. Kan
4. Quality Assurance: Software Quality Assurance Made Easy, Solis Tech.
5. Aditya P. Mathur, "Fundamentals of Software Testing", Pearson Education.
6. Naik and Tripathy, "Software Testing and Quality Assurance", Wiley
7. K. K. Aggarwal and Yogesh Singh, "Software Engineering", New Age International Publication.
8. John Watkins, Simon Mills, Testing IT: An Off-the-Shelf Software Testing Process, 2nd edition, 2011, Cambridge University Press, ISBN 978-0521148016

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MCA Semester III
MCAIER 303: E-Commerce
(Inter-departmental course)

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To provide an introduction to information systems for business and management.
2. To familiarize students with organizational and managerial foundations of commerce and business systems and lay the technical foundation for understanding it.
3. To understand online business activities such as selling, purchasing, ordering etc.
4. To understand about financial activities such utilization of cards (Credit Card, Debit Card), Money transformation etc.
5. To Review ability of existing business portal to make the future plan for business

UNIT-I **Lectures: 10**

Introduction to E-Commerce: The Scope of Electronic Commerce, Definition of Electronic Commerce, Electronic E-commerce and the Trade Cycle, Electronic Markets, Electronic Data Interchange, Internet Commerce, E-Commerce in Perspective Business Strategy in an Electronic Age: Supply Chains, Porter's Value Chain Model, Inter Organizational Value Chains, Competitive Strategy, Porter's Model, First Mover Advantage Sustainable Competitive Advantage, Competitive Advantage using E-Commerce,

Business Strategy: Introduction to Business Strategy, Strategic Implications of IT, Technology, Business Environment, Business Capability, Exiting Business Strategy, Strategy Formulation & Implementation Planning, E-Commerce Implementation, E-Commerce Evaluation.

UNIT-II **Lectures: 09**

Business-to-Business Electronic Commerce: Characteristics of B2B EC, Models of B2B Ec, Procurement Management Using the Buyer's Internal Marketplace, Just in Time Delivery, Other B2B Models, Auctions and Services from Traditional to Internet Based EDI, Integration with Back-end Information System, The Role of Software Agents for B2B EC, Electronic marketing in B2B, Solutions of B2B EC, Managerial Issues, Electronic Data Interchange (EDI), EDI: The Nuts and Bolts, EDI & Business.

UNIT-III **Lectures: 09**

Internet and Extranet: Automotive Network Exchange, The Largest Extranet, Architecture of the Internet, Intranet and Extranet, Intranet software, Applications of Intranets, Intranet Application Case Studies, Considerations in Intranet Deployment, The Extranets, The structures of Extranets, Extranet products & services, Applications of Extranets, Business Models of Extranet Applications, Managerial Issues.

UNIT-IV **Lectures: 08**

Electronic Payment Systems: Is SET a failure, Electronic Payments & Protocols, Security Schemes in Electronic payment systems, Electronic Credit card system on the Internet,

Electronic Fund transfer and Debit cards on the Internet, Stored – value Cards and E-Cash, Electronic Check Systems, Prospect of Electronic Payment Systems, Managerial Issues.

UNIT-V **Lectures: 09**

Public Policy: From Legal Issues to Privacy: EC- Related Legal Incidents, Legal Incidents, Ethical & Other Public Policy Issues, Protecting Privacy, Protecting Intellectual Property, Free speech, Internet Indecency & Censorship, Taxation & Encryption Policies, Other Legal Issues: Contracts, Gambling & More, Consumer & Seller Protection In EC. Infrastructure For EC : It takes more than Technology, A Network Of Networks, Internet Protocols, Web- Based client / Server, Internet Security, selling on the web, Chatting on the Web, Multimedia delivery, Analyzing Web Visits, Managerial Issues.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Provide foundations for understanding concepts of E-commerce and business strategy in current times.	K1, K2
2	CO2. Comprehend and understand the B2B electronic commerce model.	K1, K2
3	CO3. Explain the concept and use of Intranet and Extranet in relation to E-commerce.	K1, K2
4	CO4. Comprehend and understand the prospective of Electronic Payment Systems, concept, security and managerial issues.	K2
5	CO5.Describe, summarize and analyze Public policies from legal to privacy aspect, its infrastructure, related issues and incidents	K2, K4

Suggested Readings:

1. David Whiteley, "E-Commerce", Tata McGraw Hill.
2. Ravi Kalakota, Electronic Commerce, Pearson.
3. Goel Ritendra, E-Commerce, New Age.
4. K. C. Laudon and C. G. Traver, "E-commerce: business, technology, society", Addison Wesley
5. Eframi Turban, Jae Lee, David King, K. Michale Chung, "Electronic Commerce", Pearson.

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MCACC 304: Lab: Python Programming

Credit: 02, IA Marks: 30, ESE Marks: 70

OBJECTIVES OF THE COURSE:

1. To learn programs for solving problems in Python, handling Strings and text-files, implementing data structures as List and Dictionaries.
2. To learn programs for implementing concepts of Object Oriented Design.
3. To write programs for database handling, logging and multithreading in Python.
4. To learn implementation using Django framework.
5. To learn programs to be able to use Python Standard libraries as Numpy.

Programming exercise in Python:

- Problem solving, Strings and Text Files. List and Dictionaries.
- Object Oriented Design
- Python Database Interaction
- Python Multithreading
- Logging in python
- Introduction to Django framework
- Numpy

Note: The Instructor may add/delete/modify experiments, wherever he/she feels in a justified manner.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Write and execute programs for solving basic problems using Python	K3
2	CO2. Write programs for handling Strings, text-files, implementing data-structures as dictionaries and lists.etc.	K3
3	CO3. Write programs for implementing concepts of Object oriented design.	K3
4	CO4. Write programs using Database interaction/ operations, logging and multi-threading.	K3
5	CO5. Implement programs using Django framework and standard Python libraries.	K3

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MCACC 305: Lab: Minor Project (Software/ Research)

Credit: 02, IA Marks: 30, ESE Marks: 70

OBJECTIVES OF THE COURSE:

1. To help students develop openness to new ideas in computer science.
2. To develop the ability to draw reasonable inferences from observations and learn to formulate and solve new computer science problems using analytical and problem-solving skills.
3. To help students develop a research project.
4. To help students acquire the necessary competences to build a real-life software system by completing different software life cycle phases (like, specification, architecture, design, implementation, validation, documentation, etc.)

Minor-Project using Web Engineering Tools: Design and Implementation of Web Applications, Web Services, Mobile Applications etc. Students are required to incorporate the followings: Dynamic Pages, Adding Dynamic Functionality Interactive User Interface Database in the back-end XML and Databases Provision for EDIs Adding Security Features, etc.

For developing the project, students may use the followings:
.NET Platform, J2EE Platform, Eclipse JAVA, C#, VC++, etc. XML, DHTML, CGI, CSS, PHP &MySql, Scripting Languages (JSP, ASP), or Suitable Technologies.

OR

Research Project.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Design and develop mini-project following proper software development life-cycle.	K3, K4
2	CO2. Demonstrate capacity to develop research project, apply and evaluate methodologies throughout the project	K3, K4

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MCA Semester IV

MCACC 401- Design and Analysis of Algorithms

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To introduce the basic concepts of Algorithm design.
2. To analyze the complexity of an Algorithm.
3. To develop an understanding of various Algorithm paradigms.
4. Explain fundamental computing algorithms
5. Analyze algorithms and identify key algorithmic strategies
6. Demonstrate knowledge of programming language design issues.

UNIT-I **Lectures: 9**

Introduction, Growth Functions and Recurrences: Role of Algorithms in Computing, Analyzing and designing of algorithms, Mathematical Foundations, Growth Functions-Different Asymptotic Notations, Worst, Average and Best case Analysis, Recurrences- Substitution, Recursion Tree and Master Methods.

UNIT-II **Lectures: 9**

Brute Force and Divide and Conquer Methods: Brute Force, Exhaustive Search-Travelling Salesman Problem, Knapsack Problem and Assignment problem. Divide and conquer method– Merge sort, Quick sort, Binary search, Strassen's Matrix Multiplication.

UNIT-III **Lectures: 9**

Dynamic Programming, Greedy Techniques and Randomized algorithms: Elements of Dynamic Programming, Assembly Line Scheduling, Matrix Chain Multiplication, Elements of Greedy Algorithms, Prim's algorithm- Kruskal's Algorithm- Dijkstra's Algorithm-Huffman Trees. Randomized Algorithms**.**

UNIT-IV **Lectures: 9**

Backtracking and Branch and Bound: Introduction, The Eight queen's problem, Knapsack problem, Travelling Salesman problem, Sum of subsets problem. String Matching: Introduction, The naive string matching algorithm, The Rabin-Karp algorithm

UNIT-V **Lectures: 9**

Complexity Theory and Approximation algorithms: Introduction, P, NP, NP-Hard, NP Complete and Associated Problems, Approximation Algorithm- Vertex Cover and Travelling Salesman-Problem.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's

		Taxonomy
1	CO1.Identify the problem given and design the algorithm using various algorithm design techniques	K2,K3
2	CO2. Implement various algorithms in a high level language	K3, K4
3	CO3. Analyze the performance of various algorithms	K2, K4
4	CO4.Compare the performance of different algorithms for same problem	K3
5	CO5.Able to describe the classes P, NP, and NP Complete and be able to prove that a certain problem is NPComplete.	K2,K4

Suggested Readings:

1. Thomas H Cormen Leiserson "Introduction to Algorithms", PHI Learning.
2. Sara Baase and Allen Van Gelder ,Computer Algoritms : "Introduction to Design and Analysis", Pearson Education
3. Jon Kleinberg and Eva Tardos "Algorithm Design", Pearson Education
4. Brassard Bratley "Fundamental of Algorithms", PHI Learning Private Limited, Delhi India.
5. M T Goodrich "Algorithms Design", John Wiley
6. Aho, "Design and Analysis of Computer Algorithms", Pearson Education.
7. Horowitz and Sahani ,"Fundamentals of Computer Algorithms", Galgotia Publications.
8. Tremblay & Sorenson, "An Introduction to Data Structures with Applications", Mcgraw Hill.
9. J. P. Tremblay and R.B. Bunt, "An Introduction of Computer Science –An Algorithmic Approach", Tata Mcgraw Hill.

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MCA Semester IV (Elective-III)
MCAE31: Machine Learning

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To understand the basics of machine learning and need for it, understand human learning aspects and relate it with machine learning concepts.
2. To understand implementation aspects of machine learning through Scikit learn and understand the concepts and importance of feature selection and filtering.
3. To learn about linear and logistic regression models, their concepts and methodologies.
4. To understand working of SVM, Bayes classifier and their methodologies.
5. To understand, evaluate and analyze different machine learning models such as decision trees, perceptron, clustering basics, etc.

UNIT-I **Lectures: 09**

Introduction- Introduction to different types of learning, Supervised and Unsupervised learning – Reinforcement learning- Basics of Neural network models, beyond machine learning-deep learning and bio inspired adaptive systems, Machine learning and big data.

Important Elements of Machine Learning- Data Representation, Diversity of Data: Structured/Unstructured, Statistical learning approaches,Basic Linear Algebra in Machine Learning Techniques.

UNIT-II **Lectures: 08**

Scikit- learn Dataset, Creating training and test sets, managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and Filtering, Principle Component Analysis(PCA)-non negative matrix factorization, Sparse PCA, Kernel PCA. Atom Extraction and Dictionary Learning.

UNIT-III **Lectures: 09**

Linear regression- Linear models, A bi-dimensional example, Linear Regression and higher Dimensionality, Ridge, Lasso and Elastic Net, Robust regression with random sample consensus, Polynomial regression, **Logistic Regression**-Linear classification, Implementation and Optimizations, Stochastic gradient descendent algorithms.

UNIT-IV **Lectures: 10**

Introduction to Bayes Decision Theory, Bayes Theorem, Maximum Likelihood hypotheses for predicting probabilities, class conditional probability distributions, Naïve Bayes Classifiers.

Support Vector Machines (SVM)- Introduction, Hyperplanes and Support Vectors, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly separable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines.

UNIT-V **Lectures: 09**

Decision Tree Learning: Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.

Clustering Fundamentals- Basics, Types of clustering methods, Clustering algorithms as K-means.

Multilayer Perceptron Networks and error back propagation algorithm, Radial Basis Functions Networks.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand and comprehend basics of machine learning techniques and design issues.	K1, K2
2	CO2. Learn and study about dataset for training and testing, managing categorical data, feature selection and filtering, etc. and understand their implementations.	K2, K3
3	CO3. Comprehend and understand linear and logistic regression models and their methodologies.	K2, K4
4	CO4. Understand basics of Bayes Decision Model and Support Vector Machines concepts and techniques.	K1, K2
5	CO5. Comprehend and understand working of Decision trees, fundamental concept of clustering and multilayer perceptron networks overview.	K1, K2

Suggested Readings:

1. T. M. Mitchell, Machine Learning, McGraw-Hill, 1997.
2. E. Alpaydin, Introduction to Machine Learning, Prentice Hall of India, 2006.
3. Applied Machine Learning, M. Gopal, McGraw Hill Education.
4. Machine Learning: A Probabilistic Perspective, Kevin Murphy, MIT Press,2012.
5. Peter Harrington, Machine Learning in action, Wiley.
6. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2009.
7. Pattern Recognition and Machine Learning, Christopher Bishop, Springer,2007.
8. Vladimir N. Vapnik, Statistical Learning Theory, John Wiley and Sons, 1998.
9. Shawe-Taylor J. and Cristianini N., Cambridge, Introduction to Support Vector Machines, University Press, 2000.
10. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012, ISBN-10: 1107422221; ISBN-13: 978-1107422223.
11. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited,ISBN10: 1785889621, ISBN-13: 978-1785889622.

12. Stephan Marsland, "Machine Learning - An Algorithmic Perspective", Chapman and Hall, 1st Edition, 2009.
13. Nils Nilsson, "Introduction to Machine Learning", MIT Press, 1997.
14. Building Machine Learning Systems with Python – WilliRichert, Luis Pedro Coelho

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MCA Semester IV (Elective-III)
MCAE32: Neural Network

Credit: 03, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To understand the fundamental theory and concepts of computational intelligence methods, in particular neural networks, fuzzy systems, genetic algorithms and their applications in the area of machine intelligence.
2. To understand human learning aspects and relate it with machine intelligence.
3. To understand the concepts of Multi-layered network architecture, Recurrent Neural Network and their working.
4. To understand the basics of an evolutionary computing algorithms and its application to engineering optimization problems.

UNIT-I **Lectures: 09**

Neuro computing and Neuroscience: Historical notes, human Brain, neuron Model, Knowledge representation, Al and NN. Learning process: Supervised and unsupervised learning, Error correction learning, competitive learning, adaptation, statistical nature of the learning process.

UNIT-II **Lectures: 09**

Data processing: Scaling, normalization, Transformation (FT/FFT), principal component analysis, regression, covariance matrix, eigen values & eigen vectors. Basic Models of Artificial neurons, activation. Functions, aggregation function, single neuron computation, multilayer perceptron, least mean square algorithm, gradient descent rule, nonlinearly separable problems and bench mark problems in NN.

UNIT-III **Lectures: 09**

Multi-layered network architecture, back propagation algorithm, heuristics for making BP-algorithm performs better. Accelerated learning BP (like recursive least square, quick prop, RPROP algorithm), approximation properties of RBF networks and comparison with multilayer perceptron.

UNIT-IV **Lectures: 09**

Recurrent network and temporal feed-forward network, implementation with BP, self-organizing map and SOM algorithm, properties of feature map and computer simulation. Principal component and independent component analysis, application to image and signal processing.

UNIT-V **Lectures: 09**

Complex valued NN and complex valued BP, analyticity of activation function, application in 2D information processing. Complexity analysis of network models. Soft computing. Neuro-Fuzzy-genetic algorithm Integration.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand and demonstrate knowledge of Neurocomputing and Neuroscience for understanding human learning aspects and relate it to machine intelligence.	K1, K2
2	CO2. Explain the concepts of data processing and attain the capability to apply them in various real life problem domains.	K2, K3
3	CO3. Describe and analyze the capability of Multi-layered network architecture, back propagation algorithm, multilayer perceptron, etc.	K2
4	CO4. Understand, describe and analyze Recurrent network, temporal feed-forward network, self-organizing map, Principal component, etc. and their applications.	K2, K4
5	CO5. Comprehend and attain capability to understand and analyze complex neural network models, fuzzy-systems, genetic algorithm, etc.	K1, K2

Suggested Readings:

1. J.A. Anderson, An Intoduction to Neural Networks, MIT
2. Hagen Demuth Beale, Neural Network Design, Cengage Learning
3. R.L. Harvey, Neural Network Principles, PHI
4. Kosko, Neural Network and Fuzzy Sets, PHI

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MCA Semester IV (Elective-III)
MCAE33: Artificial Intelligence

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To learn and understand an overview of artificial intelligence (AI) principles and approaches.
2. To get an overview of different domains of AI as in Computer Vision, Machine Learning, Natural Language Possessing, etc.
3. To develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning.
4. To learn about different Machine Learning models and techniques.
5. To understand basics of Pattern Recognition approaches and techniques.

UNIT-I **Lectures: 09**

Introduction- Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.

UNIT-II **Lectures: 09**

Introduction to Search- Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.

UNIT-III **Lectures: 09**

Knowledge Representation &Reasoning- Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

UNIT-IV **Lectures: 09**

Machine Learning- Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning.

UNIT-V **Lectures: 09**

Pattern Recognition- Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbour (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand and become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.	K1, K2
2	CO2. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.	K1, K2
3	CO3. Analyze and formalize the problem and select amongst different search or game based techniques to solve them.	K2, K4
4	CO4. Experiment with machine learning models, explore the current scope, potential, limitations, and implications.	K2, K3
5	CO5. Attain the capability to understand pattern-recognition based techniques, solve problems with uncertain information using Bayesian approaches and some other types of classifiers.	K1, K2

Suggested Readings:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-hill Education Pvt. Ltd.
3. E.Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education
4. Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India.
5. T. M. Mitchell, Machine Learning, McGraw-Hill, 1997.
6. E. Alpaydin, Introduction to Machine Learning, Prentice Hall of India, 2006.
7. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", 2nd Edition, John Wiley, 2006.

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MCA Semester IV (Elective-III)
MCAE34: Pattern Recognition

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To learn the fundamentals of pattern recognition and its relevance to classical and modern problems.
2. To develop a basic understanding of the scientific discipline whose goal is the classification of objects into a number of categories or classes.
3. To introduce the student to the basic concepts and methods for the recognition of patterns in data. This is accomplished via the presentation of the underlying theory and algorithmic approaches for the detection and characterization of patterns in multidimensional data.

UNIT-I **Lectures: 09**

Introduction: Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test.

UNIT-II **Lectures: 09**

Statistical Patten Recognition: Bayesian Decision Theory, Classifiers, Normal density and discriminant functions.

UNIT-III **Lectures: 09**

Parameter estimation methods: Maximum- Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods-Principal Component Analysis(PCA),Fisher Linear discriminate analysis, Expectation-maximization(EM),Hidden Markov Models(HMM), Gaussian mixture models.

UNIT-IV **Lectures: 09**

Nonparametric Techniques: Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification.

UNIT-V **Lectures: 09**

Unsupervised Learning & Clustering: Criterion functions for clustering, Clustering Techniques:
Iterative square - error partitional clustering – K means, agglomerative hierarchical clustering, Cluster validation.

Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand and become familiar with concepts of pattern recognition	K1, K2

2	CO2. Explain and distinguish procedures, methods and algorithms related to pattern recognition	K1, K2
3	CO3. Summarize, analyze, relate and compare simple pattern classifiers, statistical pattern recognition techniques, non-parametric techniques, etc.	K2, K4
4	CO4. Understand and experiment with pattern recognition techniques using unsupervised learning and clustering.	K1, K2
5	CO5. Attain the capability to represent, design and develop pattern recognition systems for real-world problems.	K2, K3

Suggested Readings:

1. Richard O. Duda, Peter E. Hart and David G. Stork, “Pattern Classification”, 2nd Edition, John Wiley, 2006.
2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2009.
3. S. Theodoridis and K. Koutroumbas, “Pattern Recognition”, 4th Edition, Academic Press,2009.

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MCA Semester IV (Elective-IV)

MCAE41- Data Warehousing & Data Mining

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To understand data warehouse concepts, architecture, business analysis and tools.
2. To understand data pre-processing and data visualization techniques.
3. To study algorithms for finding hidden and interesting patterns in data.
4. To understand and apply various classification and clustering techniques using tools.

UNIT-I **Lectures: 09**

Data Warehousing and On-Line Analytical Processing: Data Warehouse basicconcepts, Data Warehouse Modeling, Data Cube and OLAP, Data Warehouse Design and Usage, DataWarehouse Implementation, Data Generalization by Attribute-Oriented Induction.
Data Cube Technology: Efficient Methods for Data Cube Computation, Exploration andDiscovery in Multidimensional Databases.

UNIT-II **Lectures: 09**

Introduction to Data Mining: Motivation, Importance, Definition of Data Mining, Kind of Data,Data Mining Functionalities, Kinds of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of A Data Mining System With A Database or Data Warehouse System, Major Issues In Data Mining, Types of Data Sets and Attribute Values, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity. **Preprocessing:** Data Quality, Major Tasks in Data Preprocessing, Data Reduction, DataTransformation and Data Discretization, Data Cleaning and Data Integration

UNIT-III **Lectures: 09**

Mining Frequent Patterns, Associations and Correlations: Basic Concepts,Efficient and Scalable Frequent Item set Mining Methods, Are All the Pattern Interesting, Pattern Evaluation Methods, Applications of frequent pattern and associations.
Frequent Pattern and Association Mining: A Road Map, Mining Various Kinds ofAssociation Rules, Constraint-Based Frequent Pattern Mining, Extended Applications of Frequent Patterns

UNIT-IV **Lectures: 09**

Classification: Decision Tree Induction, Bayesian Classification Methods, Rule-Based Classification, Model Evaluation and Selection, Bayesian Belief Networks, Classification by Neural Networks, Support Vector Machines, Pattern-Based Classification, Lazy Learners (or Learning from Your Neighbors).

UNIT-V **Lectures: 09**

Clustering Analysis: Basic Concepts of Cluster Analysis, Clustering structures, Major ClusteringApproaches, Partitioning Methods, Hierarchical Methods, Density-Based Methods, ModelBased Clustering - The Expectation-Maximization Method, Other Clustering Techniques, Clustering High-Dimensional Data, Constraint-Based and User-Guided Cluster Analysis, Link-Based Cluster Analysis, Semi-Supervised Clustering and Classification, Bi-Clustering, Collaborative Clustering.

Course Outcomes: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Demonstrate the concept of Data warehouse system and perform business analysis with OLAP tools	K1, K2
2	CO2. Understand and Apply suitable pre-processing and visualization techniques for data analysis	K2, K3
3	CO3. Apply frequent pattern and association rule mining techniques for data analysis	K3
4	CO4. Understand and Apply appropriate classification techniques for data analysis	K2, K3
5	CO5. Understand and apply various clustering techniques for data analysis	K2, K3

Suggested Readings:

1. Jiawei Han, MichelineKamber, Jian Pei (2012), Data Mining: Concepts and Techniques, 3 rdedition, Elsevier, United States of America.
2. Margaret H Dunham (2006), Data Mining Introductory and Advanced Topics, 2ndedition,PearsonEducation, New Delhi, India.
3. AmiteshSinha (2007), Data Warehousing, Thomson Learning, India.
4. Xingdong Wu, Vipin Kumar (2009), the Top Ten Algorithms in Data Mining, CRC Press, UK.

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MCA Semester IV (Elective-IV)
MCAE42- Big Data Analytics

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To Understand the concepts of Big Data fundamentals.
2. To Learn the importance of Hadoop and SQL Languages.
3. To use Hive and NoSQL

UNIT-I **Lectures: 09**

Introduction to Big Data: Types of digital data, history of Big Data innovation, introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Big Data importance and applications, Big Data features – security, compliance, auditing and protection, Big Data privacy and ethics, Big Data Analytics, Challenges of conventional systems, intelligent data analysis, nature of data, analytic processes and tools, analysis vs reporting, modern data analytic tools.

UNIT-II **Lectures: 09**

Hadoop: History of Hadoop, Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop Echo System.
Map Reduce: Map Reduce framework and basics, how Map Reduce works, developing a Map Reduce application, unit tests with MR unit, test data and local tests, anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats, Map Reduce features, Real-world Map Reduce

UNIT-III **Lectures: 09**

HDFS (Hadoop Distributed File System): Design of HDFS, HDFS concepts, benefits and challenges, file sizes, block sizes and block abstraction in HDFS, data replication, how does HDFS store, read, and write files, Java interfaces to HDFS, command line interface, Hadoop file system interfaces, data flow, data ingest with Flume and Scoop, Hadoop archives, Hadoop I/O: compression, serialization, Avro and file-based data structures. Hadoop Environment: Setting up a Hadoop cluster, cluster specification, cluster setup and installation, Hadoop configuration, security in Hadoop, administering Hadoop, HDFS monitoring & maintenance, Hadoop benchmarks, Hadoop in the cloud

UNIT-IV **Lectures: 09**

Hadoop Eco System and YARN: Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 New Features - NameNode high availability, HDFS federation, MRv2, YARN, Running MRv1 in YARN.
NoSQL Databases: Introduction to NoSQL
MongoDB: Introduction, data types, creating, updating and deleing documents, querying, introduction to indexing, capped collections

Spark: Installing spark, spark applications, jobs, stages and tasks, Resilient Distributed 09 Databases, anatomy of a Spark job run, Spark on YARN
SCALA: Introduction, classes and objects, basic types and operators, built-in control structures, functions and closures, inheritance.

UNIT-V **Lectures: 09**

Hadoop Eco System Frameworks: Applications on Big Data using Pig, Hive and HBase
Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators,
Hive: Apache Hive architecture and installation, Hive shell, Hive services, Hive metastore, comparison with traditional databases, HiveQL, tables, querying data and user defined functions, sorting and aggregating, Map Reduce scripts, joins &subqueries.
HBase:Hbase concepts, clients, example, Hbasevs RDBMS, advanced usage, schema design, advance indexing, Zookeeper – how it helps in monitoring a cluster, how to build applications with Zookeeper. IBM Big Data strategy, introduction to Infosphere, BigInsights and Big Sheets, introduction to Big SQL.

Course Outcomes: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand and Identify Big Data and its business implications.	K2, K3
2	CO2. Make use various techniques for mining data stream.	K3
3	CO3. List the components of Hadoop and Hadoop Eco-System	K1
4	CO4. Apply Map Reduce programming model to access and process data on Distributed File System	K3
5	CO5. Manage job execution in Hadoop environment and develop Big Data solutions by applyingHadoop Eco System components	K3

Suggested Readings:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business, Intelligence and Analytic Trends for Today's Businesses", Wiley
2. Big-Data Black Book, DT Editorial Services, Wiley
3. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill.

4. Thomas Erl, WajidKhattak, Paul Buhler, “Big Data Fundamentals: Concepts, Drivers and Techniques”, Prentice Hall.
5. Bart Baesens “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)”, John Wiley & Sons
6. ArshdeepBahga, Vijay Madisetti, “Big Data Science & Analytics: A HandsOn Approach“, VPT
7. AnandRajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP
8. Tom White, "Hadoop: The Definitive Guide", O'Reilly.
9. Eric Sammer, "Hadoop Operations", O'Reilly.
10. Chuck Lam, “Hadoop in Action”, MANNING Publishers
11. Deepak Vohra, “Practical Hadoop Ecosystem: A Definitive Guide to Hadoop-Related Frameworks and Tools”, Apress
12. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilly
13. Lars George, "HBase: The Definitive Guide", O'Reilly.
14. Alan Gates, "Programming Pig", O'Reilly.
15. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer
16. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons
17. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons
18. Pete Warden, “Big Data Glossary”, O’Reilly

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MCA Semester IV (Elective-IV)

MCAE43- Advanced Database Management System

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To Understand the principles of distributed databases and how they differ from centralized databases.
2. To enhance the previous knowledge of database systems by deepening the understanding of the theoretical and practical aspects of the database technologies and showing the need for distributed database technology to tackle deficiencies of the centralized database systems.
3. Focuses on understanding the concepts of designing and managing distributed databases.
4. To Provide a cohesive overview regarding the importance of data management and data analytics in the era we are living

UNIT-I **Lectures: 09**

Introduction
Distributed Data Processing, Distributed Database System, Promises of DDBSs, Problem areas, Architectural Models for Distributed DBMS, DDMBS Architecture, Alternative Design Strategies, Distribution Design Issues, Fragmentation, and Allocation.

UNIT–II **Lectures: 09**

Query Processing and Decomposition
Query processing objectives, characterization of query processors, layers of query processing, query decomposition, localization of distributed data, Query optimization, centralized query optimization, distributed query optimization algorithms.

UNIT-III **Lectures: 09**

Transaction Management
Definition, properties of transaction, types of transactions, distributed concurrency control: serializability, concurrency control mechanisms & algorithms, time - stamped & optimistic concurrency control Algorithms, deadlock Management.

UNIT–IV **Lectures: 09**

Distributed DBMS Reliability
Reliability concepts and measures, fault-tolerance in distributed systems, failures in Distributed DBMS, local & distributed reliability protocols, site failures and network partitioning.Parallel database system architectures, parallel data placement, parallel query processing, load balancing, database clusters.

UNIT-V **Lectures: 09**

Distributed Object Database Management Systems

Fundamental object concepts and models, object distributed design, architectural issues, object management, distributed object storage, object query Processing, Inheritance, object identity, persistent programming languages, persistence of objects, comparison OODBMS and ORDBMS

Course Outcomes: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand theoretical and practical aspects of distributed database systems.	K1
2	CO2. Study and identify various issues related to the development of Query processing and decomposition in distributed database system.	K2
3	CO3. Illustrate the concept and significance of transactions in distributed database system.	K2
4	CO4. Identify the concept of Reliability, fault-tolerance and Parallel database system architectures.	K3
5	CO5. Understand the design aspects of object-oriented database system and related development.	K1

Suggested Readings:

1. M. Tamer OZSU and PatuckValduriez: Principles of Distributed Database Systems, Pearson Edn. Asia, 2001.
2. Stefano Ceri and Giuseppe Pelagatti: Distributed Databases, McGraw Hill.
3. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom: "Database Systems: The Complete Book", Second Edition, Pearson International Edition
4. Garcia-Molina, Ullman, Widom,′ Database System Implementation′ Pearson Education
5. Silberschatz, Korth and Sudershan, DatabaseSystemConcept′,McGrawHill

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MCA Semester IV (Elective-IV)
MCAE44- Compiler Design

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To Explore the principles, algorithms, and data structures involved in the design and construction of compilers.
2. The course is intended to teach the students the basic techniques that underlie the practice of Compiler Construction.
3. To Introduce the major concept areas of language translation and compiler design and to develop an awareness of the functions.

UNIT-I **Lectures: 09**

Introduction to Compiler: Phases and passes, Bootstrapping, Finite state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG.

UNIT–II **Lectures: 09**

Basic Parsing Techniques: Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables

UNIT-III **Lectures: 09**

Syntax-directed Translation: Syntax-directed Translation schemes, Implementation of Syntaxdirected Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array references in arithmetic expressions, procedures call, declarations and case statements.

UNIT–IV **Lectures: 09**

Symbol Tables: Data structure for symbols tables, representing scope information. Run-Time Administration: Implementation of simple stack allocation scheme, storage allocation in block structured language. Error Detection & Recovery: Lexical Phase errors, syntactic phase errors semantic errors

UNIT-V **Lectures: 09**

Code Generation: Design Issues, the Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator. Code optimization: Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.

Course Outcomes: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Acquire knowledge of different phases and passes of the compiler and also able to use the compiler tools like LEX, YACC, etc.	K3
2	CO2. Understand the parser and its types i.e. Top-Down and Bottom-up parsers and construction of LL, SLR, CLR, and LALR parsing table.	K2, K3
3	CO3. Analyze the compiler using syntax-directed translation method and get knowledge about the synthesized and inherited attributes.	K4,
4	CO4. Acquire knowledge about run time data structure like symbol table organization and different techniques used in that.	K3
5	CO5. Understand the target machine's run time environment, its instruction set for code generation and techniques used for code optimization.	K12, K4

Suggested Readings:

1. K. Muneeswaran,CompilerDesign,FirstEdition,Oxford University Press.
2. J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, Tata McGraw-Hill,2003.
3. HenkAlblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.
4. Aho, Sethi& Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education
5. V Raghvan, " Principles of Compiler Design", TMH
6. Kenneth Louden," Compiler Construction", Cengage Learning.
7. Charles Fischer and Ricard LeBlanc," Crafting a Compiler with C", Pearson Education

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MCA Semester IV

MCAIRA 402- Office Automation
(Intra-departmental Course)

Credit: 04, IA Marks: 30, ESE Marks: 70
Lectures: 45 Hours, Tutorials: 15 Hours

OBJECTIVES OF THE COURSE:

1. To understand the fundamental concept of computer.
2. To understand the basics concept of communication and network.
3. To explore various features of MS-Word and its applications.
4. To develop understanding of MS-Excel. To design the presentation using MS-power Point.
5. To understand the fundamental concept of database and working with MS-Access.

UNIT-I **Lectures: 06**

Basics of Computers: Introduction, Functional Components of Computers (Input unit, CPU, Memory and Output unit), Block diagram of computer, Characteristics of Computers. Application of Computers, Types of Memory (Primary and Secondary), Introduction to software.Introduction to Data Communication and Networking, Introduction to Internet.

UNIT–II **Lectures: 09**

MS-Word:

Working with Documents: Opening & Saving files, Editing text documents, Inserting, Deleting, Cut, Copy, Paste, Undo, Redo, Find, Search, Replace, Formatting page & setting Margins, Converting files to different formats, Importing & Exporting documents, Sending files to others, Using Tool bars, Ruler, Using Icons, using help

Formatting Documents: Setting Font styles, Font selection- style, size, colouretc, Type face - Bold, Italic, Underline, Case settings, Highlighting, Special symbols, Setting Paragraph style, Alignments, Indents, Line Space, Margins, Bullets & Numbering.

Setting Page style: Formatting Page, Page tab, Margins, Layout settings, Paper tray, Border & Shading, Columns, Header & footer, Setting Footnotes & end notes – Shortcut Keys; Inserting manual page break, Column break and line break, Creating sections & frames, Anchoring & Wrapping, Setting Document styles, Table of Contents, Index, Page Numbering, date & Time, Author etc., Creating Master Documents, Web page.

Creating Tables: Table settings, Borders, Alignments, Insertion, deletion, Merging, Splitting, Sorting, and Formula, Drawing - InsertingClipArts, Pictures/Files etc.,

Tools: Word Completion, Spell Checks, Mail merge, Templates, Creating contents for books, Creating Letter/Faxes, Creating Web pages, Using Wizards, Tracking Changes, Security, Digital Signature.

Printing Documents: Shortcut keys.

UNIT-III **Lectures: 10**

MS-Excel: Spread Sheet & its Applications, Opening Spreadsheet, Menus - main menu, Formula Editing, Formatting, Toolbars, Using Icons, Using help, Shortcuts, Spreadsheet types.

Working with Spreadsheets- opening, Saving files, setting Margins, Converting files to different formats (importing, exporting, sending files to others), Spread sheet addressing - Rows, Columns & Cells, Referring Cells & Selecting Cells – Shortcut Keys.

Entering & Deleting Data: Entering data, Cut, Copy, Paste, Undo, Redo, Filling Continuous rows, columns, Highlighting values, Find, Search & replace, Inserting Data, Insert Cells, Column, rows & sheets, Symbols, Data from external files, Frames, Clipart, Pictures, Files etc, Inserting Functions, Manual breaks

Setting Formula: finding total in a column or row, Mathematical operations (Addition, Subtraction, Multiplication, Division, Exponentiation), Using other Formulae.

Formatting Spreadsheets: Labelling columns & rows, Formatting- Cell, row, column & Sheet, Category - Alignment, Font, Border & Shading, Hiding/ Locking Cells, Anchoring objects, Formatting layout for Graphics, Clipart etc., Worksheet Row & Column Headers, Sheet Name, Row height & Column width, Visibility - Row, Column, Sheet, Security, Sheet Formatting & style, Sheet background, Colouretc, Borders & Shading – Shortcut keys.

Working with Sheets: Sorting, Filtering, Validation, Consolidation, and Subtotal.

Creating Charts: Drawing. Printing

Using Tools: Error checking, Spell Checks, Formula Auditing, Creating & Using Templates, Pivot Tables

UNIT–IV **Lectures: 10**

MS-Power Point: Introduction to Presentation, Opening New Presentation, Different Presentation Templates, Setting Backgrounds, Selecting Presentation Layouts.

Creating a Presentation: Setting Presentation style, Adding text to the Presentation

Formatting a Presentation: Adding style, Colour, gradient fills, Arranging objects, Adding Header & Footer, Slide Background, Slide layout. Adding Graphics to the Presentation- Inserting pictures, movies, tables etc into presentation, Drawing Pictures using Draw.

Adding Effects to the Presentation: Setting Animation & transition effect.

Printing Handouts: Generating Standalone Presentation viewer

UNIT-V **Lectures: 10**

MS-Access: Data and information – Limitations of Manual Data Processing – Advantages of databases. Introduction to MS-Access: Creating Tables, Modifying Table Structures, Data Entity, Edit, Delete, Importing – Exporting table.

Queries: Select Queries, Grouping, Parameters, Data Formatting, queries based on multiple sources, Cross Tab Queries , Action Queries , Make Table Queries, Append, Delete and Update Queries.

Forms and Reports: Forms – functions and uses – creating, Modifying labels List Boxes, Dialog Boxes. Reports: Creating, Modifying reports, Creating Reports.

Course Outcomes: Course Outcome: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand the basic component of computers, software and	K2

	hardware.	
2	CO2. Acquire knowledge about MS-Word and different formatting styles used in that.	K2, K3
3	CO3. Acquire knowledge about MS-Excel and different techniques used in that.	K2, K3
4	CO4. Acquire knowledge about MS-Power Point and formatting styles used in that.	K2, K3
5	CO5. Acquire knowledge about MS-Access and different techniques such as creating form, writing queries used in that.	K2, K3

Suggested Readings:

1. Fundamental of Computers – By V.Rajaraman, B.P.B. Publications
2. Fundamental of Computers – By P.K. Sinha
3. Microsoft Office 2007 Bible - John Walkenbach,HerbTyson,FaitheWempen,caryN.Prague,MichaelR.groh,PeterG.Aitken, and Lisa a.Bucki -Wiley India pvt.ltd
4. Discovering the Internet: Complete - Shelly Cashman 4th Edition - Course Technology
5. Introduction to Information Technology - Alexis Leon, Mathews Leon, and Leena Leon, Vijay Nicole Imprints Pvt. Ltd., 2013.
6. Office 2007 – By Shelly, Cengage Publication

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MCA Semester IV

MCAPD 403- Dissertation (Project) (Software/Research) **Credit: 04, IA Marks: 30, Final Marks: 70**

MCAPV 404- Project- Viva-Voce **Credit: 04, IA Marks: 30, Final Marks: 70**

OBJECTIVES OF THE COURSE:

To help students develop openness to new ideas in computer science, develop the ability to draw reasonable inferences from observations and learn to formulate and solve new computer science problems using analytical and problem-solving skills; To help students develop the ability to synthesize and integrate information and ideas, develop the ability to think creatively, develop the ability to think holistically and develop the ability to distinguish between facts and opinion; To help students acquire the necessary competences to build a real-life software system by completing different software life cycle phases (like, specification, architecture, design, implementation, validation, documentation, etc. To help students acquire the necessary competences to build a Research Project.

Major-Project using Web Engineering Tools: Design and Implementation of Web Applications, Web Services, Mobile Applications etc. Students are required to incorporate the followings: Dynamic Pages, Adding Dynamic Functionality Interactive User Interface Databasein the back-end XML and Databases Provision for EDIs Adding Security Features, etc.

For developing the project, students may use the followings:

J2EE Platform, .NET Platform, Eclipse JAVA, C#, VC++, Python, etc Microsoft Frontpage/Flash/PHP/Dreamweaver etc. XML, DHTML, CGI, Scripting Languages (JSP, ASP, PHP),
PYTHON or Suitable Technologies.

Course Outcomes: After successful completion of this course students will be able to:

S. No.	Course Outcome	Bloom's Taxonomy
1	CO1. Understand project characteristics and various stages of a project.	K2
2	CO2. Understand the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic	K2, K3
3	CO3. Demonstrate a sound technical knowledge of the project.	K2, K4
4	CO4. Illustrate & Apply different software package for project	K4, K5