UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A ++' GRADE' UNIVERSITY)
Baba Saheb Ambedkar Road, Jammu-180006 (J&K)

Academic Section
Email: academicsectionju14@gmail.com

NOTIFICATION
(25/Sept./Adp./88)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the syllabi and courses of studies for **Post Graduate Programme** in **Computer Application (MCA)** under **NEP-2020** as per details given below:-

Two Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
MCA	Semester-I	December 2025, 2026 and 2027
	Semester-II	May 2026, 2027 and 2028
	Semester-III	December 2026, 2027 and 2028
	Semester-IV	May 2027, 2028 and 2029

The Syllabi of the courses are also available on the University website: www.jammuuniversity.ac.in

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/25/10221-23
Dated: 25/9/25
Copy for information and necessary action to:

1. Dean, Faculty of Mathematical Science
2. Director/Convener, Board of Studies in Computer Science and IT
3. Sr. P.A. to the Controller of Examinations
4. Director, Centre for IT Enabled services and Management, University of Jammu for information and for uploading on University Website.
5. All members of the Board of Studies
6. Joint Registrar (Evaluation/P.G. Exam.)
7. Programmer, Computer Section, Examination Wing

Dhruva 24/9/25
Joint Registrar (Academic)
18/9/25

Proforma for syllabi

MCA Syllabi (NEP-2020)

						Course Type	Marks		Nature of Course						
S. No.	Course No.	Course Title	No. of Credits	Credit Level	Credit points	Core/Elective/Any Other	Theory	Practical	Global	National	Regional	Skill	SWAYAM / MOOC	Vocational course	Research Project/Summer Internship/ Dissertation
1	P2CSTC101	Operating System using Linux	4	400		Core	100		Yes				No		
2	P2CSTC102	Advanced Database Management System	4	400		Core	100		Yes				No		
3	P2CSTC103	OOPS using C++	4	400		Core	100		Yes			Yes	No		
4	P2CSTC104	Discrete Mathematics	4	400		Core	100		Yes				No		
5	P2CSTC105	Computer Architecture	4	400		Core	100		Yes				No		
6	P2CSPC180	Practical (C++, SQL and Linux)	6			Core		150	Yes			Yes	No		
7	P2CSTC201	Data Structures using C++	4	400		Core	100		Yes				No		
8	P2CSTC202	Algorithm Design & Analysis	4	400		Core	100		Yes				No		
9	P2CSTC203	Web Technologies	4	500		Core	100		Yes			Yes	No		
10	P2CSTC204	Computer Networks	4	500		Core	100		Yes				No		

11	P2CSTC205	Artificial Intelligence	4	500		Core	100		Yes				No		
12	P2CSPC280	Practical (based on above courses)	6			Core		150	Yes			yes	No		
13	P2CSVC251	Machine Learning using Python	4	500		Core	100		Yes			Yes	No	Yes	
14	P2CSTC301	Theory of Computation and Compiler Design	4	500		Core	100		Yes				No		
15	P2CSTC302	Machine Learning using Python	4	500		Core	100		Yes			Yes	No		
16	P2CSTC303	Java Programming	4	500		Core	100		Yes			Yes	No		
17	P2CSTE304	Software Engineering	4	500		Elective	100		Yes				No		
18	P2CSTE305	Network Security and Cryptography	4	500		Elective	100		Yes				No		
19	P2CSTE306	Data Mining & Warehousing	4	500		Elective	100		Yes				No		
20	P2CSTE307	Cloud Computing and Internet of Things	4	500		Elective	100		Yes				No		
21	P2CSTE308	Image Processing and Data Visualization	4	500		Elective	100		Yes				No		

22	P2CSTE309	Computer Graphics	4	500		Elective	100		Yes				No	No	
23	P2CSTE310	Blockchain Technology	4	500		Elective	100		Yes				No	No	
24	P2CSTE311	Neural Networks and Fuzzy Logic	4	500		Elective	100		Yes				No	No	
25	P2CSMO351	MOOC/ SWAYAM Course*	4				100						Yes	No	
26	P2CSPC380	Practical (based on above courses)	6			Core		150	Yes			Yes	No	No	
27	P2CSRC480	Project Work	20			Core		450	Yes			Yes	No	No	Yes

Master of Computer Applications (MCA)

Programme Outcomes

- After pursuing the MCA degree candidates have a wide range of job opportunities in various industries, particularly in the software industry. Some of the most common career paths include software developer, data scientist, business analyst, web developer, and project manager.
- An MCA graduate can also make productive careers in academia as the Department provides an outstanding environment for teaching and research in the core and emerging areas of the discipline.
- Develop the ability to analyze, design, develop, and integrate software systems and computer applications using appropriate programming languages, tools, and methodologies.
- Understand and demonstrate professional ethics, legal responsibilities, and best practices in computing to contribute responsibly to the IT profession and society.

Programme Specific Outcomes

- The graduates shall be proficient in applying software engineering principles and practices to design, develop, and deploy scalable and efficient software solutions across various domains.
- The graduates shall be capable of contributing to research, innovation, and the development of emerging technologies such as AI, Data Science, Blockchain, and IoT.
- The graduates shall be equipped with strong analytical and programming skills to work effectively both independently and as part of multidisciplinary teams.

Annexure-A

Revised Syllabus - 2025
(NEP-2020)

MASTER OF COMPUTER APPLICATIONS
(MCA)
(Two Years Programme)

Programme Code: PGFMC001

Revised Syllabus - 2025
(NEP-2020)

MASTER OF COMPUTER APPLICATIONS (MCA)

(Two Years Programme)

Guidelines, Scheme and Course Details

FOR THE STUDENTS
TO BE ADMITTED IN THE SESSIONS

2025-2026, 2026-2027, 2027-2028

DEPARTMENT OF COMPUTER SCIENCE & IT,
UNIVERSITY OF JAMMU

MCA PROGRAMME STRUCTURE (TWO YEARS)
(NEP 2020)

Semester I

Course No.	Title	Credits	Contact hours per week
			L-T-P
P2CSTC101	Operating System using Linux	4	4-0-0
P2CSTC102	Advanced Database Management System	4	4-0-0
P2CSTC103	OOPS using C++	4	4-0-0
P2CSTC104	Discrete Mathematics	4	4-0-0
P2CSTC105	Computer Architecture	4	4-0-0
P2CSPC180	Practical (C++, SQL and Linux)	6	0-0-12
	Total Credits	**26**	
P2CSTB100	Mathematical Foundation of Computer Science	4	4-0-0

Semester II

Course No.	Title	Credits	Contact hours per week
			L-T-P
P2CSTC201	Data Structures using C++	4	4-0-0
P2CSTC202	Algorithm Design & Analysis	4	4-0-0
P2CSTC203	Web Technologies	4	4-0-0
P2CSTC204	Computer Networks	4	4-0-0
P2CSTC205	Artificial Intelligence	4	4-0-0
P2CSPC280	Practical (based on above courses)	6	0-0-12
	Total Credits	**26**	
P2CSVC251	Machine Learning using Python	4	4-0-0

Semester III

Course No.	Title	Credits	Contact hours per week
			L-T-P
P2CSTC301	Theory of Computation and Compiler Design	4	4-0-0
P2CSTC302	Machine Learning using Python	4	4-0-0
P2CSTC303	Java Programming	4	4-0-0
P2CSTE304 P2CSTE305 P2CSTE306 P2CSTE307	**Elective I (Anyone of the following courses)** Software Engineering Network Security and Cryptography Data Mining & Warehousing Cloud Computing and Internet of Things	4	4-0-0
P2CSTE308 P2CSTE309 P2CSTE310 P2CSTE311	**Elective II (Anyone of the following courses)** Image Processing and Data Visualization Computer Graphics Blockchain Technology Neural Networks and Fuzzy Logic	4	4-0-0
P2CSMO351	MOOC/ SWAYAM Course*	4	4-0-0
P2CSPC380	Practical (based on above courses)	6	0-0-12
	Total Credits	**30**	

*Student shall register for SWAYAM/MOOC in December/January of 1st Year of MCA Programme and shall be credited in 3rd semester.

Semester IV

Course No.	Title	Credits	Contact hours per week
			L-T-P
P2CSRC480	Project Work	20	0-4-36
	Total Credits	**20**	

TOTAL CREDITS=102

MCA - FIRST SEMESTER

Course title: **Operating System using Linux**
Course no: **P2CSTC101**
No. of credits: **04**
Total marks: **100**

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2025, 2026, and 2027

Course objectives & learning outcomes:

1. To learn the mechanisms involved in memory management in Operating System (OS)
2. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion, deadlock detection algorithms and agreement protocols
3. To brief the students about basic concepts of Unix & Linux and programs using shell programming
4. Students will be able to understand core operating system concepts, including process, memory, file, and I/O management
5. Students will be able to apply Linux commands and shell scripting for basic system operations and automation

UNIT–I Operating System(OS)

OS (Types, views and services), System calls, Types of system calls, Layered structure of OS, Microkernels, Virtual machines.

(10 Hours)

UNIT–II Process Management

Process (concept and operation), Inter-process communication, Mutual exclusion, Process scheduling, Scheduling algorithms, Process Synchronization, Inter process Synchronization, Critical section problem, Semaphores, Monitors, Message passing, Deadlocks (System Model, Characterization, Prevention and Avoidance).

(10 Hours)

UNIT–III Memory Management

Memory management, Swapping, Contiguous memory allocation, Relocation & protection, Paging, Segmentation, Intel Pentium (Segmentation and Paging), Virtual memory, Demand paging, Performance of demand paging, Page replacement algorithms (FIFO, Optimal, LRU, Counting based).

(10 Hours)

UNIT–IV File & I/O Management

Files system (Structure and implementation), Directory Implementation, File Allocation Methods, Disk organization, Disk space management, Disk scheduling, Disk Management, RAID Structure.

(10 Hours)

UNIT –V LINUX / UNIX

Files and Directories, Directory Tree, File and Directory Commands, Pipes and Filters, Processes commands. Shell Programming (Logical Operators, Control statements).

(10 Hours)

Suggested readings/ references:

1. ***Operating System Concepts*** – *Silberschatz, Galvin, Gagne , WSE Wiley*
2. ***Modern Operating Systems*** – *Andrew S. Tanenbaum , Pearson Prentice Hall*
3. ***Operating System: Concepts and Design*** – *Milan Milenkovic , McGraw Hill International*
4. ***Operating Systems*** – *A. S. Godbole , Tata McGraw Hill*
5. ***Operating System*** – *Deitel H. M. , Pearson Publications*
6. ***Operating Systems*** – *Madnick & Donovan , Tata McGraw Hill*
7. ***The Complete Reference Linux*** – *Richard L. Petersen , Tata McGraw Hill*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A &amp: B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA - FIRST SEMESTER

Course title: **Advanced Database Management System**
Course no: **P2CSTC102**
No. of credits: **04**
Total marks: **100**

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2025, 2026, and 2027

Course objectives & learning outcomes:

1. To introduce the fundamental concepts and architecture of database systems, including data models, schemas, and DBMS components.
2. To develop the ability to design, normalize, and manipulate relational databases using ER models, relational algebra, and SQL.
3. To understand transaction management and ensure data consistency through concurrency control and recovery techniques.
4. Students will be able to understand core database concepts including data models, schemas, and architectures.
5. Students will be able to design, normalize, and query relational databases using SQL, and apply concurrency control and recovery techniques.

UNIT–I Database Systems and Architectures

Traditional file-based system, Conventional file organizations, Need and Components of DBMS, Hierarchical and network data models, Schemas and Instances, Data independence, DBMS Architectures (Three level, Centralized and client server).

(10 Hours)

UNIT–II Relational Data Models

Entity relationship model, Relational Database Design using ER to Relational Mapping, EER Model, Joins, Relational Algebra and Relational Calculus Concepts, Queries using Relational Algebra and Calculus.

(10 Hours)

UNIT–III Normalization

Concept of keys, Functional dependencies, Inference rules, Covers, Closure, Equivalence of functional dependencies, Multivalued dependencies, Theory of normalization, Normal forms.

(10 Hours)

UNIT–IV Concurrency Control

Transaction processing, Deadlocks, Concurrency control, Locking techniques, Timestamp ordering, Recovery techniques, Distributed Database Concepts.

(10 Hours)

UNIT–V SQL

SQL query processing, Table creation and management, Inbuilt functions, Data integrity constraints, Views, Joins, Operators, Privileges, roles and security policies.

(10 Hours)

Suggested readings/ references:

1. ***An Introduction to Database Systems*** – *Bipin C. Desai , West Publishing Company*
2. ***Fundamentals of Database Systems*** – *Ramez Elmasri, Shamkant B. Navathe , Pearson Education*
3. ***An Introduction to Database Systems*** – *C. J. Date , Addison Wesley Pearson Education*
4. ***Data Modeling and Database Design*** – *Narayan S. Umanath, Richard W. Scamell , Thomson Course Technology India*
5. ***The Power of Oracle 9i*** – *R. A. Parida, Vinod Sharma , Firewall Media Publications*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA - FIRST SEMESTER

Course title: **OOPS using C++**
Course no: **P2CSTC103**
No. of credits: **04**
Total marks: **100**

Minor Test 1: 20 Marks of 1.5 hours duration
Minor Test 2: 20 Marks of 1.5 hours duration
Major Test: 60 Marks of 3.0 hours duration

For examinations to be held in Dec- 2025, 2026, and 2027

Course objectives & learning outcomes:

1. To understand fundamental concepts such as objects, classes, inheritance, polymorphism, and compare it with procedural programming
2. To learn and apply basic C++ programming constructs including data types, control statements, functions, structures, and I/O operations.
3. To develop object-oriented programs using concepts like constructors, operator overloading, inheritance, file handling, templates, and exception handling for building reusable and maintainable applications.
4. Students will be able to design and implement object-oriented programs in C++ using classes, inheritance, polymorphism, and operator overloading.
5. Students will be able to perform file I/O operations, handle errors, and use templates and exceptions to create robust and reusable software components.

UNIT–I Object Oriented Methodology

Programming Languages Paradigms, Comparison of Object Oriented and Procedure Oriented Approaches, Applications of OOPS, Objects, classes, inheritance, reusability, creating new data types, polymorphism and overloading.

(10 Hours)

UNIT–II Programming Constructs

Basic program construction, data types, Input output statements, control statements, Structures, Enumeration. Functions : passing arguments, returning values, reference arguments, overloaded functions, inline functions, default arguments, variables and storage class and returning by reference

(10 Hours)

UNIT–III Classes and Operator Overloading

Class, object as function argument, constructors as function argument, overloaded constructors, copy constructors, returning objects from functions, structures and classes, static class data, const and classes, Arrays and Strings.

Overloading unary and binary operator, data conversion, and pitfalls.

(10 Hours)

UNIT–IV Inheritance and Virtual Functions

Inheritance: derived class and base class, derived class constructors, overloading member functions, class hierarchies, public and private inheritance, level of inheritance, multiple inheritance, virtual inheritance new and delete operator. Virtual functions.

(10 Hours)

UNIT –V Files and Generic Programming

Virtual functions, friend functions, static functions, this pointer. Streams and files: stream classes, stream errors, disk file I/O with streams, file pointers, error handling in file I/O.

Generic Programming: Templates (function templates, class templates), exceptions.

(10 Hours)

Suggested readings/ references:

1. ***C++: The Complete Reference*** *- Herbert Schildt, McGraw Hill*
2. ***Object Oriented Programming in C++*** *- Robert Lafore, Galgotia Publications*
3. ***C++; How to Program - H.M. Deitel and P.J. Deitel,*** *Prentice Hall*
4. ***The C++ Programming Language*** *- Bjarne Stroustrup, Addison Wesley*
5. ***Programming with C++*** *- D. Ravichandran, Tata McGraw Hill*
6. ***Object Oriented Programming Using C++*** *- E. Balagurusamy, Tata McGraw Hill*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA - FIRST SEMESTER

Course title: **Discrete Mathematics**
Course no: **P2CSTC104**
No. of credits: **04**
Total marks: **100**

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2025, 2026, and 2027

Course objectives & learning outcomes:

1. To understand concepts of discrete mathematics including counting, relations, graphs, and logic.
2. To develop problem-solving skills through recurrence relations, graph theory, and combinatorial structures.
3. To apply discrete mathematical concepts in computer science contexts such as algorithms, data structures, and formal logic.
4. Students will be able to apply principles of discrete mathematics—including counting, recurrence relations, relations, functions, and graph theory—to model and solve computational problems.
5. Students will be able to analyze and construct logical expressions, graph structures, and mathematical models relevant to computer science applications.

Unit –I Overview of Counting

Basic principles of counting, pigeon-hole principle, generating functions, recurrence relations, linear recurrence relations with constant coefficients, Modeling various problems as recurrence relations. Homogenous recurrence relations and their solutions, particular solutions and total solution. Recurrence Relations (Fibonacci and Tower of Hanoi Problems)

(10 Hours)

Unit –II Relations and Functions

Domain, range and inverse of Relation, Composition of relations, Types of relations, Closure of relations etc. Relation vs Function, Types of functions, Sum and product of functions, functions used in Computer Science (Floor and Ceil functions, Remainder, characteristic and hash function),

(10 Hours)

Unit –III Theory of Graphs

Graphs, multigraphs, directed and weighted graphs, Paths and Circuits, Types of graphs, Computer representation of graphs, Operations on Graphs, spanning trees (BFS, DFS and their applications), shortest path in weighted graphs and planar graphs, Detection of planarity. Eulerian paths and circuits, Hamiltonian paths and circuits.

(10 Hours)

Unit –IV Trees and Graph Coloring

Tree and its properties, Center of a tree and rooted trees, tree traversals, minimal spanning trees, cut sets, etc. Coloring of graphs, dual graph; Vertex coloring, Chromatic number; Chromatic polynomial, The four colour problem, Edge Coloring, Coloring algorithms, Applications of trees and graph coloring.

(10 Hours)

Unit –V Mathematical Logic

Propositions, connectives, conditionals and biconditionals, well-formed formulas, tautologies, equivalence of formulas, duality law, normal forms, inference theory for propositional calculus; predicate calculus: predicates, free and bound variables, inference theory of predicate calculus. Introduction to algebraic structures, groups.

(10 Hours)

Suggested Readings/References:

1. ***Elements of Discrete Mathematics*** – *C. L. Liu – McGraw-Hill Education*
2. ***Discrete Mathematics and Its Applications*** – *K. H. Rosen – McGraw-Hill Education*
3. ***Concrete Mathematics*** – *R. L. Graham, D. E. Knuth, O. Patashnik – Addison Wesley*
4. ***Discrete Mathematical Structures with Applications to Computer Science*** – *J. P. Tremblay, R. P. Manohar – McGraw-Hill*
5. ***Graph Theory with Applications to Engineering and Computer Science*** – *N. Deo – Prentice-Hall Inc.*
6. ***Applied Discrete Structures of Computer Science*** – *A. Doerr, K. Levasseur – Galgotia Publications Pvt. Ltd.*

MCA - FIRST SEMESTER

Course title: **Computer Architecture**
Course no: **P2CSTC105**
No. of credits: **04**
Total marks: **100**

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2025, 2026, and 2027

Course objectives & learning outcomes:

1. To develop a strong foundation in digital logic design, number systems, and circuit implementation using combinational and sequential components.
2. To understand the architecture and organization of memory systems, including memory hierarchy, I/O techniques, and data transfer mechanisms.
3. To introduce students to processing concepts such as RISC architecture, pipelining, and parallel processing.
4. Students will be able to identify and explain the components of digital electronics, understand logical organization, and perform computer arithmetic operations.
5. Students will understand and analyze memory organization, data flow, and control mechanisms within computer systems.

UNIT–I Digital Systems and Number Representation

Digital systems: Von Neumann architecture, Digital and Analog systems.
Number Systems: Representation & conversions (Decimal, Binary, Octal, Hexadecimal), Binary arithmetic operations, Representation of negative numbers (1's complement and 2's complement), Code Representation (BCD code & Excess-3 and their arithmetic operations).

(10 Hours)

UNIT–II Logic Gates and Boolean algebra

Logic Gates: Basic, Universal Gates, Derived.
Boolean algebra: Boolean laws, Boolean Expressions (SOP, POS form and their simplifications), K–map, code converters; Error detection & correction (Hamming code).

(10 Hours)

UNIT–III Combinational circuits

Half and Full Adder, Half and Full Subtractor, Parallel adders, Encoder (4-to-2 binary encoder, priority encoder); Decoder (2-to-4 and 3-to-8 line decoder); Multiplexer and Demultiplexer.

(10 Hours)

UNIT–IV Sequential circuits

Flip-flops and their types, level clocking and edge triggered clocking, Registers and their types, bidirectional register.

(10 Hours)

Unit –V Memory Organization and Advanced Processing Concepts

Memory (hierarchy, characteristics and types), Cache memory, Memory address map to CPU, Bus structure, Modes of I/O transfers.
RISC Architecture, Pipelining Concepts, instruction and arithmetic pipeline, Parallel Processing, Flynn's Classification.

(10 Hours)

Suggested readings/ references:

1. ***Computer System Architecture*** *– M. M. Mano – Prentice-Hall*
2. ***Digital Principles and Applications*** *– A. P. Malvino, D. P. Leach – Tata McGraw-Hill*
3. ***Digital Electronics – Fundamental Concepts*** *– C. E. Strangio – Prentice-Hall*
4. ***Structured Computer Organization*** *– Andrew S. Tanenbaum – Pearson Education Inc.*
5. ***Microprocessor and Microcomputer*** *– J. Khambata – John Wiley and PHI*
6. ***Introduction to Computer Architecture*** *– S. Stone – Galgotia Publications*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -
The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA - FIRST SEMESTER

Course title: **Mathematical Foundation of Computer Science**
Course no: **P2CSTB100**
No. of credits: **04**
Total marks: **100**

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2025, 2026, and 2027

Course objectives & learning outcomes:

1. To provide a strong foundation in set theory, linear algebra, and vector operations essential for computer science applications.
2. To develop analytical skills in probability, statistics, and their application in data analysis and decision-making.
3. To equip students with numerical techniques for solving differentiation and integration problems arising in computational tasks.
4. Students will be able to apply mathematical concepts such as sets, matrices, vectors, and probability to solve real-world computing problems.
5. Students will gain the ability to use numerical methods for differentiation and integration in scientific and engineering computations.

UNIT -I Set Theory
Sets and Subsets (Intersection Union and Complements), Demorgan's Law, Cardinality, Relations , Mapping.
(10 Hours)

UNIT-II Linear Equations and Matrices
Matrices (Types and Operations), Determinants (Properties and Operations), Solving linear equations, Solving Simultaneous equation.
(10 Hours)

UNIT-III Vector Algebra
Vectors in 2D and 3D, Vector addition and subtraction, product (Scalar and Vector), triple product (Scalar and Vector)
(10 Hours)

UNIT-IV Probability and Statistics
Random variables, Discrete random variables, Probabilty Distributions (Binomial and Poisson).
Measures of central tendency (mean, median for grouped data), Measures of dispersion (Mean deviation and Standard deviation. Variance)
(10 Hours)

UNIT- V Numerical Differentiation and Integration
Finite differences, Newton's forward and backward difference formulas, Numerical differentiation using finite differences, Central difference formulas. Numerical integration, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Error analysis in numerical integration.
(10 Hours)

Suggested readings/ references:

1. ***Discrete Mathematics and Its Applications*** *- Kenneth H. Rosen, McGraw Hill*
2. ***Higher Engineering Mathematics*** *- B.S. Grewal, Khanna Publishers*
3. ***Advanced Engineering Mathematics*** *- Erwin Kreyszig, Wiley*
4. ***Probability and Statistics for Engineers and Scientists*** *- Ronald E. Walpole, Pearson*
5. ***Numerical Methods for Engineers*** *- S.S. Sastry, PHI Learning*
6. ***Vector Algebra*** *– R. Gupta ,Laxmi Publications*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -
The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)
Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

BRIDGE COURSE

Students admitted to MCA programme who have not studied mathematics at 10+2 level, are required to enrol and compulsorily pass the Bridge Course in addition to the passing the regular Semester-I courses, in order to earn eligibility for admission to Semester–III of the MCA programme. Bridge Course shall be of qualifying nature only and will not be included in the total credits earned by the student for awarding MCA degree. The bridge course exam will be conducted twice a year.

MCA-FIRST SEMESTER

Course title: **Practical**
Course no: **P2CSPC180**
No. of credits: **06**
Total marks: **150**

Internal Evaluation: **75 Marks**
External Evaluation: **75 Marks**

For examinations to be held in Dec- 2025, 2026, and 2027

This Practical course shall be primarily based on C++, SQL and Linux. The course carries 150 marks distributed as follows:

Practical			**Marks**	
Internal Evaluation	I	Program Implementation & Viva-Voce	65	75
	II	Practical File	10	
External Evaluation				75
Total				**150**

Internal Evaluation

Guidelines for internal Assessment of practical courses

- Performance of the students will be evaluated based on a comprehensive system of continuous evaluation.
- For each practical course, students will be given regular assignments by the concerned practical teacher(s).
- The Implementation of assignments will be assessed & evaluated and viva-voce will be conducted at least once in every fifteen days and the students shall be awarded based on their performance.
- Record of the Internal evaluation shall be maintained regularly by the concerned teacher(s).
- At the end of the semester all the awards of the students shall be consolidated for the purpose of preparing the final award of the Internal Evaluation.

External Evaluation

The External practical evaluation shall be conducted by an external examiner. The internal practical teacher incharge shall coordinate the conduct of the external practical examination.

MCA –SECOND SEMESTER

Course title: **Data Structures Using C++**
Course no: **P2CSTC201**
Total marks: **100**

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in May- 2026, 2027, and 2028

Course objectives & learning outcomes:

1. To impart the basic concepts, implementations and analysis of data structures.
2. To strengthen the ability to solve problems with the help of fundamental data structures.
3. Student will be able to implement appropriate data structure in various domains
4. Students will be able to analyze and apply linear and non-linear data structures with respect to time and space complexity.
5. Students will be able to implement efficient sorting, searching, and indexing techniques for problem-solving.

UNIT–I Fundamental Notations
Primitive and composite data types, self-referential structures, Algorithms, Types of data structures, Operations, Time and space complexity of algorithms, Asymptotic notation.
(10 Hours)

UNIT–II Linear Data Structures
Arrays, Linked lists, Stacks, Queues, operations and their complexities, Implementations, Applications.
(10 Hours)

UNIT–III Non-Linear Data Structures
Trees, Binary Trees, Traversing binary trees, Threaded binary trees, Binary search trees, heaps, Graphs, Traversing graphs.
(10 Hours)

UNIT–IV Indexing Structures
ISAM, m-way trees, B–trees, B+–trees, Hashing techniques for direct access, Collision in hashing, Collision resolution.
(10 Hours)

UNIT–V Sorting & Searching
Internal and External sorts, Bubble sort, Insertion sort, Selection sort, Shell sort, Quick sort, Radix sort, Merge sort, Types of merging, Searching-linear and binary search methods, Comparison of sorting and searching methods.
(10 Hours)

Suggested readings/ references:

1. ***Data Structures and Algorithms-*** Alfred V. Aho, John E. Hopcroft, and Jeffrey D. Ullman *Pearson Education India*
2. ***Introduction to Data Structures with Applications-*** Jean-Paul Tremblay and Paul G. Sorenson, *Tata McGraw-Hill*
3. ***Data Structures Using C and C++*** - Yedidiah Langsam, Moshe J. Augenstein, and Aaron M. Tenenbaum, *Pearson Prentice Hall*
4. ***Data Structures and Algorithms-*** GAV Pai, *Tata McGraw-Hill*
5. ***Data Structures and Algorithms in C++*** -Adam Drozdek, *Thomson Asia Pvt. Ltd.*
6. ***Advanced Data Structures-*** Peter Brass,*Cambridge University Press*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -
The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA –SECOND SEMESTER

Course title: **Algorithm Design & Analysis**
Course no: **P2CSTC202**
No. of credits: **04**
Total marks: **100**

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in May- 2026, 2027, and 2028

Course objectives & learning outcomes:

1. To understand the fundamental principles of algorithm design and analysis, including recursive algorithms, recurrence relations, and performance evaluation.
2. To learn various algorithm design techniques such as divide-and-conquer, dynamic programming, backtracking, and greedy methods.
3. To explore the classification of computational problems, NP-completeness, and graph algorithms for problem-solving in computer science.
4. Students will be able to design algorithms using techniques such as divide-and-conquer, dynamic programming, etc.
5. Students will gain the ability to classify problems based on complexity and apply graph algorithms to solve real-world scenarios.

UNIT–I Algorithms and Randomized Techniques

Algorithm (Characteristic and Specifications), Recursive Algorithms, Recurrence Relations, Induction proofs, Performance Analysis. Sets and Disjoint Set Union.

Randomized Algorithms: Basic of Probability Theory, Classification of Randomized algorithms, Identifying the repeated Elements, Primality Testing, Advantages and Disadvantages.

(10 Hours)

UNIT–II Analysis Techniques

Efficiency of an Algorithm, Asymptotic Functions & Notations, Sorting Algorithms, Comparison of Sorting Algorithms, Best-Case and Worst-Case Analyses, Average-Case Analysis, Amortized Analysis.

(10 Hours)

UNIT–III Design Techniques-I

Divide-and-Conquer: General Method, Multiplication of two n-bit numbers, Binary Search, Merge Sort, Quick Sort, Strassen's Matrix multiplication, Exponentiation, etc.

Dynamic Programming: General Method, The Principle of Optimality, The Problem of Making Change, Chained Matrix Multiplication, etc.

(10 Hours)

UNIT–IV Design Techniques-II

Backtracking: General method, N-queen's problem, Sum of subsets problem, etc.

Greedy Algorithms: General Method, Knapsack problem, Job sequencing with deadlines, Minimum Spanning Trees, Kruskal's Algorithm, Prim's Algorithm, Dijkstra's Single Source Shortest Path Algorithm, etc.

(10 Hours)

UNIT–V Classification of Problems & Graphs Algorithms

Non-Deterministic Algorithms, Complexity classes, NP-Completeness, Establishing NP-Completeness of Problems, NP-Completeness Proofs, NP-Hard Problems.

Graphs Algorithms: Traversing Trees, Depth-First Search, Breadth-First Search, Best-First Search & Topological Sort.

(10 Hours)

Suggested readings/ references:

1. ***Introduction to Algorithms*** – *Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, MIT Press*
2. ***Computer Algorithms*** – *E. Horowitz, S. Sahni, S. Rajasekaran, Universities Press*
3. ***Design and Analysis of Algorithms*** – *Aho, Ullman, Hopcroft, Pearson Education*
4. ***Computer Algorithms: Introduction to Design and Analysis*** – *Sara Baase, Allen Van Gelder, Pearson Education*
5. ***Introduction to the Design and Analysis of Algorithms: A Strategic Approach*** – *R. C. T. Lee, S. S. Tseng, R. C. Chang, Y. T. Tsai, Tata McGraw-Hill*
6. ***Algorithm Design: Foundations, Analysis and Internet Examples*** – *M. T. Goodrich, R. Tomassia, John Wiley and Sons*

MCA –SECOND SEMESTER

Course title: **Web Technologies**
Course no: **P2CSTC203**
No. of credits: **04**
Total marks: **100**

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in May- 2026, 2027, and 2028

Course objectives & learning outcomes:

1. To introduce the fundamental concepts of web development using HTML, CSS, and JavaScript.
2. To enable students to build responsive and user-friendly interfaces using modern frameworks
3. To equip students with server-side programming skills using Node.js and MySQL for developing full-stack web applications.
4. Students will be able to design and develop static web pages using HTML and CSS, incorporating HTML5 semantic elements.
5. Students will be able to implement interactive features on web pages using JavaScript, including DOM manipulation, event handling, and the use of regular expressions.

UNIT-I: HTML

HTML Elements, HTML Tags, Formatting Tags, HTML Attributes, Lists, Images, Hyperlink, Tables, Grouping Using Div Span, iFrame, Forms, Headers, HTML5 (Semantic Elements, Form Elements, Form Input Types, Form Attributes).

(10 Hours)

UNIT-II: Cascading Style Sheets

Types, Syntax, Selectors (ID, Class, Tags, Attributes), Styling (Backgrounds, Texts, Fonts, Links, Lists, Tables), CSS Box Model, Transforms (2D, 3D), Transitions, Bootstrap, Responsive Web Design, Bootstrap 5 Setup, Grid System, Utility Classes, Typography, Forms, Navigation, Button, Cards, Alerts.

(10 Hours)

UNIT- III: JavaScript

Syntax, Data Types, Variables & Operators, Control Flow, Arrays, Objects, Functions, DOM, Event Handling, Regular Expressions.

(10 Hours)

UNIT -IV: Building Interfaces with React

Setup React, Conditionals, Class, props, state, Keys, List, children, Lifecycle methods, Events and Forms, Component composition and data flow.

(10 Hours)

UNIT- V: Server Side Scripting Using Node JS

Setup Development Environment, REPL, Command Line Options, Event loop, Node JS Module, Package Manager, Buffers, Creating Web Server, Streams, File System, Node.JS MySql.

(10 Hours)

Suggested readings/ references:

1. ***Internet and Worldwide** Web – H. M. Deitel, P. J. Deitel, A. B. Goldberg, Pearson Education*
2. ***Web Programming** – Chris Bates, Wiley Dreamtech India*
3. ***Multimedia and Web Technology** – Ramesh Bangia, Firewall Media*
4. ***Mastering Javascript and Jscript** – James Jaworski, BPB*
5. ***HTML, XHTML, and CSS Bible** – Steven M. Schafer, Wiley India*
6. ***Beginning HTML, XHTML, CSS, and JavaScript** – John Duckett, Wiley India*
7. ***Eloquent JavaScript: A Modern Introduction to** Programming – MarijnHaverbeke, No Starch Press*
8. ***React Up & Running: Building Web Applications** – StoyanStefanov, O'Reilly*
9. ***Node.JS Web Development** – David Herron, PACKT Publishing*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA –SECOND SEMESTER

Course title: **Computer Networks**
Course no: **P2CSTC204**
No. of credits: **04**
Total marks: **100**

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in May- 2026, 2027, and 2028

Course objectives & learning outcomes:

1. To study the basic taxonomy and terminology of the computer networking model and architecture.
2. To study the fundamentals of data communication and protocols.
3. To study network design and performance issues.
4. Students will be able to demonstrate a solid understanding of communication fundamentals and networking models.
5. Students will be able to design and implement networking solutions.

UNIT–I Fundamentals of Communication

Communication, Modulation, Data Encoding, OSI reference model, TCP/IP model, Inter-networking, Physical layer, Switching Technique, Transmission media, Transmission Impairments, Electromagnetic Spectrum, Radio waves, Microwaves, Satellites.

(10 Hours)

UNIT–II Data Transmission and Media access Methods

Data Link layer, Error detection and correction, Flow Control, Elementary Data link protocols, Character-oriented and Bit-oriented Protocols.

Channel allocation methods, TDM, FDM, ALOHA, Carrier sense Multiple access protocols, Collision free protocols, Token Bus, Token ring.

(10 Hours)

UNIT–III Network Establishment Concepts

Network Layer, Store and Forward Packet Switching, Connectionless and Connection-oriented services, Virtual Circuit, Routing Algorithms, Shortest path, Flooding, Link State, Distant vector, Hierarchical, Broadcast and Multicast Routing. OSPF, BGP, Congestion, Congestion control algorithms.

(10 Hours)

UNIT–IV Internet Protocols

IP Addresses, Classes of IP Addresses, Subnets, Internet Control Protocols (ARP, RARP, BOOTP, DHCP), Transport Layer, TCP and UDP, Sockets, Socket Programming concept.

(10 Hours)

UNIT–V Network Application and Network Security

Domain Name service (DNS), Traditional applications: Telnet, FTP, SMTP, MIME, World wide web-HTTP, HTTP Methods.

Cryptographic Algorithms, DES, AES, RSA, Key exchange methods, Authentication Protocol, Digital Signatures.

(10 Hours)

Suggested readings/ references:

1. ***Computer Networks*** *– Andrew S. Tanenbaum, Pearson Education Asia*
2. ***Data Communications and Networking*** *– Behrouz A. Forouzan, Tata McGraw Hill*
3. ***Data and Computer Communication*** *– William Stallings, Pearson Education Asia*
4. ***Data Communications and Computer Networks*** *– Prakash C. Gupta, PHI*
5. ***Data and Network Communications*** *– Michael A. Miller, Delmar Thomson Learning*
6. ***Computer Networking*** *– James F. Kurose, Keith W. Ross, Pearson Education*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA –SECOND SEMESTER

Course title: **Artificial Intelligence**
Course no: **P2CSTC205**
No. of credits: **04**
Total marks: **100**

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in May- 2026, 2027, and 2028

Course Objectives & Learning Outcomes

1. To provide a strong foundation of fundamental concepts in Artificial Intelligence
2. To analyze and design a real-world problem for implementation and understand the dynamic behaviour of a system.
3. To enable the student to apply these techniques in applications which involve perception, reasoning and learning.
4. Students will be able to demonstrate foundational understanding of Artificial Intelligence concepts.
5. Students will be able to apply appropriate AI search and reasoning techniques.

UNIT-I Introduction

Basic Elements of AI, Turing Test, Rational Agent Approaches, State Space Representation of Problems, Game Playing (Min-Max Search, Alpha Beta Cutoff Procedures), Expert system, Existing expert systems (MYCIN and DENDRAL)

(10 Hours)

UNIT-II Searching Techniques

Heuristic Search techniques, Hill Climbing, Best first search: A* algorithm, The AO* Algorithm. Constraint satisfaction

(10 Hours)

UNIT-III Knowledge Representation

Prepositional Logic, First Order Predicate Logic, CNF, DNF, Prenex Normal Form, Resolution, Unification, Inference Mechanisms: Semantic Nets, Frames, Scripts, conceptual dependencies, Procedural & Declarative knowledge, Reasoning, Uncertainty.

(10 Hours)

UNIT–IV Multi Agent Systems and Genetic Algorithms

Multi Agent Systems, Agents and Expert Systems, Generic Structure of Multiagent System, Semantic Web, Agent Communication, Knowledge Sharing using Ontologies, Genetic Algorithms (GA): Encoding Strategies, Genetic Operators, Fitness Functions and GA Cycle; Problem Solving using GA.

(10 Hours)

UNIT–V Natural Languages

Parsing techniques, context free and transformational grammars, transition nets, augmented transition nets, Fillmore's grammar, sentence generation.

(10 Hours)

Suggested readings/references:

1. ***Artificial Intelligence*** *– Kevin Knight, Elaine Rich, B. Nair, McGraw Hill Education*
2. ***Introduction to Artificial Intelligence*** *– E. Charniak, Narosa Publishing House*
3. ***Artificial Intelligence: A Modern Approach*** *– S. Russell, P. Norvig, Pearson Education*
4. ***Artificial Intelligence*** *– George F. Luger, Pearson Education*
5. ***Introduction to Artificial Intelligence and Expert Systems*** *– Dan W. Patterson, PHI*
6. ***Our Final Invention: Artificial Intelligence and the End of the Human Era*** *– James Barrat, Macmillan*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA- SECOND SEMESTER

Course title: **Practical**
Course no: P2CSPC280
No. of credits: **06**
Total marks: **150**

Internal Evaluation: **75 Marks**
External Evaluation: **75 Marks**

*For examinations to be held in **May- 2026, 2027, and 2028***

This Practical course shall be primarily based on Data structures using C++, Algorithm Design and Web Technology. The course carries 150 marks distributed as follows:

Practical			Marks	
Internal Evaluation	I	Program Implementation & Viva-Voce	65	75
	II	Practical File	10	
External Evaluation				75
Total				**150**

Internal Evaluation

Guidelines for internal Assessment of practical courses

- Performance of the students will be evaluated based on a comprehensive system of continuous evaluation.
- For each practical course, students will be given regular assignments by the concerned practical teacher(s).
- The Implementation of assignments will be assessed & evaluated and viva-voce will be conducted atleast once in every fifteen days and the students shall be awarded based on their performance.
- Record of the Internal evaluation shall be maintained regularly by the concerned teacher(s).
- At the end of the semester all the awards of the students shall be consolidated for the purpose of preparing the final award of the Internal Evaluation.

External Evaluation

The External practical evaluation shall be conducted by an external examiner. The internal practical teacher incharge shall coordinate the conduct of the external practical examination.

VOCATIONAL COURSE

Course title: **Machine Learning Using Python**
Course no: P2CSVC251
No. of credits: 04
Total marks: 100

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

*For examinations to be held in **May- 2026, 2027, and 2028***

Course objectives & learning outcomes:

1. To introduce students to state-of-the-art methods and modern programming tools for data analysis
2. To understand complexity of Machine Learning algorithms and their limitations
3. To understand modern notions in data analysis-oriented computing
4. Student will be able to implement various packages of Python Library
5. Student will be able to perform experiments in Machine Learning using real-world data using Python

UNIT–I Machine Learning

Supervised, unsupervised, semi supervised and reinforcement learning, Steps in the design of learning system, Training and testing, Cross Validation, Feature Reduction/Dimensionality reduction, Performance prediction parameters, Applications of machine learning. (10 Hours)

UNIT–II Classification and Clustering Algorithms

Supervised Learning, Labelled data, Classification, and its algorithms (Naive-Bayes classifier, Decision trees, Support vector machines), Principal component analysis (Eigen values, Eigen vectors, Orthogonality).
Unsupervised Learning, Unlabelled data, Clustering, and its types (Hierarchical, Fuzzy, Density based, Distance based, Model based, K-means clustering, Nearest Neighbour).

(10 Hours)

UNIT–III Genetic Algorithm and Deep Learning

Introduction, Q learning, Temporal Difference Learning, Learning from Examples, Reward Hypothesis. Genetic algorithm (Steps involved in genetic algorithm, Applications of genetic algorithm). Deep learning concepts, Tools and Platforms.

(10 Hours)

UNIT–IV Python Programming

Data types, variables, and operators, Complex data types (strings, tuples, named tuples, lists, sets, frozen sets, dictionaries, iteration and copying of collections and arrays), Program flow control, Conditional statements, Loops (ranges, strings, lists, and dictionaries), Exception handling.

(10 Hours)

UNIT–V Machine Learning and Deep Learning with Python

Classification and Prediction, Text Identification, Scikit Learn, Python libraries: Pandas, NumPy, Matplotlib etc.
Deep learning (Tools, Libraries), Implementation of Deep learning model on images.

(10 Hours)

Suggested readings/ references:

1. ***Machine Learning: A Probabilistic Perspective***- *Kevin Murphy, MIT Press*
2. ***Pattern Recognition and Machine Learning***-*Christopher M. Bishop, Springer*
3. ***Understanding Machine Learning: From Theory to Algorithms***- *Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press*
4. ***Neural Networks and Learning Machines***- *Simon Haykin, Prentice Hall*
5. ***Fuzzy Logic with Engineering Applications***.-*Timothy J. Ross, John Wiley & Sons*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

Vocational: *This is 04 credit course mandatory for the students who intend to exit after First year(after semester-II) of 02 PG programme and desire to get diploma of completion of first year, the vocational course shall be held during summer term.*

MCA –THIRD SEMESTER

Course title: **Theory of Computation and Compiler Design**

Course no: P2CSTC301
No. of credits: 04
Total marks: 100

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2026, 2027, and 2028

Course objectives & learning outcomes:

1. To apply mathematical foundations, algorithmic principles and computer science theory to the modelling and design of computational systems
2. To demonstrate knowledge of basic mathematical models of computation and describe how they relate to formal languages
3. To understand the limitations of computers and know about unsolvable problems
4. Students will be able to apply formal methods and parsing techniques to design efficient compilers and to develop syntax-directed translations
5. Students will be able to analyze the capabilities and limitations of computational models to classify problems based on decidability and computability

UNIT–I Regular languages and Expressions

Symbols, Alphabet, Strings, Backus-Naur Form, Languages, Grammar, Classification of Grammars, Regular Set and expressions, Algebra of Regular expressions, Regular grammar, Regular languages, Closure properties of Regular languages, Applications of regular expressions. Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), ε-NFA, Equivalence Finite Automata, Equivalence of Regular Expression and Finite Automata, Pumping Lemma for Regular Languages, Applications of finite automata, Mealy and Moore Machines.

(10 Hours)

UNIT–II Context Free Grammar (CFG)

Production rules and derivation, Types of Productions, Reduction of Grammar, Normal Forms (Chomsky and Griebach), Pushdown Automata (PDA), Equivalence between CFG and PDA, Context Free Language, Closure properties for context free languages, Pumping Lemma for Context free languages, Applications of Context Free Grammar.

(10 Hours)

UNIT–III Turing Machines

Description, Transition diagram, Roles of Turing machine, Church-Turing Thesis, Modular Construction of complex Turing machines, Extensions of Turing machines, Non-Deterministic Turing Machines. Universal Turing Machine, Turing acceptable and Turing decidable languages.

Decidable and Undecidable Problems, The Halting Problem, Reduction to Another Undecidable Problem, Undecidability of Post Correspondence Problem.

(10 Hours)

UNIT–IV Compiler Structure &Front end

Compiler Structure: Compilers and Translators, Analysis- Synthesis Model of Compilation, Phases of Compiler, Error Reporting, LEX., Capabilities of Lexical Analyzer.

Parsing Techniques: Top-Down parsers with backtracking, Recursive Descent Parsers, Predictive Parsers, Non-recursive Predictive Parsers.

(10 Hours)

UNIT–V Errors Detection & Recovery, Code generation & Optimization

Bottom–up Parsers, Shift-Reduce Parsing, Operator Precedence Parsers, LR parsers.

Error Detection and Recovery: Lexical, Syntactic and Semantic phase errors.

Intermediate Code Generation: Intermediate Code forms (Three address code, Quadruples & Triples). Sources of optimization, Local optimization, Peephole optimization

Code Generation: Issues, Basic Blocks and Flow Graphs, Transformations on Basic Blocks, Code Generation Algorithm, Register Allocation and Assignment.

(10 Hours)

MCA –THIRD SEMESTER

Course title: **Machine Learning Using Python**
Course no: P2CSTC302
No. of credits: 04
Total marks: 100

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2026, 2027, and 2028

Course objectives & learning outcomes:

1. To introduce students to state-of-the-art methods and modern programming tools for data analysis
2. To understand complexity of Machine Learning algorithms and their limitations
3. To understand modern notions in data analysis-oriented computing
4. Student will be able to implement various packages of Python Library
5. Student will be able to perform experiments in Machine Learning using real-world data using Python

UNIT–I Machine Learning

Supervised, unsupervised, semi supervised and reinforcement learning, Steps in the design of learning system, Training and testing, Cross Validation, Feature Reduction/Dimensionality reduction, Performance prediction parameters, Applications of machine learning. (10 Hours)

UNIT–II Classification and Clustering Algorithms

Supervised Learning, Labelled data, Classification, and its algorithms (Naive-Bayes classifier, Decision trees, Support vector machines), Principal component analysis (Eigen values, Eigen vectors, Orthogonality).
Unsupervised Learning, Unlabelled data, Clustering, and its types (Hierarchical, Fuzzy, Density based, Distance based, Model based, K-means clustering, Nearest Neighbour).

(10 Hours)

UNIT–III Genetic Algorithm and Deep Learning

Introduction, Q learning, Temporal Difference Learning, Learning from Examples, Reward Hypothesis. Genetic algorithm (Steps involved in genetic algorithm, Applications of genetic algorithm). Deep learning concepts, Tools and Platforms.

(10 Hours)

UNIT–IV Python Programming

Data types, variables, and operators, Complex data types (strings, tuples, named tuples, lists, sets, frozen sets, dictionaries, iteration and copying of collections and arrays), Program flow control, Conditional statements, Loops (ranges, strings, lists, and dictionaries), Exception handling.

(10 Hours)

UNIT–V Machine Learning and Deep Learning with Python

Classification and Prediction, Text Identification, Scikit Learn, Python libraries: Pandas, NumPy, Matplotlib etc.
Deep learning (Tools, Libraries), Implementation of Deep learning model on images.

(10 Hours)

Suggested readings/ references:

6. ***Machine Learning: A Probabilistic Perspective***- *Kevin Murphy, MIT Press*
7. ***Pattern Recognition and Machine Learning***-*Christopher M. Bishop, Springer*
8. ***Understanding Machine Learning: From Theory to Algorithms***- *Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press*
9. ***Neural Networks and Learning Machines***- *Simon Haykin, Prentice Hall*
10. ***Fuzzy Logic with Engineering Applications***,-*Timothy J. Ross, John Wiley & Sons*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions.

(3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA –THIRD SEMESTER

Course title: **JAVA Programming**
Course no: P2CSTC303
No. of credits: 04
Total marks: 100

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2026, 2027, and 2028

Course Objectives & Learning Outcomes:

1. To understand the core language features of Java and understand the fundamentals of Object-Oriented Programming in Java
2. To equip students with practical skills in exception handling, file I/O, multithreading, collections, and GUI development using AWT and event handling
3. To develop the ability of using Java to solve real world problems
4. Students will be able to understand the basic programming constructs and realize the fundamentals of OOP in Java
5. Students will gain the skills and realize the exception handling mechanism, use the data structures in the collections

Unit-I: Java Constructs
Features of Java Language, JVM, Bytecode, Java Programming Structure, Basic Programming Constructs, Data Types, Variables, Operators, Expressions, Command Line argument, Control and Looping Constructs, Arrays (Fixed Size, Variable Size), String and StringBuffer, Wrapper classes, The Transient and Volatile Modifiers.

(10 Hours)

Unit-II: Object Oriented Programming
Class, Access Specifiers, objects and assigning object reference variables, array of objects, constructors and destructors, usage of "this" and "static" keywords, Inheritance and its types, Final keyword, Polymorphism, Abstract class, Interfaces.

(10 Hours)

Unit-III: Exception Handling and Multithreading
Packages: Creating and Accessing, Sub Packages
Exception Handling: Types of exception, control flow in exceptions, use of try, catch, finally, throw, throws in exception handling, user defined exception. Thread life Cycle-Creating multi-threads and synchronization.

(10 Hours)

UNIT–IV: Streams, Events and Collections
I/O in Java, Byte Stream Classes, Character Stream Classes, Reading and Writing to Console, Reading and Writing Files.
Event Delegation Model (Events, Listeners, interfaces), Handling Events of Mouse and Keyboard.
Collections, List, Queue, Maps, Iterators, Comparators.

(10 Hours)

UNIT–V: AWT, Regular Expression and JDBC
AWT Components, Building User Interface with AWT, Regular Expressions, JDBC implementation, Connection class, Statements, Types of statement objects, Types of resultset, ResultSetMetadata, Catching Database Results, Handling database Queries, JDBC and AWT.

(10 Hours)

Suggested Readings/ References:

1. ***The Complete Reference*** *- Java, Herbert Schildt- Tata McGraw-Hill.*
2. ***Core Java Volume I– Fundamentals-*** *Cay S. Horstmann, Oracle Press.*
3. ***Professional Java for Web Applications****-Nicholas S. Williams, Wrox Press.*
4. ***Effective Java-*** *Joshua Bloch, Addison-Wesley.*
5. ***Java Generics and Collections-*** *Maurice Naftalin& Philip Wadler, O'Reilly Media.*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -
The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions.

(3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

Course title: Software Engineering
Course no: P2CSTE304
No. of credits: 04
Total marks: 100

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2026, 2027, and 2028

Course objectives & learning outcomes:

1. To gain knowledge of basic software engineering methods and their appropriate application
2. To understand software testing approaches such as unit testing and integration testing
3. To produce efficient, reliable, robust, and cost-effective software solutions
4. Students will be able to perform independent research and analysis
5. Students will be able to analyze, design, verify, validate, implement, apply, and maintain software systems

UNIT–I Software Engineering

Evolution of Software Engineering, Layered technology, Process framework, Software engineering paradigms, Software process technology, Software Requirements Analysis, Analysis Principles, Modeling the system architecture, Software prototyping and specification.

(10 Hours)

UNIT–II Software Design

Design Process, Concepts, Principles, Architectural Design, Data Design, Mapping requirements into Software Architecture, Effective modular design, Procedural Design, Interface design, Human Computer Interface design.

(10 Hours)

UNIT–III Software Quality Planning and Project Management

Evaluation of individual projects: Technical assessment, Cost-benefit analysis (Evaluation Techniques and Risk evaluation), Concept and Importance of Software Project Management, Software cost estimation techniques, Types of project metrics, Models for cost estimation (COCOMO, Putnam's, function point). Project scheduling, Scheduling activities, Schedule development methods (Critical Path Method, Critical Chain Scheduling, PERT).

(10 Hours)

UNIT–IV Software Quality Assurance

Quality Planning, Quality Assurance, Quality Control (Tools and Techniques), Pareto analysis, Six Sigma, Cost of Quality, Software quality metrics (McCal's Quality Model, Boehm's Quality Model, Dromey's Quality Model), Capability maturity models.

(10 Hours)

UNIT–V Software Testing and Maintenance

Testing Issues, Testing Object-Oriented Systems, Testing Techniques: White Box Testing, Black-Box Testing, Testing Strategies: Unit Testing, Integration and Validation testing, System Testing.
Software maintenance, Characteristics, maintenance task, Reverse Engineering, Re-engineering, Clean room Software engineering.

(10 Hours)

Suggested readings/ references:

1. ***Software Engineering: A Practitioner's Approach***- *Roger S. Pressman, McGraw Hill*
2. ***Software Project Management***- *Walker Royce, Pearson Education*
3. ***An Integrated Approach to Software Engineering***- *Pankaj Jatlote, Narosa Publication*
4. ***Software Engineering Theory and Practice***- *Shari Lawrence and P. F. Legger, Pearson Education*
5. ***Object Oriented Software Metrics***- *Lorenz and Kidd, Prentice Hall*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -
The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions.

(3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA –THIRD SEMESTER

Course title: Network Security and Cryptography
Course no: P2CSTE305
No. of credits: 04
Total marks: 100

Minor Test 1: 20 Marks of 1.5 hours duration
Minor Test 2: 20 Marks of 1.5 hours duration
Major Test: 60 Marks of 3.0 hours duration

For examinations to be held in Dec- 2026, 2027, and 2028

Course Objectives & Learning Outcomes:

1. To introduce the fundamental concepts of cryptography, including encryption, decryption, and cryptanalysis.
2. To provide a strong mathematical foundation for cryptographic techniques, including modular arithmetic and totient functions.
3. To study various cryptographic concepts, techniques, and security principles used in data protection.
4. Students will be able to apply symmetric key cryptographic algorithms like DES, AES, and RC4 for secure data encryption and decryption.
5. Students will be able to design and evaluate secure communication systems using appropriate cryptographic methods and protocols.

UNIT-I Cryptography concepts and Secure Communication

Plaintext, Ciphertext, Encryption, Decryption, Modular arithmetic and Euclid's Algorithm
Number Theory concepts: Prime numbers, GCD, Fermat's Little Theorem (basic use), One-way functions (hashing), Standard security protocols and agencies (FIPS, NIST).

(10 Hours)

UNIT-II Symmetric Key Cryptography

Private key, Block Ciphers: Modes of Operation, Data Encryption Standard (DES), Double DES, Triple DES, International Data Encryption Algorithm (IDEA), Advanced Encryption Standard (AES), Stream Ciphers.

(10 Hours)

UNIT-III Asymmetric Key Cryptography

Public Key vs. Private Key Encryption, Public Key Cryptosystems, Diffie-Hellman Key Exchange, RSA Algorithm, ElGamal Cryptosystem, Knapsack Cryptosystem.
Asymmetric Cryptosystems attacks (Brute-Force, Mathematical, Side-Channel).

(10 Hours)

UNIT-IV Authentication Protocol

Authentication Fundamentals, Authentication using Symmetric and Asymmetric Key Cryptography, Reflection Attack, Man-in-the-Middle Attack, Replay Attacks, Denial of Service (DoS) and Distributed Denial of Service (DDoS) Attacks. Key Distribution Center (KDC), Kerberos Protocol, X.509 Directory Authentication Service, Pretty Good Privacy (PGP), Secure/Multipurpose Internet Mail Extensions (S/MIME).

(10 Hours)

UNIT-V Digital Signature and Hash Function

Digital Signature, Digital Signature Attacks, Hash Functions in Cryptography, Secure Hash Algorithm (SHA), Message Digest Algorithms (MD5), HMAC (Hash-based Message Authentication Code), HMAC Specifications, Digital Signature Standards (DSS), RSA.

(10 Hours)

Suggested readings/ references:

1. ***Cryptography and Network Security: Principles and Practice***-*William Stallings, Pearson Education*
2. ***Cryptography Engineering: Design Principles and Practical Applications***- *Niels Ferguson, Bruce Schneier, and Tadayoshi Kohno, Wiley*
3. ***Cryptography and Network Security***-*Behrouz A. Forouzan, McGraw-Hill Education*
4. ***Network Security Essentials: Applications and Standards***- *William Stallings, Pearson Education*
5. ***Cryptography and Network Security***-*Atul Kahate, Tata McGraw-Hill Education*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The MAJOR test will comprise into two **Sections A & B** as below.

Section A –will have 1 compulsory question comprising of 8 parts (minimum 1 from each unit) of 3 marks each. *(3 x 8 = 24 marks)*

Section B – will have 6 questions of 12 marks each to be from last three units (02 from each unit). Students are required to attend 1 question from each unit. *(12 x 3 = 36 marks)*

MCA –THIRD SEMESTER

Course title: Data Mining & Warehousing
Course no: P2CSTE306
No. of credits: 04
Total marks: 100

Minor Test 1: 20 Marks of 1.5 hours duration
Minor Test 2: 20 Marks of 1.5 hours duration
Major Test: 60 Marks of 3.0 hours duration

For examinations to be held in Dec-2026, 2027, and 2028

Course objectives & learning outcomes:

1. To understand the fundamental concepts and processes of Data Mining and Knowledge Discovery.
2. To gain proficiency in data pre-processing techniques including cleaning, integration, reduction, and transformation.
3. To gain experience of doing independent study and research in data mining.
4. Students will be able to design and develop data warehouses and apply OLAP operations for business intelligence.
5. Students will be able to apply data mining tools (like WEKA, R, Orange) in real-world scenarios across different domains including business, medical, and scientific applications.

UNIT–I Data Mining
Data Mining, Knowledge Discovery Process, Data Mining vs. Query Tools, Mining Interesting Patterns. (10 Hours)

UNIT–II Data Pre-processing
Data Cleaning, Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation. Data Mining Primitives, Data Generalization and Summarization Based Characterization, Analytical Characterization, Mining Frequent Patterns, Association and Correlations, Apriori Algorithm. (10 Hours)

UNIT-III Data Warehouse and OLAP Technology for Data Mining
Differences between Operational Databases and Data Warehouses, Three-tier Data Warehouse Architecture, Schemas - Stars, Snowflakes and Fact Constellations, Steps for the Design and Construction of Data Warehouses, Data Models (Physical, Logical and Multidimensional), Data Marts, Metadata, OLTP & OLAP, OLAP Operations, Categorization of OLAP Tools. (10 Hours)

UNIT–IV Data Mining Functionalities
Concept/Class description, Association Analysis, Classification & Prediction, Decision Tree Induction, Bayes Classification Methods, Rule –Based Classification. Cluster Analysis, Types of data, Partitioning methods (K-means), Outlier Analysis. (10 Hours)

UNIT–V Data Mining Applications and Tools
Applications (Business, Medical, Scientific), Web Mining and its applications.
Data Mining Tools: WEKA, PENTAHO, R, ORANGE. (10 Hours)

Suggested readings/ references:

1. ***Data Warehousing, Data Mining & OLAP***- *Alex Berson and Stephen J. Smith, Tata McGraw-Hill*
2. ***Fundamentals of Database Systems***- *Ramez Elmasri and Shamkant B. Navathe, Pearson Education*
3. ***Introduction to Data Mining***- *Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, Pearson Education*
4. ***Insight into Data Mining Theory and Practice***- *K. P. Soman, Shyam Diwakar, and V. Ajay, PHI*
5. ***Introduction to Data Mining with Case Studies***- *G. K. Gupta, Prentice Hall of India*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions. (3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA –THIRD SEMESTER

Course title: **Cloud Computing and Internet of Things**

Course no: P2CSTE307
No. of credits: 04
Total marks: 100

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2026, 2027, and 2028

Course objectives & learning outcomes:

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To equip students with a solid foundation in Cloud Computing for practical use and adoption in real-world scenarios.
3. To understand building blocks of Internet of Things and characteristics
4. Students will be able to explain the core concepts, characteristics, benefits, and challenges of cloud computing models and services.
5. Students will be exposed to the revolution of Internet in Mobile Devices, Cloud & Sensor Networks

UNIT–I Cloud Computing

Cloud Computing Concepts, Principles of Parallel and Distributed Computing, Cloud Characteristics. Elasticity in Cloud, On-demand Provisioning. (10 Hours)

UNIT–II Cloud Architecture, Services and Storage

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture, Types of Cloud (Public, Private and Hybrid), Cloud services (IaaS, PaaS, SaaS).
Architectural Design Challenges, Cloud Storage, Storage-as-a-Service, Cloud Storage Providers, S3, Resource Provisioning Methods in Cloud. (10 Hours)

UNIT–III Cloud Enabling Technologies and Security

Service Oriented Architecture, REST and Systems of Systems, Web Services, Publish Subscribe Model, Basics of Virtualization, Types of Virtualizations, Implementation Levels of Virtualization. Virtualization Structures, Tools and Mechanisms, Virtualization of CPU, Memory, I/O Devices, Virtualization Support and Disaster Recovery.
Security Overview, Cloud Security Challenges, Software-as-a-Service Security, Security Governance, Virtual Machine Security, IAM, Security Standards. (10 Hours)

UNIT–IV Internet of Things (IoT) and M2M

IoT & Web Technology, IoT Applications, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization.
Difference between IOT and M2M, M2M AND IoT Value Chains, ETSI M2M SCL resource structure, Security in ETSI M2M framework. (10 Hours)

UNIT–V IOT Architecture & Platforms

IOT architecture and different layers, IOT standards (RFID, NFC; IEEE 802. 15. 4: ZigBee, Z-WAVE, THREAD; Bluetooth Low Energy) and protocols.
IOT sensors (Temperature, Pressure, Proximity etc.), Microcontrollers, Microprocessors, SoC, Arduino, Pi, Spark, Intel Galileo. (10 Hours)

Suggested readings/ references:

1. ***Cloud Computing: Concepts, Technology and Architecture***- *Thomas Erl and Zaigham Mahmood, Pearson Publication*
2. ***Cloud Computing: Implementation, Management, and Security***- *John W. Rittinghouse and James F. Ransome, CRC Press*
3. ***Cloud Computing Black Book***- *Kailash Jayaswal, DreamTech Press*
4. ***The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities are Changing the World***-*Michael Miller, Pearson*
5. ***Internet of Things: A Hands-on Approach***- *Arshdeep Bahga and Vijay Madisetti, University Press*
6. ***The Internet of Things***- *Oliver Hersent, David Boswarthick, and Omar Elloumy*

MCA –THIRD SEMESTER

Course title: **Image Processing and Data Visualization**

Course no: P2CSTE308
No. of credits: 04
Total marks: 100

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2026, 2027, and 2028

Course Objectives & Learning Outcomes:

1. To understand and apply the fundamental design principles of data visualization
2. To equip students with knowledge of advanced visualization techniques
3. To enable students to apply restoration and morphological processing techniques
4. Students will be able to implement image segmentation and compression methods
5. Students will be able to apply data visualization techniques to effectively explore complex datasets

UNIT-I Data Visualization Concepts

Data Visualization Principles, Visual Encoding, Visualizing numerical quantities, distributions, and proportions, Time Series Visualization, Tools, and Implementation.

(10 Hours)

UNIT-II Advanced Visualization and Analytics

Real-time visualizations, Geospatial Data Visualization, Matrix plots and 3D plots, Graphs and Networks, Embedding Planar Graphs, Tree Maps, Principal Component Analysis, Multidimensional Scaling, Packing.

(10 Hours)

UNIT-III Image Representation and Enhancement

Digital image process, image formation and representation, image sampling and quantization, color models, image enhancement in spatial and frequency domain, image restoration.

(10 Hours)

UNIT-IV Image Restoration and Morphological Processing

Restoration process, Noise models and noise reduction, Linear and nonlinear filtering techniques, inverse filtering. Morphological Operations, Algorithms (Boundary extraction, Region filling and Skeletonization, Convex hull and Thinning)

(10 Hours)

UNIT-V Image Segmentation and Compression

Segmentation basics, Thresholding techniques, Edge-based and Region-based segmentation, Region growing and region splitting, Watershed segmentation, Morphological segmentation,
Lossless and Lossy compression strategies, Image compression standards, Image quality assessment metrics.

(10 Hours)

Suggested readings/ references:

1. ***The Visual Display of Quantitative Information***- *Edward R. Tufte, Graphics Press*
2. ***Fundamentals of Data Visualization***- *Claus O. Wilke, O'Reilly*
3. ***Digital Image Processing***- *R. C. Gonzalez and R. E. Woods, Pearson*
4. ***Digital Image Processing***- *Jayaraman, S. Esakkirajan, and T. Veerakumar, Tata McGraw-Hill Education*
5. ***Image Processing: The Fundamentals***- *M. Petrou and C. Petrou, Wiley*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions.

(3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA –THIRD SEMESTER

Course title: Computer Graphics
Course no: P2CSTE309
No. of credits: 04
Total marks: 100

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2026, 2027, and 2028

Course Objectives & Learning Outcomes:

1. To understand the fundamental principles and algorithms of 2D and 3D graphics, including primitive generation, transformations, and clipping.
2. To explore projection techniques, curve modeling, and color theories essential for realistic image generation and visualizations.
3. To gain knowledge of surface modeling and rendering methods for building and displaying complex 3D scenes and animations.
4. Students will be able to implement basic graphic algorithms and apply transformations, projections, and curve modeling techniques in computer graphics applications.
5. Students will acquire the skills to apply surface modeling and rendering techniques such as ray tracing, shading, and visibility detection for realistic graphics output.

UNIT I- Scan Conversion and Clipping Techniques
Points, Lines, Circle, Scan Conversion, Algorithms of Line (DDA and Bressenham), Circle (Bressenham, Circle Generation, Mid-Point), Side Effects of Scan Conversion, Polygon Filling, Point and Line Clipping, Line Clipping Algorithms (Cohen Sutherland and Cyrus – Beck).

(10 Hours)

UNIT II-Transformations
Introduction to 2D transformations, Composite Transformations, Transformations using Homogeneous Coordinate Systems, 3D transformations, Orientation Representation, Viewing Transformation.

(10 Hours)

UNIT III-Projections
Projections, Parallel, Orthographic and Oblique Projections, Isometric and Perspective Projections, Illumination Models, Shading.

(10 Hours)

UNIT IV-Curves and color models
Polygon representation methods, Hermite, Bezier and B-spline, Curves and their Properties. Fractals.
RGB and CMY color models, HSV and HSL color models, Color model conversions

(10 Hours)

UNIT V- Surface Modeling and Rendering Techniques
Surface of Revolution, Methods of Visible Surface Detection (Backface Removal, Z-Buffer, Painters Algorithm, Wireframe model, 3D Rendering Techniques, Ray-Tracing).

(10 Hours)

Suggested readings/ references:

1. ***Computer Graphics*** *by Donald Hearn and M. Pauline Baker, Pearson Education*
2. ***Computer Graphics with OpenGL*** *by Donald Hearn, M. Pauline Baker, and Warren Carithers, Pearson*
3. ***Principles of Interactive Computer Graphics*** *by William M. Newman and Robert F. Sproull, Tata McGraw Hill*
4. ***Computer Graphics: Principles and Practice*** *by James D. Foley, Andries van Dam, Steven K. Feiner, and John F. Hughes, Addison-Wesley*
5. ***Mathematical Elements for Computer Graphics*** *by David F. Rogers and J. Alan Adams, Tata McGraw Hill*
6. ***Computer Graphics Using OpenGL*** *by F.S. Hill Jr. and Stephen M. Kelley, Pearson*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -
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Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions.

(3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA –THIRD SEMESTER

Course title: Blockchain Technology
Course no: P2CSTE310
No. of credits: 04
Total marks: 100

Minor Test 1: 20 Marks of 1.5 hours duration
Minor Test 2: 20 Marks of 1.5 hours duration
Major Test: 60 Marks of 3.0 hours duration

For examinations to be held in Dec- 2026, 2027, and 2028

Course Objectives & Learning Outcomes:

1. To develop a deep understanding of blockchain architecture and crypto currencies
2. To explore core security mechanisms and consensus protocols in blockchain
3. Enable hands-on proficiency with blockchain platforms and smart contract development
4. Students will be able to demonstrate a comprehensive understanding of blockchain technology, decentralized systems, and the architecture of crypto currencies
5. Students will be able to evaluate and apply blockchain-based solutions to real-world problems in domains

UNIT-I Blockchain and Decentralized Systems
Blockchain, Growth of blockchain technology, Distributed systems, Bitcoin, Types of blockchain. Decentralization (Methods of decentralization, Routes of decentralization, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized organizations, platforms for decentralization).
(10 Hours)

UNI-II Blockchain and Cryptocurrencies
Blockchain Architecture, Versions, Variants, Use cases, Blockchain vs shared Database, Cryptocurrencies (types, and applications). Bitcoins (Bitcoin digital keys and addresses, Transactions, Blockchain mining). Alternative Coins. Limitations of Bitcoin.
(10 Hours)

UNIT-III Core Security and Consensus Mechanisms in Blockchain
Hashing, Cryptography, Double Spending, Consensus Protocols (Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), Practical Byzantine Fault Tolerance (PBFT)).
(10 Hours)

UNIT-IV Blockchain Platforms and Smart Contract Development
Blockchain Platforms- Public and Permissioned (Ethereum, Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts), General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, address), Hyperledger Fabric, Architecture and Components.
(10 Hours)

UNIT-V Blockchain Applications and Integration with Emerging Technologies
Blockchain Applications and Case Study: Supply Chain Management, Decentralized Identity Management, Healthcare, E-Governance, Data Security, and Integrity.
Blockchain and allied Technologies: AI, ML, IoT, Cloud Computing. (10 Hours)

Suggested readings/ references:

1. ***Blockchain Technology: Concepts and Applications*** *– Kumar Saurabh & Ashutosh Saxena, Wiley Publications.*
2. ***Mastering Blockchain*** *– Imran Bashir, Packt Publishing.*
3. ***Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World*** *– Don Tapscott & Alex Tapscott, Penguin Random House.*
4. ***Blockchain Technology: Algorithms and Applications*** *– Asharaf S., Sivadas Neelima, Adarsh S., & Franklin John, Wiley Publications.*
5. ***Cryptoassets: The Innovative Investor's Guide to Bitcoin and Beyond"*** *– Chris Burniske and Jack Tatar, McGraw-Hill Education.*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -
The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions.
(3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA –THIRD SEMESTER

Course title: Neural Networks and Fuzzy Logic

Course no: P2CSTE311
No. of credits: 04
Total marks: 100

Minor Test 1: **20 Marks of 1.5 hours duration**
Minor Test 2: **20 Marks of 1.5 hours duration**
Major Test: **60 Marks of 3.0 hours duration**

For examinations to be held in Dec- 2026, 2027, and 2028

Course Objectives & Learning Outcomes:

1. To provide a strong foundation in neural network architectures and learning algorithms
2. To introduce fuzzy logic concepts and their application to engineering problems
3. To apply soft computing techniques in intelligent systems
4. Students will be able to design, implement, and train feed-forward and recurrent neural networks using real-world datasets
5. Students will apply fuzzy rules and membership functions to handle uncertainty and imprecision in real-world scenarios

UNIT-I Neural Networks

Biological Neural Networks vs. Artificial Neural Networks, McCulloch-Pitts Neuron Model, Perceptron and Multilayer Perceptron, Activation Functions (Sigmoid, ReLU, Tanh), Learning Rules (Hebbian, Perceptron Learning, Delta Rule), Supervised vs. Unsupervised Learning.

(10 Hours)

UNIT-II Algorithms and Architectures

Backpropagation Algorithm and Gradient Descent, Convergence and Optimization, Radial Basis Function Networks, Self-Organizing Maps (Kohonen Networks), Associative Memory, Recurrent Neural Networks (RNN).

(10 Hours)

UNIT-III Advanced Neural Networks & Applications

Deep Neural Networks (DNNs), Convolutional Neural Networks (CNNs), Long Short-Term Memory Networks (LSTM), Applications in Image Processing, Forecasting, Tools & Libraries (TensorFlow, Keras, PyTorch).

(10 Hours)

UNIT-IV Fuzzy Logic

Crisp vs. Fuzzy Logic, Fuzzy Sets and Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations and Compositions, Fuzzy Rules and Inference Systems, Fuzzification and Defuzzification Methods.

(10 Hours)

UNIT-V Fuzzy Rule-Based Systems and Decision Making

Fuzzy Control Systems, Fuzzy Decision Making, Fuzzy Clustering (Fuzzy C-Means), Hybrid Systems (Neuro-Fuzzy Systems), Applications in Industrial Automation.

(10 Hours)

Suggested readings/ references:

1. ***Neural Networks and Learning Machines***- *S. Haykin, Pearson Education*
2. ***Neural Networks: A Comprehensive Foundation***- *Simon Haykin, Prentice Hall*
3. ***Neural Networks, Fuzzy Logic and Genetic Algorithms***- *S. Rajasekaran and G.A. Vijayalakshmi Pai, PHI*
4. ***Fuzzy Logic with Engineering Applications***- *Timothy J. Ross, Wiley*
5. ***Neuro-Fuzzy and Soft Computing***- *J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Prentice Hall*

NOTE FOR PAPER SETTERS FOR MAJOR EXAMINATIONS -

The question paper shall be divided into sections A & B as below. No question shall be repeated in the question paper.

Section A - There shall be eight short answer type questions of 3 marks each. In this section, questions shall be covered from each unit and the candidates shall be required to answer all the questions.

(3 x 8 = 24 marks)

Section B - There shall be three long answer type questions each set from Unit –III, IV and V with internal choice. Each question shall carry twelve marks. (12 x 3 = 36 marks)

MCA- THIRD SEMESTER

Course title: **Practical**
Course no: P2CSPC380
No. of credits: **06**
Total marks: **150**

Internal Evaluation: **75 Marks**
External Evaluation: **75 Marks**

For examinations to be held in ***December 2026, 2027, 2028***

This Practical course shall be primarily based on Python and Java. The course carries 150 marks distributed as follows:

Practical			Marks	
Internal Evaluation	I	Program Implementation & Viva-Voce	65	75
	II	Practical File	10	
External Evaluation				75
Total				**150**

Internal Evaluation

Guidelines for internal Assessment of practical courses

- Performance of the students will be evaluated based on a comprehensive system of continuous evaluation.
- For each practical course, students will be given regular assignments by the concerned practical teacher(s).
- The Implementation of assignments will be assessed & evaluated, and viva-voce will be conducted at least once in every fifteen days and the students shall be awarded based on their performance.
- Record of the Internal evaluation shall be maintained regularly by the concerned teacher(s).
- At the end of the semester all the awards of the students shall be consolidated for the purpose of preparing the final award of the Internal Evaluation.

External Evaluation

The External practical evaluation shall be conducted by an external examiner. The internal practical teacher in charge shall coordinate the conduct of the external practical examination.

MCA –FOURTH SEMESTER

Course title: **Project Work**
Course no: **P2CSRC480**
No. of credits: **20**

Internal Evaluation: **200 Marks**
External Evaluation: **300 Marks**
Total marks: **500**

For examinations to be held in May- 2027, 2028, and 2029

Project Guidelines & Scheme of evaluation

The project in fourth semester shall carry 500 marks distributed as follows:

Project Component		**Marks**
Mid-Semester Presentation & Internal Evaluation		200
End-Semester Evaluation	Project Evaluation	200
	Project Viva-voce	100
	Total	**500**

In this course a student is required to undertake a project work of four to six months duration. During this period the student shall work on a real life project under the supervision of a teacher of the department. Keeping in view the industry requirements the department will encourage students to undergo this project work in National/Multinational Companies for having an exposure of working on a project within the industry. If due to certain reasons, the students failing to get a chance to work in project in an industrial organization, the department will provide necessary facilities to work on the project within the department. The guidelines for undergoing the project work within the department or outside the department shall be as follows:

- Each student shall carry out the project work in an Industrial Organization/ Institution/Department as approved by the Department.
- In the beginning of the Semester, each student will prepare and submit a synopsis for approval of the department.
- Each student will work under the supervision of a teacher of the department. The allocation of the supervisor shall be done by the department.
- There shall be a Mid-Semester Presentation of each student where in the student will make a PowerPoint presentation of his/her work completed within that period. The date of Mid-Semester Presentation will be fixed by the department tentatively after two months duration and shall be communicated to the students through the university website/WhatsApp group and will be displayed on the department notice board.
- All the students are required to keep in touch with the respective project supervisor.
- The evaluation of Mid-Semester presentation shall be internal, to be done at the departmental level.
- End semester evaluation will be carried out by external and internal examiners.
- Each student shall be required to complete his/her project work within four to six months duration. The student failing to submit the project within the stipulated period shall have to seek special permission from the department with full justification as to why he have failed to submit the project within the stipulated period.