FACULTY OF ENGINEERING & TECHNOLOGY

SYLLABUS FOR THE

SUBJECT: COMPUTER SCIENCE

for the award of the Degree in

BACHELOR OF ARTS/ BACHELOR OF SCIENCE/ HONOURS

(Offered under 4-year UG Degree Programme)

(Credit Based Grading System)
under NEP 2020

Batch: 2025–29

(SEMESTER I-VIII)

GURU NANAK DEV UNIVERSITY AMRITSAR

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Bachelor of Arts /Bachelor of Science/Honours (Computer Science) (CBGS)
(under NEP 2020) (Batch 2025-29) (Semester System)
*(*Faculty of Engineering & Technology)

SCHEME
COMPUTER SCIENCE

SEMESTER-I				
S. No.	**Course Code**	**Course Title**	**Credits L-T-P**	**Marks**
1.		Computer Fundamentals & PC Software (Theory)	3-0-0	75
2.		Computer Fundamentals & PC Software (Practical)	0-0-1	25
		Total Semester credits	**04**	
SEMESTER-II				
1.		Introduction to Programming in C (Theory)	3-0-0	75
2.		Introduction to Programming in C (Practical)	0-0-1	25
		Total Semester credits	**04**	
SEMESTER-III				
1.		Computer Oriented Numerical & Statistical Methods (Theory)	3-0-0	75
2.		Computer Oriented Numerical & Statistical Methods (Practical)	0-0-1	25
		Total Semester credits	**04**	
SEMESTER-IV				
1.		Data Structures & File Processing using C++ (Theory)	3-0-0	75
2.		Data Structures & File Processing using C++ (Practical)	0-0-1	25
		Total Semester credits	**04**	
SEMESTER-V				
1.		Web Designing & Development (Theory)	3-0-0	75
2.		Web Designing & Development (Practical)	0-0-1	25
3.		Internship with local public/private industry/ business /organization Field Practice – 1	0-0-2	50
		Total Semester credits	**06**	
SEMESTER-VI				
1.		Data Base Management Systems (Theory)	3-0-0	75
2.		Data Base Management Systems (Practical)	0-0-1	25
		Total Semester credits	**04**	
SEMESTER-VII				
1.		Computer Networks (Theory)	4-0-0	100
2.		Information Systems (Theory)	4-0-0	100
3.		Operating System (Theory)	4-0-0	100
4.		Programming in Java (Theory)	3-0-0	75
5.		Programming in Java (Practical)	0-0-1	25
6.		Data Analytics with Python (Theory) **(Minor-1)**	3-0-0	75
7.		Data Analytics with Python (Practical) **(Minor-1)**	0-0-1	25
8.		Internship with local public/private industry/ business /organization Field Practice – 2	0-0-2	50
		Total Semester credits	**22**	

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SEMESTER-VIII

Sr. No.	Course Code	Course Title	Credits L-T-P	Marks
1.		Cloud computing (Theory)	4-0-0	100
2.		Artificial Intelligence (Theory)	4-0-0	100
3.		Software Engineering (Theory)	4-0-0	100
4.		Machine Learning (Theory)	3-0-0	75
5.		Machine Learning (Practical)	0-0-1	25
6.		Data Visualization (Theory) **(Minor-2)**	3-0-0	75
7.		Data Visualization (Practical) **(Minor-2)**	0-0-1	25
		Total Semester credits	**20**	

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SEMESTER–I
COMPUTER SCIENCE
COMPUTER FUNDAMENTALS & PC SOFTWARE
(THEORY)

M. Marks: 75 **Credits**
Time: 3 Hours **L-T-P**
3-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course outcomes:

- learn the functioning of various components of a computer system.
- identify input and output devices and storage devices.
- getting familiar with software.
- create documents, spreadsheets, and presentations

SECTION–A (12 Hrs.)

Introduction to Computer, Generations of Computers, Classification of Computers, Computer Applications:
Computer as a system, basic concepts – hardware and software, functional units, and their interrelation. Block diagram showing Central Processing Unit, Memory, and Input/Output Devices. Communication devices.

SECTION–B (11 Hrs.)

Software: System software and Application software. Programming languages.
Hardware: Input Devices- Keyboard, mouse, pens, touch screens, Bar Code reader, joystick, source data automation, (MICR, OMR, OCR), screen assisted data entry: portable/handheld terminals for data collection, voice recognition systems
Output Devices: Display Monitors, Printers, Impact Printers, Non-impact Printers, Plotters, Voice Output Systems, Projectors, Terminals.
Storage Devices: Concept of storage units (bit, byte, KB, MB etc.), Primary storage, Secondary storage, Magnetic storage devices, and Optical Storage Devices.

SECTION–C (11 Hrs.)

Operating System: meaning, purpose, Windows GUI, Command-line, Powershell overview. File Explorer.
Microsoft (MS) Office: download and install; different components
Word Processing using Microsoft (MS) Word: Overview, creating, saving, opening, importing, exporting and inserting files, formatting pages, paragraphs and sections, indents and outdents, creating lists and numbering. headings, styles, fonts and font size; editing, positioning, and viewing texts; finding and replacing text; inserting page breaks, page numbers, bookmarks, symbols, and dates; using tables, header, footer, macros, mail-merge; printing setup

SECTION–D (11 Hrs.)

Presentations using MS Powerpoint : Presentation overview, entering information, presentation creation, opening and saving presentation; inserting audio and video, shapes, different views, formatting; playing slides. Spreadsheets using MS Excel: Spreadsheet overview, Editing, Formatting, freeze panes, using formulas and functions, sorting and filtering, pivot tables, charts and Graphs.

Recommended Books:

1. P. K. Sinha, Computer Fundamentals : concepts, systems and applications, BPB Publications
2. E Balagurusamy, FUNDAMENTALS OF COMPUTERS Tata McGraw Hill Education Private Limited New Delhi.
3. Peter Norton, Introduction to Computers, McGraw Hill Education
4. MS–Office _ BPB Publications.
5. Gurvinder Singh & Rachpal Singh, Windows-Based Computer Courses.
6. E-books at OpenOffice.org
7. A Conceptual Guide to OpenOffice.org3, 2nd Edition, R. Gabriel Gurley

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SEMESTER-I

COMPUTER SCIENCE

COMPUTER FUNDAMENTALS & PC SOFTWARE (PRACTICAL)

M. Marks: 25 **Credits**
Time: 3 Hours **L-T-P**
0-0-1

Lab 2h/week
Instructions for the examiners: -
Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva should also be conducted alongside, and the student is asked viva questions related to the question and the solution he/she is working on during the exam.

Students will prepare a report after analyzing print and social media advertisements along with the local market survey to understand the desktop/laptop vendors and prices. Arrange the options available as per price/performance preferences

Lab exercises based on:

- Practice the Windows Operating System command line and the GUI for user interaction, personalization and file management
- Document preparation with Word using the features mentioned in the syllabus
- Spreadsheet processing with Excel using the features mentioned in the syllabus
- Presentation preparation with PowerPoint using the features mentioned in the syllabus

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SEMESTER-II
COMPUTER SCIENCE
INTRODUCTION TO PROGRAMMING IN C
(THEORY)

M. Marks: 75 **Credits**
Time: 3 Hours **L-T-P**
3-0-0

Instructions for the Paper Setters : -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Outcome:

- Understand and use program development lifecycle and can employ various tools for it.
- Develop the program logic to solve simple and complex problems.
- Use various programming constructs of C like branching, looping and arrays.
- Deploy the pointers for memory management.

SECTION–A

Introduction:-Introduction to Computer Programming, concept of algorithm, flow chart, program structure, Program Development life cycle - Compiling and executing programs using IDE, command line

Fundamentals: Token, Character set, Identifiers and Key Words, Constants, Variables, Expressions, Statements, Symbolic Constants; Data types, declaring variables, initializing variables, types of integers, types of floats, strings, characters

C Preprocessor directives: #define Statement, Conditional Compilation, include Files typedef, enum, Type Casting

Operations and Expressions: Arithmetic operators, Unary operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Data Input and Output statements, Library functions

SECTION–B

Control Statements: Preliminaries, While, Do–while and For statements, Nested loops, If–else, Switch, Break – Continue statements.

Program Structure Storage Class: Automatic, external and static variables, multiple file programs.

Arrays: Defining, processing an array, passing arrays to a function, multi–dimensional arrays,

Strings: String declaration, string functions and string manipulation.

SECTION–C

Functions: Brief overview, defining, accessing functions, passing arguments to function, variable scope, specifying argument data types, function prototypes, recursion.
Pointers: Fundamentals, pointer declaration, passing pointer to a function, pointer and one-dimensional arrays, operation on pointers, pointers & multi–dimensional arrays of pointers, passing functions, dynamic memory management.

SECTION–D

Structures & Unions: Defining and processing a structure, user defined data types, structures and pointers, passing structures to functions, self-referenced structure, unions, Arrays and Structures,
File handlingin C:- Introduction, file input/output function, binary file and text file.

References:

1. R.S. Salaria, Applications Programming in C, Khanna Book Publishing Co. (P) Ltd., Delhi.
2. Byron Gotterfied, Programming in C, Tata McGraw Hill Publishing Company Ltd., Delhi.
3. Yashvant Kanetkar, Let Us C, BPB Publications, Delhi.
4. Dennis Ritchie, Brian Kernighan, C Programming Language, Prentice Hall India

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SEMESTER-II

COMPUTER SCIENCE

INTRODUCTION TO PROGRAMMING IN C

(PRACTICAL)

M. Marks: 25 **Credits**
Time: 3 Hours **L-T-P**
0-0-1

Lab 2h/week
Instructions for the examiners: -
Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Lab Exercises based on Implementation of C:

1. Compiling and executing programs using IDE
2. C Preprocessor directives
3. Operations & Expressions
4. Data Input and Output statements
5. Control Statements
6. Program Structure Storage Class
7. Arrays & Strings
8. Functions & Pointers
9. Structures & Unions
10. File handling in C

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SEMESTER-III

COMPUTER SCIENCE

COMPUTER ORIENTED NUMERICAL & STATISTICAL METHODS (THEORY)

M. Marks: 75 **Credits**
Time: 3 Hours **L-T-P**
3-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course outcomes:

- learn the numerical and statistical analysis of data.
- identify different iterative solution of Non-linear Equations.
- getting familiar with trend analysis.
- Using tools for data analysis

SECTION–A

Introduction:
Numerical methods, Numerical methods versus numerical analysis, Errors and Measures of Errors.
Non-linear Equations, Iterative Solutions, Multiple roots and other difficulties, Interpolation methods, Methods of bisection, False position Method, Newton Raphson-method.

SECTION–B

Simultaneous Solution of Equations, Gauss Elimination Method Gauss Jordan method. Gauss Siedel Method, Matrix Inversion Method.

SECTION–C

Interpolation and Curve Fitting, Lagrangian Polynomials, Newtons Methods: Forward Difference Method, Backward Difference Method Divided Difference Method.
Numerical Integration and Different Tryaperzoidal Rule, Simpson's 1/3 Rule Simpson's 3/8 Rule.

SECTION–D

Numerical differentiation by Polynomial Fit Statistical Techniques
Measure of Central Tendency, Preparing frequency distribution table, Mean Arithmetic, Mean geometric, Mean harmonic, Mean median Mode.
Measure of dispersion, Skewness and Kurtosis Range, Mean deviation, Standard deviation, co-efficient of variation, Moments Skewness Kurtosis.
Correlation Bivariate Distribution Multivariate distribution.
Regression B.C., Linear Regression, Multiple Regression.
Trend Analysis least square fit linear trend, Non-linear trend

Y=axb
Y=abx
Y=acx

Polynomial fit: Y=a+alX+ea^2x2+a^nxn+n

Recommended Books:

1 B.S. Grewal: *Numerical Methods for Engineering,* Sultan Chand Publications.
2 V. Rajaraman: *Computer Oriented Numerical Methods,* Prentice Hall of India Private Ltd., New Delhi.

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SEMESTER-III

COMPUTER SCIENCE

COMPUTER ORIENTED NUMERICAL & STATISTICAL METHODS

(PRACTICAL)

M. Marks: 25 **Credits**
Time: 3 Hours **L-T-P**
0 -0 -1

Lab 2h/week

Instructions for the examiners: -

Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Lab exercises :

Numerical method exercises in C :

1. Iterative Solutions
2. Simultaneous Solution of Equations
3. Interpolation and Curve Fitting

Statistical analysis using a spread sheet tool such as MS Excel :

4. Measures of Central Tendency, Measures of dispersion
5. Correlation
6. Regression
7. Trend Analysis

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SEMESTER-IV

COMPUTER SCIENCE

DATA STRUCTURES & FILE PROCESSING USING C++

(THEORY)

M. Marks: 75 **Credits**
Time: 3 Hours **L-T-P**
3-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course outcome:

- To understand the motivation to transition to object oriented programming and its principles.
- To understand the C++ fundamental constructs
- To understand the performance of the implementations of basic linear data structures.
- To be able to implement the abstract data type list as a linked list using the node and reference pattern.
- To understand and implement trees and graph data structures

SECTION–A

Object Oriented Programming (OOP) v/s Procedural Programming; Evolution of C++; OOP Principles: Encapsulation, Inheritance, Polymorphism, Abstraction; Object Oriented Programming: Objects & Classes, Constructor & Destructor, C++ variables, identifiers, data types, operators, Classes and Objects: Constructors and Destructors; Access Specifiers (public, private, protected); I/O statements; Control statements; functions – inbuilt, user-defined, recursion;

SECTION–B

Overloading Operators: Arithmetic, Relational, Assignment, etc; Inheritance: class hierarchies, Public & Private inheritance, Level of inheritance, Overloading v/s overriding; virtual functions; Friend Functions and Friend Classes; Dynamic Memory Management in C++: New and Delete Operators; Basics of Pointer Arithmetic in C++; file handling in C++: Writing and Reading Class Objects to/from Files*;*

SECTION–C

Basic Data Structures: Introduction to elementary Data Organization and its operations, complexity of Algorithms – Big O-Notation, Time/space trade off, Arrays and Strings; Stack and its applications

Searching Techniques: Linear and Binary Search; Sorting Techniques: Bubble Sort, selection sort, insertion sort, quick sort, merge sort, heap sort.

Linked Lists: Implementation of linked list, singly and doubly linked list, linked list operations with algorithms

SECTION–D

Queues: Description of queue structure, applications, implementation of queue using arrays, priorities queues,

Trees: Description of tree structure and its terminology, binary search tree, AVL Trees, B–Trees, B+ trees.

Graphs: Description of graph structure, implementing graphs in memory using adjacency matrix or adjacency lists, various graphs traversing algorithms, finding shortest path between two nodes.

Files: File Organization Techniques (Sequential, Indexed)

Reference Books:

1. Seymour Lipschutz, Data Structure –Schaum Outline Series.
2. E Balaguruswamy, Data Structures using C++, McGraw Hill Education
3. Yashwant Kanetker, Data Structures through C++, BPB Publications
4. Trambley & Sorenson, Data Structures
5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms
6. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++
7. Robert Sedgewick, Algorithms in C, Parts 1-4: Fundamentals, Data Structures, Sorting, Searching

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SEMESTER-IV

COMPUTER SCIENCE

DATA STRUCTURES & FILE PROCESSING USING C++

(PRACTICAL)

M. Marks: 25 **Credits**
Time: 3 Hours **L-T-P**
0-0-1

Lab (2h/week)
Instructions for the examiners: -
Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Lab Exercises based on Implementation of Data Structures using C++:

- Classes and Objects, constructors and destructors
- Data types and type conversions
- Control statements
- Arrays & Strings in C++
- Searching(binary search, linear search)
- Sorting: Bubble Sort, selection sort, insertion sort, quick sort, merge sort, heap sort.
- Linked list
- Stacks (Using Arrays)
- Queues (Using Arrays)
- Trees – Traverse the BST, AVL Trees.
- Graph-transversal, finding the shortest path
- File handling

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SEMESTER-V

COMPUTER SCIENCE

WEB DESIGNING & DEVELOPMENT

(THEORY)

M. Marks: 75 **Credits**
Time: 3 Hours **L-T-P**
3-0-0

Instructions for the Paper Setters: -
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Course outcomes:

- learn the web technologies and the web development process.
- getting familiar with HTML Basics, CSS
- create websites using BootStrap and JavaScript
- Awareness of Responsive Design and Web performance optimization

SECTION-A

Introduction to Web Design and Development: Overview of web technologies and the web development process, Understanding the difference between web design and development, Introduction to HTML, CSS, and JavaScript

HTML Basics: Structure of an HTML document, Common HTML elements (headings, paragraphs, lists, links, images, Tables, Linking, Frames, Forms), Semantic HTML and its importance, Introduction to DOM.

SECTION-B

CSS Fundamentals: Introduction to CSS and its role in web design, CSS selectors, properties, and values, Box model, layout techniques (flexbox, grid)

Responsive Design: Principles of responsive web design, Media queries and breakpoints, Using frameworks like Bootstrap for responsive layouts

SECTION-C

JavaScript Basics: Introduction to JavaScript and its role in web development, Basic Programming Techniques & Constructs: Variables, data types, functions, and control structures, Operators, Functions, GET/POST Methods, DOM Manipulation & Event handling

SECTION-D

Forms Validation, Cookies, Inter-page communication and form data handling using JavaScript Web Performance Optimization: Techniques for optimizing website performance, Using tools to analyze website performance, Importance and usage of SEO (Search Engine Optimization).

Recommended books:

1. Jon Duckett, HTML and CSS: Design and Build Websites
2. Jon Duckett, JavaScript and J Query: Interactive Front-End Web Development"
3. Jennifer Niederst Robbins, Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics
4. Ben Frain, Responsive Web Design with HTML5 and CSS
5. Ethan Brown, Web Development with Node and Express
6. Terry Felke-Morris, Web Development and Design Foundations with HTML5, McGraw Hill
7. Jon Duckett, Beginning HTML, XHTML, CSS, and JavaScript, Cengage
8. Luke Welling and Laura Thomson, PHP and MySQL Web Development, Pearson Education

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SEMESTER-V

COMPUTER SCIENCE

WEB DESIGNING & DEVELOPMENT

(PRACTICAL)

M. Marks: 25 **Credits**
Time: 3 Hours **L-T-P**
0-0-1

Lab (2h/week)
Instructions for the examiners: -
Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Programming exercises based on:

- Exploring Web Technologies and Setting up the Development Environment (e.g. Visual Studio Code)
- Creating HTML Documents using headings, paragraphs, lists, links, and images
- Advanced HTML Elements (create forms), applying CSS styles, understanding Box model, Layout techniques
- Integrate Bootstrap into the project and use its grid system to create a responsive layout
- Basic JavaScript programming: GET/POST methods, DOM Manipulation, Event handling, Form validation, working with cookies
- Analyze the performance of the developed webpage using tools like Google Page Speed Insights and Understanding basic SEO

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SEMESTER-V

COMPUTER SCIENCE

INTERNSHIP WITH LOCAL PUBLIC/PRIVATE INDUSTRY/ BUSINESS/ ORGANIZATION FIELD PRACTICE-1

M. Marks: 50 **Credits**
Time: 3 Hours **L-T-P**
0-0-2
Field Practice (4h) /week

Course Outcomes:

- To put theory into practice
- To expand thinking and broaden the knowledge and skills acquired through course work in the field.
- To relate to, interact with, and learn from current professionals in the field.
- To understand and adhere to professional standards in the field
- To gain insight to professional communication
- To identify personal strengths and weaknesses
- To develop the initiative and motivation to be a self-starter and work independently

Internship/Professional practice: Internship/Professional practice can provide students the opportunity to enhance skills which include knowledge of office automation, problem-solving skills, database creation, debugging, cybersecurity, programming languages, frameworks etc. Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to implement as much knowledge as possible. The students shall take part in discussions to foster friendly and stimulating environment in which they are motivated to reach high standards and become self-confident.

Assessment : Each student, is required to

- Submit a report.
- Present the seminar on the internship orally through power point slides.
- Answer the queries.

Instructions for the Assessment:

- Candidates will undergo training and prepare an internship report. As End-Semester Examination, evaluation of the student will be based on the quality of report submitted, presentation skills and their response in the Q/A session by the examiners. The internship report carries 30 marks, seminar of 10 marks, and Q/A 10 marks.

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SEMESTER-VI

COMPUTER SCIENCE

DATABASE MANAGEMENT SYSTEMS

(THEORY)

M. Marks: 75 **Credits**
Time: 3 Hours **L-T-P**
3-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course outcomes:

- learn the various aspects of database systems.
- identify different models and the concept of ER Modelling.
- getting familiar with relational algebra and calculus.
- create queries with SQL
- Understanding database security, backup and recovery concepts

SECTION-A

Introduction to Databases: Overview of databases and DBMS, History and evolution of database systems; Types of databases: Relational, NoSQL, Object-oriented; Relational model concepts::tables, rows, columns; Comparison of database models (Hierarchical, Network, Relational); **Entity-Relationship (ER) Modeling:** Introduction to ER diagrams, Entities, attributes, relationships, Designing a database using ER modelling

SECTION-B

Relational Database Design: Converting ER diagrams to relational schemas; Relational integrity constraints, Understanding keys: Primary, Foreign, Composite; Normalization: 1NF, 2NF, 3NF, BCNF
Relational algebra operators like selection, projection, cartesian product, join and write queries using them.

SECTION-C

SQL Fundamentals: Introduction to SQL: Syntax and structure, Data Definition Language (DDL): CREATE, ALTER, DROP, Data Manipulation Language (DML): INSERT, UPDATE, DELETE; **Advanced SQL Queries:** SELECT statements: WHERE, ORDER BY, GROUP BY; Joins: INNER, OUTER, CROSS, SELF; Subqueries and Common Table Expressions (CTEs).

SECTION-D

Database Security: Understanding database security concepts, User roles and permissions, Data encryption and access control measures

Backup, Recovery, and Maintenance: Strategies for database backup and recovery, Disaster recovery planning, Regular maintenance practices for databases

Recommended books:

1. Silberschatz, Korth, and Sudarshan, Database System Concepts
2. John Viescas and Michael Hernandez, SQL Queries for Mere Mortals
3. Elmasri, R., Navathe, B. S., Fundamentals of Database Systems, 7th edition, Pearson Education, 2016.
4. Murach, J., Murach's MySQL, 3th edition, Pearson, 2019.
5. Connolly, T. M., Begg, C. E., Database Systems: A Practical Approach to Design, Implementation and Management, 6th edition, Pearson, 2019.
6. Silberschatz, A., Korth, H.F., Sudarshan S., Database System Concepts, 7th edition, McGraw Hill, 2019.
7. R. K. Gupta, Database Management Systems by BPB Publications
8. John Date, Database Management Systems by Cengage
9. Raghu Ramakrishnan and Johannes Gehrke, Database Management System by Pearson

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SEMESTER-VI

COMPUTER SCIENCE

DATABASE MANAGEMENT SYSTEMS

(PRACTICAL)

M. Marks: 25 **Credits**
Time: 3 Hours **L-T-P**
0-0-1

Lab 2h/week

Instructions for the examiners: -

Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Programming exercises based on:

- DBMS Introduction and Database Creation: Familiarize with DBMS software,
- create simple databases and tables.
- ER Diagrams and Relational Schema: Design ER diagrams, convert them to relational tables with primary and foreign keys.
- Normalization: Apply 1NF, 2NF, and 3NF to optimize tables for minimal redundancy.
- Basic SQL Queries: Practice data retrieval using SELECT, WHERE, ORDER BY, GROUP BY, DISTINCT, BETWEEN, IN, LIKE, and aggregate functions (COUNT, SUM, AVG, MIN, MAX).
- Advanced SQL Joins: Practice INNER, OUTER, CROSS, and SELF joins on relational data.
- Subqueries: Write nested queries for complex data retrieval.
- User Roles and Security: Implement roles, permissions, and
- basic encryption for database security.

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SEMESTER-VII

COMPUTER SCIENCE

COMPUTER NETWORKS

(THEORY)

M. Marks: 100 **Credits**
Time: 3 Hours **L-T-P**
4-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course outcomes:

- To develop an understanding of different components of computer networks, various protocols, modern technologies and their applications.
- To understand the working principle of various communication protocols.
- Study the basic taxonomy and terminology of the computer Networking and enumerate the layers of OSI model and TCP/IP model.
- Gain core Knowledge of network layer routing protocols and IP addressing.
- To know the concept of data transfer between nodes.

SECTION–A

Introduction: Network Definition, Basic Components of a Network, Network types and topologies, Uses of Computer Networks.
Introduction to Analog and Digital Transmission: Telephone system, Modems, Types of modems, pulse code modulation.
Transmission Media: Coaxial cable, twisted pair cable, fiber optics & satellites.
OSI reference model, TCP/IP reference model, comparison of OSI and TCP reference models

SECTION–B

Transmission & Switching: Multiplexing, circuit switching, packet switching, hybrid switching. **Data Link Layer Design Issues:** Services provided to Network layer, Framing, error control, flow control, link management. Error detection & correction, Elementary Datalink Protocols.

SECTION–C

Local Area Network Protocols: CSMA Protocols, IEEE standards 802, Token Bus, Token Ring
Design Issues of Network Layer: Services provided to transport layer, routing, connection.
Application layer protocols and client-server model - The Internet & World Wide Web

SECTION–D

Network Security:. Overview of threats, cryptography, authentication, and firewalls
Network Services: File transfer, Access & Management, Electronic Mail, Remote login
Wireless and mobile networks.

References:

1. Tannanbum, A.S.: Computer Networks, Prentice Hall, 1992, 3rd Edition.
2. Stallings, William: Local Networks: An Introduction: Macmillan Publishing Co.
3. Stallings, William: Data Computer Communication, Macmillan Publishing Co.

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SEMESTER-VII

COMPUTER SCIENCE

INFORMATION SYSTEMS

(THEORY)

M. Marks: 100 **Credits**
Time: 3 Hours **L-T-P**
4-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course outcomes:

- Learn the functioning of various components of an information system.
- Identify Challenges in Information Systems
- Getting familiar with different types of information systems
- Fundamentals of knowledge management

SECTION–A

An Introduction to Information System: Information Concepts, System Concepts; Components of IS: People, Processes, Technology, and Data; Information Systems and society: Business Information Systems, organizations and Information systems, Ethical, legal, and Security issues, Global Challenges in Information Systems, careers in Information System; Types of Information Systems - Transaction Processing Systems (TPS), Management Information Systems (MIS), Decision Support Systems (DSS), Executive Information Systems (EIS), Enterprise Systems: ERP, CRM, SCM

SECTION–B

Management Information System: Fundamental types of Management, Information Systems, Management Decision, Pitfalls in MIS Development Making Process; Building and Maintaining Information Systems, Information System Security and Control

SECTION–C

Decision Support Systems (DSS): Conceptual Foundations of DSS, Concepts of DSS, DSS Software, Strategies for DSS, Group Support Systems, Executive Information Systems (EIS), Executive Support System (ESS)

SECTION–D

Enterprise Systems: Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM);
Knowledge Management systems (KMS): Fundamentals of Knowledge Management; Knowledge Sharing and Organizational Culture; The Role of KMS in Organizational Agility and Innovation; Document Management Systems (DMS), Content Management Systems (CMS), Collaborative Tools and Platforms (Wikis, Intranets, Social Networks), Knowledge Bases

References:

1. Ralph Stair and George Reynolds, Principles of Information Systems: A Managerial Approach, Cenage Learning.
2. Laudon C. Kenneth & Laudon P. Janes, Management Information Systems, Pearson Education.
3. Turban Ejraini & Aronson E. Jay, Decision Support Systems & Intelligent Systems Pearson Education,.
4. Mudrick R.G., Ross, J.E. & Glegge, J.R., Information Systems for Modern Management, 3rd Edition, Prentice Hall of India.
5. Alter Steven, Information Systems, Pearson Education.

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SEMESTER-VII

COMPUTER SCIENCE

OPERATING SYSTEM

(THEORY)

M. Marks: 100 **Credits**
Time: 3 Hours **L-T-P**
4-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Outcomes:

1. To understand the services provided by and the design of an operating system.
2. To understand what a process is and how processes are synchronized and scheduled.
3. To understand the structure and organization of the file system.
4. To understand different approaches to memory management.
5. Students should be able to use system calls for managing processes, memory and the file system.

SECTION-A

Introduction: Definition, Early Systems, Simple Batch system, Multi-programming/Multi-Tasking, Time Sharing Systems, Personal Computer System, Parallel Systems, Distributed Systems, Real–time Systems.

Processes: Process concept, Inter Process communication, Process Scheduling, Threads.

CPU–Scheduling: Basic concepts, Scheduling Criteria, Scheduling Algorithms, Algorithm Evaluation.

SECTION–B

Process Synchronization: Critical – section problem, semaphores, classical problem of synchronization. Semaphores, **Threads:** Multicore Programming, Multithreading Models, Thread Libraries, Implicit Threading, Threading Issues.

Memory Management: Background, Logical v/s Physical address space, swapping, continuous allocation, paging, segmentation.

SECTION–C

Virtual Memory: Background, demand paging, performance of demand paging, page replacement, page replacement algorithms, thrashing.

Deadlocks: System Model, Deadlock characterization, methods for handing deadlocks, Deadlocks Prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock, combined approach to deadlock handling.

SECTION–D

Operating System Security – authentication & authorization, file ownership and user groups, Access Control, password vulnerabilities, strong passwords, Operating System protection from security breaches, such as runaway processes (denial of service), memory-access violations, stack overflow violations, the launching of programs with excessive privileges. Protecting against viruses and worms
CASE STUDY – Windows Operating System, Linux

Recommended Books & Materials:

1. Silberschatz, Galvin, and Gagne, Operating System Concepts, Global Edition, Wiley India 2023
2. Crowley, Operating Systems, A Design Oriented Approach, Tata McGraw Hill.
3. Dietel, Operating Systems, Second Edition by Addison Wesley.
4. William Stallings, Operating Systems –Internals and Design Principles, Pearson Publications
5. Andrew S. Tanenbaum, Modern Operating Systems, Pearson Publications
6. Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau, Operating Systems: Three Easy Pieces, https://pages.cs.wisc.edu/~remzi/OSTEP/

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SEMESTER-VII
COMPUTER SCIENCE
PROGRAMMING IN JAVA
(THEORY)

M**. Marks: 75** **Credits**
Time: 3 Hours **L-T-P**
3-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Outcomes:

- To use different variables of varying data types, operators, control structures for developing solutions to real world problems
- To use input and output streams to read and write data
- To access, define and use the packages and interfaces in java
  To handle the exceptions in programs using exception handling mechanism of java

SECTION–A

Introduction to Java: Importance of JAVA to Internet, Features of JAVA, Bytecode, Object Oriented Approach.
The Java Environment: Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions.
Data Types, Variables and Arrays: Data types, Declaration of Variable, Type Conversion and Casting, One Dimensional and Multidimensional arrays, String handling.

SECTION–B

Operators and Control Structures: Arithmetic, Bitwise, Relational, Boolean, Assignment Operators, Operator precedence, Selection Statements, Iteration Statements, Jump statements.
Classes: Class Fundamentals, Declaring objects, introducing methods, constructors, this keyword, Overloading constructors, Recursion, Nested and Inner classes.

SECTION–C

Inheritance: Basics, Types of Inheritance in Java, Inheriting Data members and Methods Creating Multilevel hierarchy, Method Overriding, Abstract Classes, Role of Constructors in inheritance , Overriding Super Class Methods ,Use of "super", Polymorphism in inheritance
Packages & Interfaces: Packages, Access Protection, Importing Packages, Organizing Classes and Interfaces in Packages, Package as Access Protection , CLASSPATH Setting for Packages Interfaces, Defining, Implementing, Applying Interfaces, Extending Interfaces

SECTION-D

Exception Handling: Fundamentals, Exception Types, uncaught exceptions, try and catch,

Input/Output Operation in Java (java. io Package), Streams and the new I/O Capabilities, Understanding Streams, The Classes for Input and Output, The Standard Streams, Working with File Object, File I/O Basics, Reading and Writing to Files

Reference Books:

1. Patrick Naughton & Herbert Schildt : The Complete Reference Java, Tata McGraw Hill Edition.
2. E. Balagurusamy : Programming in JAVA, Tata McGraw Hill
3. Herbert Schildt, Java - A Beginners Guide, Oracle Press

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SEMESTER-VII

COMPUTER SCIENCE

PROGRAMMING IN JAVA

(PRACTICAL)

M. Marks: 25 **Credits**
Time: 3 Hours **L-T-P**
0-0-1

Lab 2h/week

Instructions for the examiners: -

Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Lab exercises based on:

1. Java Data Types,
2. Variable declarations and scope, type casting,
3. String handling,
4. Operators,
5. Control Statements,
6. Arrays (One and Two dimensional arrays),
7. Classes and objects (declaring objects, methods, overloading constructors, recursion), Inheritance (Multilevel hierarchy, Method overriding, Abstract classes),
8. creating and importing packages,
9. applying and extending interfaces,
10. exception handling and
11. Input and Output streams

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SEMESTER-VII
COMPUTER SCIENCE
(MINOR-1)
DATA ANALYTICS WITH PYTHON
(THEORY)

M. Marks: 75 **Credits**
Time: 3 Hours **L-T-P**
3-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Outcomes:

- Understand the strengths of the Python language.
- Gain proficiency in string handling, functions, and control flow statements.
- Understand the operations involved in creating and manipulating file systems
- Using numpy and pandas for data processing

SECTION–A

Problem Solving, Problem Analysis, Concept of writing an algorithm, drawing a flowchart, developing a program.; Introduction to Python: Python's features, Story behind the name, Python versions, Execution environments: the Python Interpreter and IDEs (e.g. PyCharm or VSCode), Getting and Setting up Python.

Python program structure; writing your first "Hello World" program; creating, saving and executing a program; comments, Indentation.

Data and Expressions: Literal Constants, numbers, strings – immutable strings, quotes, the escape sequence, the format methos; Variables and Identifiers, data types, object, Operators & Expressions – short cuts, evaluation order, Boolean Expressions (Conditions), Logical Operators. User Input/output

SECTION–B

Control Flow: Selection Control, Nested conditions, Loops, break and Continue Statements,

Data Structures: list, tuple, dictionary and set; basic operations e.g. creating, indexing, slicing, membership Functions: defining and calling functions, passing and returning values, local and global variables, recursive functions, Iteration vs. Recursion

SECTION–C

Modules: purpose and usage, the import statement, from – import statement, the __main__ attribute, creating a module and importing, the dir() function

Handling Exceptions – try.. catch and with statements, errors, debugging

Files and Strings: Opening Files, Using Text Files, Reading files, Writing files, Understanding read functions, Understanding write functions

SECTION–D

Numpy for data processing: Creating NumPy Arrays; Array Attributes: NumPy Arrays; Array Manipulation: Reshaping and Flattening Arrays, Stacking and Splitting Arrays, Sorting and Filtering Arrays; NumPy for Statistical Analysis;
Pandas for data processing: Key Features, Series, Data Frame, Dicts, and NumPy Arrays; Data Frame Attributes; Data Manipulation with Pandas; Filtering Data Frames: Conditional Selection, Adding and Dropping Columns and Rows; Data Cleaning and Preparation; Data Aggregation and Grouping; Pivot Tables: Creating and Manipulating Pivot Tables

Recommended Books and Materials:

1. Yashavant Kanetkar, Aditya Kanetkar, Let Us Python-6th Edition, BPB Publications.
2. Charles Dierbach, Introduction to Computer Science Using Python: A Computational Problem-Solving Focus, Wiley Publications.
3. Martin C. Brown, Python: The Complete Reference, Indian Edition, McGraw Hill Education (India) Private Limited
4. Mark J. Guzdial, Introduction to Computing and Programming in Python, Pearson Education.
5. https://www.python.org/about/
6. Swaroop C.H., A Byte of Python available at https://python.swaroopch.com/
7. https://checkio.org/
8. https://www.jetbrains.com/pycharm-edu/
9. Numpy and pandas online documentation

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SEMESTER-VII
COMPUTER SCIENCE
(MINOR-1)
DATA ANALYTICS WITH PYTHON
(PRACTICAL)

M. Marks: 25 **Credits**
Time: 3 Hours **L-T-P**
0-0-1

Lab 2h/week

Instructions for the examiners: -

Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Programming exercises based on:

- Use the Python interactive interpreter
- Getting familiar with a Python IDE
- Python fundamentals, data types, operators
- Operators, flow control using if, else and elif, While statement, loops using For, Loop Patterns,
- Implementation of different collections like list, tuple and dictionary and their various functions,
- Demonstrating creation of functions, passing parameters and return values,
- Working with modules
- Handling Exceptions
- Implementation of reading, writing and organizing files
- numpy and pandas for data processing

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SEMESTER-VII

COMPUTER SCIENCE

INTERNSHIP WITH LOCAL PUBLIC/PRIVATE INDUSTRY/ BUSINESS/ ORGANIZATION FIELD PRACTICE-2

M. Marks: 50 **Credits**
Time: 3 Hours **L-T-P**
0-0-2
Field Practice (4h) /week

Course Outcomes:

- To put theory into practice
- To expand thinking and broaden the knowledge and skills acquired through course work in the field.
- To relate to, interact with, and learn from current professionals in the field.
- To understand and adhere to professional standards in the field
- To gain insight to professional communication
- To identify personal strengths and weaknesses
- To develop the initiative and motivation to be a self-starter and work independently

Internship/Professional practice: Internship/Professional practice can provide students the opportunity to enhance skills which include knowledge of office automation, problem-solving skills, database creation, debugging, cybersecurity, programming languages, frameworks etc. Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to implement as much knowledge as possible. The students shall take part in discussions to foster friendly and stimulating environment in which they are motivated to reach high standards and become self-confident.

Assessment: Each student, is required to

- Submit a report.
- Present the seminar on the internship orally through power point slides.
- Answer the queries.

Instructions for the Assessment:

- Candidates will undergo training and prepare an internship report. As End-Semester Examination, evaluation of the student will be based on the quality of report submitted, presentation skills and their response in the Q/A session by the examiners. The internship report carries 30 marks, seminar of 10 marks, and Q/A 10 marks.

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SEMESTER-VIII

COMPUTER SCIENCE

CLOUD COMPUTING

(THEORY)

M. Marks: 100 **Credits**
Time: 3 Hours **L-T-P**
4-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Outcomes:

1. Understand the fundamental concepts and models of cloud computing.
2. Analyze different cloud service and deployment models.
3. Implement and manage cloud-based solutions using popular platforms.
4. Evaluate security and compliance issues in cloud computing.
5. Develop applications that leverage cloud services.

SECTION-A

Introduction and Overview: Definition and characteristics of cloud computing, History and evolution of cloud computing, Benefits and challenges of cloud computing

Cloud Computing Architecture: Basic architecture of cloud computing, Components: Front-end, back-end, cloud service models; Virtualization technology and its role in cloud computing; **Service Models:** Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Comparison of service models and use cases

SECTION-B

Cloud Deployment Models: Public cloud: Characteristics, benefits, and examples; Private cloud: Characteristics, benefits, and examples; Hybrid cloud: Integration of public and private clouds; Community cloud: Shared infrastructure for specific communities

Cloud Providers and Platforms: Overview of major cloud service providers (AWS, Azure, Google Cloud), Features and services offered by each provider, Cost models and pricing strategies

Cloud Storage and Data Management: Types of cloud storage: Block, file, object storage; Data management strategies in the cloud; Backup and disaster recovery in cloud environments

SECTION-C

Security in the Cloud: Key security concepts: Confidentiality, integrity, availability; Cloud security architecture and controls; Identity and access management (IAM) in the cloud

Cloud Monitoring and Management: Tools and techniques for monitoring cloud resources, Performance management and optimization, Incident response and remediation in cloud environments

SECTION-D

Cloud Application Development: Overview of cloud-native application development, Micro services architecture and containerization (Docker, Kubernetes), Serverless computing concepts and platforms (AWS Lambda, Azure Functions)

Future Trends and Challenges: Emerging trends in cloud computing, Challenges and considerations for cloud adoption, Case studies of successful cloud implementations

Recommended Books:

1. Thomas Erl, Zaigham Mahmood and Ricardo Puttini**, Cloud Computing: Concepts, Technology & Architecture**
2. Michael J. Kavis**, Architecting the Cloud: Design Decisions for Cloud Computing Service Models**
3. Judith S. Hurwitz, Robin Bloor, Marcia Kaufman, and Fern Halper, **Cloud Computing for Dummies**
4. Raj kumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing : principles and paradigms, Pearson Education
5. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter, Cloud Computing: A Practical Approach, McGraw Hill Education

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SEMESTER-VIII
COMPUTER SCIENCE
ARTIFICIAL INTELLIGENCE
(THEORY)

M. Marks: 100 **Credits**
Time: 3 Hours **L-T-P**
4-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course outcomes:
1. To understand the different needs and benefits of Artificial Intelligence, intelligent agents and different searching techniques.
2. To develop semantic-based and context-aware systems.
3. To acquire, organize process, share and use the knowledge embedded in multimedia content.
4. To understand the basic areas of artificial intelligence including knowledge representation, reasoning, learning, natural language processing, fuzzy systems and ANN.

SECTION–A

AI Introduction, foundation of AI and history of AI .Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation. Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A* , AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions.

SECTION–B

Introduction to knowledge-based intelligent systems: Intelligent machines, Introduction to Expert Systems. Logic and Inferences: Propositional Logic, First Order Logic (FOL), Resolution method for FOL, Forward and Backward chaining.

Fuzzy Sets: Notion of Fuzziness, Membership Functions, Fuzzification and Defuzzification Operations on Fuzzy Sets, Fuzzy Functions and Linguistic Variables; Fuzzy Relations, Fuzzy Rules and Fuzzy Inference; Fuzzy Control System and Fuzzy Rule Based Systems.

SECTION–C

Natural Language Processing: Natural Language Processing (NLP) Introduction ,overview of linguistics, Grammars and Languages, Basic Parsing Techniques, syntactic Processing, Semantic Analysis, Natural Language Generation , Natural Language Systems.

Learning Introduction, Role of Learning, Types of Learning, General Learning Model, Performance Measures.

SECTION–D

Probabilistic Reasoning: Representation, Bayesian Networks, Conditional Independence. Making Simple Decisions: Beliefs, Desires and Uncertainty, Decision Networks, Value of Information. Making Complex Decisions : Stochastic Problems.

Recommended Books:

1. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice- Hall India Private Limited, 2006.
2. Rich Knight, Artificial Intelligence , Tata McGraw Hill, 2007.
3. P H. Winston, Artificial Intelligence, Addison Wesley, 2006.
4. E Charniak and D Mcdermott, Introduction to Artificial Intelligence, Addison Wesley, 2004
5. Bishop, Christopher, Neural Networks for Pattern Recognition. New York, NY: Oxford University Press. ISBN: 9780198538646.
6. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience. ISBN: 9780471056690.

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SEMESTER-VIII
COMPUTER SCIENCE
SOFTWARE ENGINEERING
(THEORY)

M. Marks: 100 **Credits**
Time: 3 Hours **L-T-P**
4-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course outcomes:

- learn the concept of the engineering approach to software development.
- Understand the concept of product vs project vs process .
- getting familiar with software development phases.
- Understand the software evolution and change management

SECTION–A

Introduction to Software: Definition, Software characteristics, the evolving role of software, changing nature of software, Software components, Software Applications.

Introduction to Software Engineering: Definition, Software Engineering Paradigms, product vs project vs process, a process oriented framework, process patterns, waterfall method, prototyping, incremental process models, evolutionary process models, the unified process, the Spiral model, the agile process. Process assessment, the capability maturity model integration (CMMI)

SECTION–B

Software Requirement Specification (SRS): Problem analysis, structuring information, Data flow diagram and data dictionary, structured analysis, Characteristics and component of SRS.

Planning a Software Project: Cost estimation, uncertainties in cost estimation, Single variable model, COCOMO model, on software size estimation, Project scheduling and milestones, Software & Personal Planning, Rayleigh curve, Personal Plan, Quality Assurance Plan, Verification & Validation (V & V), inspection & review

SECTION–C

System Design: Design Objectives, Design Principles, problem, Partitioning, Abstraction, Top Down and Bottom–up techniques.

Coding: Coding by Top–down and Bottom–up, Structured Programming, Object Oriented Programming, Information Hiding, Programming style, Internal Documentation

Software Metrics: Role of Metrics and measurement, Metrics for software productivity and quality, Measurement software, size–oriented metrics, function oriented metrics, Object-oriented metrics, Metrics for software quality.

SECTION–D

Testing: Level of testing, Test cases and test criteria, Testing levels, Testing types: White box v/s black box testing: Functional Testing, Structural Testing.

Software Maintenance: Types of Maintenance, Corrective and Preventive Maintenance; Software Evolution, Change management

Recommended books:

1. Roger S. Pressman, Software Engineering
2. Pankaj Jalote, An Integrated Approach to Software Engineering

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SEMESTER-VIII

COMPUTER SCIENCE

MACHINE LEARNING

(THEORY)

M. Marks: 75 **Credits**
Time: 3 Hours **L-T-P**
3-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Outcomes:

1. Understand key concepts and terminology in machine learning.
2. Apply supervised and unsupervised learning algorithms to datasets.
3. Evaluate and optimize machine learning models.
4. Utilize machine learning libraries and tools for implementation.
5. Analyze real-world problems and propose machine learning solutions.

SECTION-A

Introduction to Machine Learning, Definition and history of machine learning, Types of machine learning: Supervised, unsupervised, and reinforcement learning, Applications of machine learning in various fields

Key Concepts and Terminology: Features, labels, training, and testing datasets, Overfitting vs. underfitting, Bias-variance tradeoff

SECTION-B

Data Pre-processing: Importance of data pre-processing, Techniques: Data cleaning, normalization, and transformation, Handling missing data and categorical variables

Supervised Learning: **Regression Algorithms:** Linear regression: Theory and implementation, Evaluation metrics: Mean squared error, R^2 score, Regularization techniques: Lasso and Ridge regression

SECTION-C

Supervised Learning: **Classification Algorithms-** Logistic regression and its applications, Decision trees and random forests, **Model Evaluation and Selection:** Train-test split and cross-validation, Confusion matrix and classification metrics (precision, recall, F1 score), Hyperparameter tuning and model selection techniques

SECTION-D

Dimensionality Reduction: Introduction to dimensionality reduction techniques, Principal component analysis (PCA)

Unsupervised Learning- **Clustering Algorithms:** K-means clustering: Theory and implementation, Hierarchical clustering and DBSCAN, Evaluation of clustering results

Recommended Books:

1. Christopher M. Bishop, Pattern Recognition and Machine Learning
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow
3. Tom Mitchell, Machine Learning, McGraw Hill
4. Kamalkant Hiran, Dr. Ruchi Doshi, Ritesh Kumar Jain, Dr. Kamlesh Lakhwani. Machine Learning, BPB publications.
5. Dr. Amit Dua and Umair Ayub, Beginning with Machine Learning, BPB publications.
6. Saikat Dutt , Subramanian Chandramouli , Amit Kumar Das, Machine Learning, Pearson Education
7. Vinod Chandra , Anand Hareendran S., Machine Learning : A Practitioner's Approach, PHI Learning

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SEMESTER-VIII

COMPUTER SCIENCE

MACHINE LEARNING

(PRACTICAL)

M. Marks: 25 **Credits**
Time: 3 Hours **L-T-P**
0-0-1
Lab (2h/week)

Instructions for the examiners: -
Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Lab Exercises based on:

- Understanding Machine Learning Concepts: Explore and define key concepts in machine learning, including features, labels, and the types of learning (supervised, unsupervised).
- Data Pre-processing: Perform data cleaning, normalization, and handling of missing values in a given dataset.
- Implementing Linear Regression: Build a linear regression model, compute evaluation metrics (MSE, R^2), and interpret the results.
- Logistic Regression Application: Develop a logistic regression model for binary classification and evaluate its performance.
- Decision Trees and Model Evaluation: Create a decision tree model and utilize techniques such as train-test split and cross-validation to assess its accuracy.
- Hyperparameter Tuning: Apply hyperparameter tuning techniques (e.g., grid search) to improve model performance on selected algorithms.
- Dimensionality Reduction with PCA: Implement Principal Component Analysis (PCA) on a dataset and visualize the impact of dimensionality reduction.
- K-means Clustering: Conduct K-means clustering on a dataset, visualize the clusters, and evaluate the clustering results.

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SEMESTER-VIII

COMPUTER SCIENCE

(MINOR-2)

DATA VISUALIZATION

(THEORY)

M. Marks: 75 **Credits**
Time: 3 Hours **L-T-P**
3-0-0

Instructions for the Paper Setters: -
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Outcomes:

1. understanding of data visualisation and key terms.
2. skills on creating visual representation of data.
3. develop insights how Tableau is better than excel.
4. using interactive data visualisation.

SECTION–A

Introduction: Data Visualisation, Importance of data visualisation, Advantages and Disadvantages of Data Visualisation, Applications of data Visualisation. Data analysis Definition, data analysis process, sensitivity analysis with data tables in excel, summarizing data with data functions, optimization with excel solver.

SECTION–B

Types of Data Visualisation Techniques (Charts, Plots, Maps) Correlation and Regression coefficients, visualisation of correlation and regression coefficients. Tools for visualisation of Data, Tableau basic overview, tableau installation, tableau data types, working with different Visualisation in Tableau.

SECTION–C

Visualising Data process: acquiring and processing Dataset. Quick Table calculation: Running Total, Moving average, Filtering, Multiple Measures, Boolean and Numerical Formulas. Dashboard Development : Layout , Dashboard Sizzling ,Titles ,Formatting. Tableau Public and Desktop: Copy, Export, Print , Print screen .

SECTION–D

Interactive Data Visualisation: Drawing with data , scales ,axes, updates. Transition and motion. Common pitfalls of colour use, Visualisation along Linear axis , visualisation along logarithmic axes.

Recommended Books:

1. Kavitha Ranganathan, Impactful Data Visualization: Hide and Seek with Graphs, Penguin Random House India Private Limited 2023
2. Purna Chander Rao. Kathula, Hands-on Data Analysis & Visualization with Pandas, BPB Publications
3. Claus O. Wilke, Fundamentals of Data Visualization, ORielly, available at https://clauswilke.com/dataviz/
4. Jeffrey Ohlmann, Michael Fry, Data Visualization: Exploring And Explaining With Data By Cengage Learning
5. Dunlop, Dorothy D., and Ajit C. Tamhane, “Statistics and data analysis: from elementary to intermediate”, Prentice Hall, 2000.
6. Joseph F Hair, William C Black et. al , Multivariate Data Analysis, Pearson Education, 7th edition, 2013.

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SEMESTER-VIII

COMPUTER SCIENCE

(MINOR-2)

DATA VISUALIZATION

(PRACTICAL)

M. Marks: 25 **Credits**
Time: 3 Hours **L-T-P**
0-0-1
Lab (2h/week)

Instructions for the examiners: -
Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Lab exercises based on:

- Work with a simple dataset to create visualizations that show relationships within data (using basic tools like Excel or Google Sheets).
- Understanding Data Types and Visual Encoding:
- Work with datasets containing categorical, numerical, time series, and geospatial data types.
- Identify suitable visual encodings (e.g., color, shape, size) based on data types.
- Practice encoding categorical and numerical data, with exercises in visualizing data along both linear and logarithmic scales.
- Create basic visualizations (e.g., bar chart, line chart) using sample data on both linear and logarithmic scales.
- Experiment with both types of scales in a tool like Python's Matplotlib or Excel, exploring data that covers wide-ranging values.