Curriculum Structure (2015-18)

Scheme of Teaching and Syllabus for M.C.A.

Curriculum framework:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Subject Area</th>
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Lecture (L): One Hour /week – 1 credit
Practical (P): Three hours /week – 2 credits
Tutorials (T): 2 hours /week – 1 credit

Distribution of credits

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## I Semester

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**Total**: 19-1-3  26  30  400  400  800

**CIE**: Continuous Internal Evaluation  **SEE**: Semester End Examination  **L**: Lecture  **T**: Tutorial  **P**: Practical

**CC**: Core Course  **CF**: Compulsory Foundation

* SEE: SEE (Theory exam) will be conducted for 100 marks of 3hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA.

## II Semester

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**Total**: 19-2-3  28  32  450  400  850

**CIE**: Continuous Internal Evaluation  **SEE**: Semester End Examination  **L**: Lecture  **T**: Tutorial  **P**: Practical

**CC**: Core Course  **CF**: Compulsory Foundation
### III Semester

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*CIE: Continuous Internal Evaluation  SEE: Semester End Examination  L: Lecture  T: Tutorial  P: Practical  CC: Core Course  CF: Compulsory Foundation  FE: Foundation Elective  MNC: Mandatory Non-Credit*

* SEE: SEE (Theory exam) will be conducted for 100 marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA.

### Certification Courses: 2-credits
- Two certifications are compulsory and need to be completed before start of 6th semester.
- Choose certifications, which have industrial acceptance.

### IV Semester

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**Seminar Component: 1-Credit**
Seminar topics to be chosen from any reputed journals like IEEE/ Springer/Elsevier (Science Direct)/scopus/DBLP indexed conference papers etc.

### Elective Pool

*Note:* Students are advised to select any of the elective for specialization.

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Image Processing
## Semester -1

### UNIX and Shell Programming

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<td>Total Hours:</td>
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<td>SEE Duration:</td>
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</table>

### Course Learning Objectives

The course aims at
1. Providing a clear understanding of core aspects of UNIX operating system, focusing on its history, architecture and the file system.
2. Exploring an overview of UNIX processes and editors.
3. Familiarizing the concepts related to filters and the regular expressions.
4. Providing an insight into the fundamentals of UNIX command set and their usage to give sufficient knowledge on writing shell scripts and awk scripts.

### Prerequisites:

Basic knowledge of operating system and concepts of programming.

### UNIT 1

#### 10 Hours

**Introduction to UNIX, Files and File Organization:** Brief History, Introduction to UNIX and its Components, Using UNIX, Commands in UNIX, Some basic commands, Getting help, Command substitution, Giving multiple commands, Aliasis. UNIX files, Categories of Files, Hidden Files, The file system, path names, the Home directory, directory commands, The dot and Double dot file names, File related commands, wild cards-Filename generation, displaying the contents of a file, Printing of files, Comparing files.

### UNIT 2

#### 10 Hours

**Basic File Attributes, The shell:** ls – l, the –d option, File Permissions, chmod, Security and File Permission, users and groups, security level, changing permission, user masks, changing ownership and group, File Attributes, More file attributes: hard link, symbolic link, umask, find. The shell as command processor, Escaping. **Standard I/O, redirection Pipes:** Standard I/O, Redirection, Pipe & Pipeline, Mixing inputs from standard input and a file, tee command Terminal (/dev/tty) and Trash(/dev/null) files.

### UNIT 3

#### 11 Hours

**Shell Programming:** Shell variables, The export command, The .profile file, read command, positional parameters, the $? Variable, set command, exit command, Branching Control Structures, Loop-Control Structures, The continue & break statements, The expr command, real arithmetic in shell programs, here document, sleep command, script command.

### Self-Learning Topics:

Debugging Scripts

### UNIT 4

#### 10 Hours
Simple Filters and Regular Expressions: cut, paste, sort, uniq, tr commands, Filters using Regular Expression: grep –searching for a pattern, options, Regular Expressions-Basic & Extended. Uses of Regular Expressions, Example scripts of Regular Expression Patterns in contexts such as File renaming, text search, Database Queries. egrep, fgrep, sed-The stream editor, Line Addressing, Inserting and Changing Text, Context addressing, editing text, substitution.

Self-Learning Topics:
Interval Regular Expressions and Tagged Regular Expressions.

UNIT 5 11 Hours

The Process, AWK-Advanced filter: Meaning, Parent and Child processes, types of processes, More about foreground and Background processes, internal and external commands, the ps command, process creation, The nohup command, The nice command, Signals, trap, sty, kill, wait commands, Job control, command history, Scheduling jobs’ execution.

Syntax of an awk program statement, structure of an awk script, operational mechanism of awk, variables, records, fields and special variables, Addressing-Line and Context, Patterns, Operators, Sample input files, awk control structures, Functions in awk, Executing awk scripts with the Shell, Arrays.

Reference Books

Course Outcomes
After going through this course the student will be able to:
1. Explain the fundamental UNIX concepts, architecture and features of UNIX operating system and demonstrate the flexibility of command usage. [L2]
2. Classify the file types with different file attributes and demonstrate file-handling techniques. [L2, L4]
3. Explain vi editor and demonstrate different modes and features. [L2]
4. Demonstrate the use of pipes and filters like grep, sed using basic and extended regular expressions. [L2]
5. Design Shell programs for solving various problems using essential and advanced features of shell programming. [L6]
6. Explain process creation mechanism and identify kernel’s role in Process Management & job scheduling. [L2]

Program Outcomes (PO’s):
1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
3. Postgraduates will demonstrate skills to use modern software tools and technology to build
Program Specific Outcomes (PSO’s):

1. Problem-Solving Skills: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO 2]

Scheme of Continuous Internal Evaluation (CIE):

<table>
<thead>
<tr>
<th>Components</th>
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Scheme of Continuous Internal Evaluation (CIE):

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
Web Programming

Course Code: 15MCA12  Credits: 04
Course Type: CF  CIE Marks: 50
Hrs/Week :L:T:P 4:0:0  SEE Marks: 100
Total Hours: 52  SEE Duration: 3 Hrs.

Course Learning Objectives:
The course aims at
1. Providing a clear understanding of Web Technologies.
2. Delivering the importance of HTML, JavaScript and XML.
3. Making use of different tools to develop Web Applications.
4. Imparting the knowledge of programming using XHTML, JavaScript and XML.
5. Guiding the students to construct simple JavaScript user interfaces and an ability to build platform independent web applications using LAMP Standard development kit.

Prerequisites:
Exposure to web technologies

UNIT-I  10 Hours

UNIT-II  10 Hours
Introduction to XHTML, Cascading Style Sheets:
Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The <span> and <div> tags, Conflict resolution.

UNIT-III  10 Hours
The Basics of JavaScript: Overview of JavaScript, Object orientation and JavaScript, Syntactic characteristics, Primitives, operations and expressions, Screen output and keyboard input, Control statements, Object creation and modification, Arrays, Functions, Constructors.
Self-Learning Topics:
Pattern Matching using regular expressions, Errors in scripts, Examples.

UNIT-IV  10 Hours
from Body Elements, Handling Events from Text Box and password Elements, The DOM2 Event Model, The navigator Object Dom Tree Traversal and Modification.

**UNIT-V**

12 Hours

**Dynamic Documents with JavaScript, Introduction to XML:**
Introduction, Positioning Elements, Moving Elements, Element Visibility, Changing Colors and Fonts, Dynamic Content, Stacking Elements, Locating the Mouse Cursor, Reacting to a Mouse Click, Slow Movement of Elements, Dragging and Dropping Elements.

Introduction, Syntax, Document structure, XML displaying raw XML documents

**Self-Learning Topics:**
Displaying XML documents with CSS.

**Reference Books:**

**Course Outcomes:**
After going through this course the student will be able to:

1. **Explain** basic web concepts to build applications that are Object Based and Platform Independent. [L2]
2. **Analyze** any given problem to get the desired output. [L4]
3. **Apply** the concepts of JavaScript Technology in building web applications. [L3]
4. **Develop** client side web applications. [L6]
5. **Design** applications using XML. [L6]
6. **Apply** the concepts of Web Technology in establishing his/her own entrepreneurship in the world of web programming. [L3]

**Program Outcomes (PO’s):**
1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
3. Postgraduates will demonstrate knowledge of professional and ethical responsibilities. [PO7]

**Program Specific Outcomes (PSO’s):**

**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]

**Scheme of Continuous Internal Evaluation (CIE):**
### Course Level Objectives:
The course aims at:
1. Providing a clear understanding of the basic structure and operation of a digital computer.
2. Studying different number system representation and conversion from one number system to another.
3. Discussing the theorems and properties of Boolean algebra.
4. Learning the working of flip-flops, logical gates, multiplexers, and adders.
5. Discussing in detail the arithmetic operations and algorithms on fixed-point numbers and IEEE floating point representation.
6. Explaining the different ways of communicating with I/O devices and standard I/O interfaces.
7. Studying the hierarchical memory system including cache memories and virtual memory.
8. Emphasizing on the performance of computer system and calculate the performance using SPEC rating.

### Prerequisites:
Idea of Basic Computer and its Operations

### UNIT I

**Binary Systems, Combinational Logic:** Digital Computers and Digital Systems, Binary Numbers, Number Base Conversion, Octal and Hexadecimal Numbers, Subtraction using r’s
and r-1 complements, Binary Code, Binary storage and Registers, Binary Logic, Integrated Circuits.


**UNIT II**  
10 Hrs

**Arithmetic Circuits, Sequential Logic:** NAND and NOR Implementation, Other Two-Level Implementations, Don’t Care Conditions. Introduction: Adders, Subtractors, Binary Parallel Adder, Decimal Adder, Magnitude Comparator, Decoders, Multiplexers. Ripple counter and Synchronous Counter.

**Self-Learning Topics:** Different types of Flip-Flops, Triggering of Flip-Flops, Registers, Shift Registers

**UNIT III**  
10 Hrs

**Basic Structure of Computers, Machine Instructions and Programs:**
Computer types, Functional Units, Basic Operational Concepts, Bus Structure, Software, Performance, Multiprocessors and Multicomputers,
Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes.

**Self-Learning Topics:** 8086 addressing modes and instruction sets, Examples

**UNIT IV**  
12 Hrs

**Arithmetic, Input/output Organization:** Addition and Subtraction of Signed Numbers, Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division, Floating Point Numbers and operations.
Accessing I/O Devices, Interrupts, DMA, Buses.

**Self-Learning Topics:** Processor Examples,

**UNIT V**  
10 Hrs

**The Memory System:** Some Basic Concepts, Semiconductor RAM Memories, Read-only Memories, Speed, Size, Cost, Cache Memories, Virtual Memories, Memory Management Requirements,

**Self-Learning Topics:** Secondary Storage.

**Reference Books:**
Course Outcomes:

After going through this course the student will be able to:

1. Explain the basic structure and operation of a digital computer. [L2]
2. Explain logical gates and design different circuits using logic gates. [L2, L6]
3. Demonstrate the working of adders, subtractors, and multiplexers in a computer system. [L2]
4. Apply the theorems and properties of Boolean algebra to simplify Boolean expression and design logical circuits. [L3, L6]
5. Apply arithmetic operations on binary number system. [L3]
6. Explain different ways of communication with I/O devices and standard I/O interfaces. [L2]
7. Explain how programs and data are stored and represented in a computer system. [L2]
8. Analyze the performance of different computer systems by considering memory size, speed, architecture, and instruction set. [L4]
9. Design memory chip organization for different memory configuration. [L6]

Program Outcomes (PO’s):

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
4. Postgraduates will develop confidence for self education and ability for life-long learning. [PO10]
5. Post graduates can participate and succeed in competitive examinations. [PO11]

Program Specific Outcomes(PSO’s):

Professional Skills: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

Scheme of Continuous Internal Evaluation(CIE):

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Scheme of Continuous Internal Evaluation(CIE):

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3
hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA

### Semester -1

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<td>SEE Duration:</td>
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**Course Learning Objectives:**

**The course aims at**

1. Analyzing and designing solution for a given problem and represent the solution in the form of flowchart/algorithm.
2. Introducing Computer Programming Language fundamental concepts, and implement these concepts using C Language.
3. Imparting the knowledge of writing modular programming using C Language for solving various scientific, engineering, and business problems.
4. Imparting the knowledge of verification and validation in a program.
5. Providing guidance on good programming practices required in the industry.

**Prerequisites:**

Knowledge of elementary mathematics including operator precedence.
## UNIT I 11 Hrs

**Algorithms and Flowcharts, Constants, Variables and Data Types, Operators and Expressions, Managing Input and Output Operations:**

The meaning of algorithms, Flowcharts and their need, writing algorithms and drawing flowcharts for simple exercises like finding biggest of three numbers, to find roots of given quadratic equation, to find the biggest and smallest of given set of numbers and such other simple examples.

Character set, C tokens, keywords & identifiers, structure of C program, executing a C program. Constants, variables, data types, declaration of variables, declaration of storage classes, assigning values to variables defining symbolic constants, declaring a variable as constant, declaring a variable as volatile, overflow and underflow of data.

Arithmetic operators, relational operators, logical operators, assignment operator, increment and decrement operator, conditional operator, bitwise operators, comma operator, special operators, arithmetic expressions, evaluation of expressions, precedence of arithmetic operators, type conversions in expressions, operator precedence and associativity, mathematical functions.

The scanf() & printf() functions for input and output operations, reading a character, writing a character, (the getchar() & putchar() functions), the address operator(&), formatted input and output using format specifiers, Writing simple complete C programs.

**Self-learning Topics:** gets(), puts(), advance format specifiers.

## UNIT II 10 Hrs

**Control Statements, Loop Control Structures:**

Decision making with if statement, simple if statement, the if..else statement, nesting of if..else statements, the else..if ladder, the switch statement, the ? : operator, the goto statement, the break statement, programming examples.

The while statement, the do..while statement, the for statement, nested loops, jumps in loops, the continue statement, programming examples.

**Self-learning Topics:** Time complexity for each loop.

## UNIT III 10 Hrs

**Arrays, Character Arrays and Strings:**

The meaning of an array, one dimensional and two dimensional arrays, declaration and initialization of arrays, reading, writing and manipulation of above types of arrays, multidimensional arrays, dynamic arrays, programming examples.

Declaration and initialization of string variables, reading string from terminal, writing string to screen, arithmetic operations on characters, putting strings together, comparison of two strings, string handling functions, table of strings, other features of strings, programming examples.

**Self-learning Topics:** Dynamic Array.

## UNIT IV 11 Hrs

**User Defined Functions, Structures and Unions:** Need for user defined functions, a multi function program, elements of User defined functions, defining functions, return values and their types, function calls, function declaration, category of functions, no arguments and no return values, arguments but no return values, arguments with return values, no arguments with return value, functions that return multiple values, nesting of functions,
recursion, passing arrays to functions, passing string to functions, programming examples. Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, operations on individual members, array of structures, structures within structures, structures and functions, Unions, size of structures, bit fields, programming examples.

Self-learning Topics: Passing structures using pointers.

UNIT V 10 Hrs

Pointers, File Management in C, Dynamic Memory Allocation, The Preprocessor: Understanding pointers, accessing the address space of a variable, declaration and initialization of pointer variables, accessing a variable through its pointer, chain of pointers, pointer expressions, pointers and arrays, pointer and character strings, array of pointers, pointer as function arguments, functions returning pointers, pointers to functions, pointers and structures, programming examples. Defining and opening a file, closing a file, input/output operations on files, error handling During I/O operations, random access files, command line arguments, programming examples. Dynamic memory allocation, allocating a block of memory: malloc, allocating multiple blocks of memory: calloc, releasing the used space: Free, altering the size of a block: realloc, programming examples. Introduction, macro substitution, files inclusion, compiler control directives, ANSI additions, programming exercises.

Self-learning Topics: Advance File Management

Reference Books:
3. Reema Thareja Programming in C, Oxford Higher Education

Course Outcomes:
At the end of the course student should be able to:
1. Develop, compile and debug programs in C language. [L6]
2. Adapt the common data structures typically found in C programs namely arrays, strings, structures, unions, and files. [L6]
3. Explain the dynamics of memory by the use of pointers. [L2]
4. Design a computer program to solve simple and complex problems of different domains. [L6]
5. Assess industry standard programming styles and practices. [L5]

Program Outcomes (PO’s):
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
5. Postgraduates will demonstrate skills to use modern software tools and technology to
build and test applications. [PO6]
6. Postgraduates can participate and succeed in competitive examinations. [PO11]

**Program Specific Outcomes (PSO’s):**

**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]

**Scheme of Continuous Internal Evaluation (CIE):**

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**Scheme of Continuous Internal Evaluation (CIE):**

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours’ duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
Curriculum Structure with Content- Course wise

Semester – 1

Discrete Mathematical Structures

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<td>Total Hours:</td>
<td>52</td>
<td>SEE Duration:</td>
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</table>

Course Learning Objectives:

The course aims at
1. Providing a clear understanding of Set Theory and its fundamental requirement to study DMS (Discrete Mathematical Structures).
2. Applying the language of logic
3. Explaining the concepts of Relations and Functions.
4. Identifying the problems involving Number theory, Permutations and Combinations
5. Reproducing the techniques of Mathematical Induction and Recurrence Relations.
6. Criticizing Graph theory and its implication in Matrix oriented topic.

Pre-Requisites: Set Theory

UNIT – I

Fundamentals of Logic 12 Hours

UNIT – II

Set Theory 9 Hours

UNIT – III

Properties of Integers and Recurrence 9 Hours
Mathematical Induction, Recursive definitions, The Greatest Common Divisor Euclidian Algorithms, The first order Linear recurrence relation

UNIT – IV

Relations and Functions 12 Hours

UNIT-V
Graph Theory and Trees

Terminology, Definitions, Properties and Examples, Connectivity and Adjacency, Euler and Hamilton, Representation and Isomorphism, Planarity and Chromatic Number, Directed Graphs and Weighted Graphs, Rooted Trees, Trees and Sorting

Reference Books:

Course outcomes:

After going through this course the students will be able to:
1. Compile the concepts of sets of practical situations. [L6]
2. Discuss the mathematical logic and construct logical arguments. [L2]
3. Distinguish problems involving number theory, permutations and combinations. [L4]
4. Apply concepts of Relations and Functions. [L3]
5. Apply tools of Mathematical Induction and Recurrence Relations. [L3]
6. Compare and Contrast Graph theory as one of the important, essential and useful matrix oriented topics. [L2]

Program Outcomes(PO’s):
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]

Program Specific Outcomes(PSO’s):

Professional Skills: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity[PSO1]

Scheme of Continuous Internal Evaluation(CIE):

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Scheme of Semester End Examination(SEE):

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice
Curriculum Structure with Content- Course wise

Semester -1

**UNIX and Shell Programming Laboratory**

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**Course Learning Objectives**

The course aims at

1. Providing a clear understanding of core aspects of UNIX operating system, focusing on editors, command usage, filters, regular expressions, and other utility tools.
2. Exploring the fundamentals of UNIX command set and their usage to provide sufficient knowledge on writing scripts with different UNIX languages.

**Prerequisites**

A basic understanding on various computer concepts and shell programming concepts

**Laboratory Exercises:**

Maximum 10 experiments can be framed on the following concepts:

General purpose utilities, File handling commands, Basic file attribute commands, Simple filters and Regular expressions, grep command, sed command, awk command

**Reference Books**

Course Outcomes

After going through this course the student will be able to:
1. Demonstrate the flexibility of command usage. [L2]
2. Classify the file types with different file attributes. [L4]
3. Demonstrate file handling techniques. [L2]
4. Appraise vi editor and demonstrate different modes and features. [L2, L5]
5. Demonstrate the use of pipes and filters like grep, sed. [L2]
6. Develop basic and extended regular expressions to demonstrate pattern matching techniques. [L6]
7. Design Shell programs for solving various problems using essential and advanced features of shell programming. [L6]

Program Outcomes (PO’s):

1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
3. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]

Program Specific Outcomes(PSO’s):

1. Problem-Solving Skills: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO 2]

Scheme of Continuous Internal Evaluation (CIE): 50 Marks

<table>
<thead>
<tr>
<th>CIE</th>
<th>Conduct of lab</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Journal writing</td>
<td>10</td>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>Two lab tests of 10Marks will be conducted and average of the two tests will be considered for the calculation of CIE</td>
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</table>

Scheme of Semester End Examination (SEE): 50 Marks

<table>
<thead>
<tr>
<th>SEE</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Viva – voce</td>
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</tr>
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NOTE: - Change of program during lab examinations is not permitted
Semester - 1

Web Programming Laboratory

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>15MCA17</th>
<th>Credits:</th>
<th>02</th>
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</tr>
<tr>
<td>Total Hours:</td>
<td>42</td>
<td>SEE Duration:</td>
<td>3 Hrs.</td>
</tr>
</tbody>
</table>

Course Learning Objectives:

The course aims at
1. Providing knowledge of Web Technologies to build a Web Application.
2. Designing and developing front-end and back-end of a Web Application
3. Exploring the advantages of emerging Web Technologies and the environment in which they are used.

Prerequisites:

Knowledge of editors, explorers used in different Operating Systems

Laboratory Exercises:
Maximum 10 experiments can be framed on the following Concepts:

Basic text formatting tags, fonts, tables, external hyperlinks and Internal hyperlinks, on image insertion, Cascading Style Sheets(CSS), forms, JavaScript Arrays, JavaScript strings, string Manipulations, JavaScript operators, event handling, Extensible Markup Language(XML), XML Schemas and Document Type Definitions (DTD’s).
Coding Practice:

1. Use of Good Programming practices: Declaration of variables, Indentation, Documentation, Simplicity of logic, Efficiency of logic, uniformity etc.
2. Generic and Reusable code.
3. Inclusions of exceptional cases. Better usability

Reference Books:


Course Outcomes:

At the end of this course the student should be able to:

1. Develop web pages that adhere to the standards of W3C recommendation. [L6]
2. Categorize the various navigation strategies. [L4]
3. Design Web pages using Client-Side technologies like XHTML CSS forms, and JavaScript. [L 6]
4. Develop Web documents that are usable and accessible using Web Authoring. [L6]
5. Identify and evaluate Website organizational structure. [L3, L5]
6. Develop an XML application. [L6]

Program Outcomes (PO’s):

1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
3. Postgraduates will demonstrate knowledge of professional and ethical responsibilities. [PO7]

Program Specific Outcomes(PSO’s):

Professional Skills: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]

Scheme of Continuous Internal Evaluation (CIE): 50 Marks

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**Scheme of Semester End Examination (SEE): 50 Marks**

<table>
<thead>
<tr>
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**NOTE:** - Change of program during lab examinations is not permitted

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**Semester – 1**

**Computer Programming Laboratory (C)**

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<td>Hrs/Week :L:T:P</td>
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</tr>
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<td>Total Hours:</td>
<td>42</td>
<td>SEE Duration:</td>
<td>3 Hrs.</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:**

The course aims at

1. Delivering knowledge of computer programming to implement of Top-Down problem solving strategy using C Language.
2. Providing skills to develop, test, implement, and document programs.
3. Inculcating the knowledge of writing algorithms using programming structures like functions, arrays, strings, and pointers.
4. Demonstrating the problem solving ability, code reviewing skills and code debugging skills.

**Prerequisites:**

1. Knowledge of programming constructs

**Laboratory Exercises:**

Maximum 10 experiments can be framed on the following topics:
Usage of variables and operations, control statements, loop control structures, static memory structures viz. arrays, Different operations on strings, User defined data types and functions, file structures and pointers.

**Coding Practice**
1. Use of Good Programming practices: Declaration of variables, Indentation, documentation, Simplicity of logic, Efficiency of logic, uniformity etc.
2. Generic and Reusable code.
3. Inclusions of exceptional cases. Better usability

**Reference Books:**
3. Reema Thareja Programming in C, Oxford Higher Education

**Course Outcomes:**
At the end this course the student should be able to:

1. **Interpret** various searching and sorting techniques. [L2]
2. **Improve** cognitive skills to find solutions for a given problem. [L4]
3. **Develop** skills to write algorithms and flow-charts. [L6]
4. **Develop** skills to write C programs using various programming constructs. [L6]

**Program Outcomes (PO’s):**
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
5. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
6. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
7. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]
8. Postgraduates can participate and succeed in competitive examinations. [PO11]

**Program Specific Outcomes (PSO’s):**
**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]
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### Scheme of Semester End Examination (SEE): 50 Marks

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**NOTE:** - Change of program during lab examinations is not permitted

### Semester-2

**Data Structures**

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<tr>
<td>Total Hours:</td>
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<td>SEE Duration:</td>
<td>3 Hrs.</td>
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</tbody>
</table>

**Course Learning Objectives:**

The course aims at
1. Providing knowledge of fundamental data structures like stacks, queues, linked lists, and trees.
2. Comparing and contrasting the costs and benefits of dynamic and static data structure implementations.
3. Providing guidelines on selection of the appropriate data structure for modelling a given problem.
**Prerequisite:** Problem Solving and Programming in C

### UNIT-I 10 Hrs.


**Self-learning Topics:** Dynamic memory allocation for recursion. Advantages of using dynamic memory allocations.

### UNIT-II 11 Hrs.

**THE STACKS AND QUEUES:** Stack: Definition and examples. Primitive operation, Example, testing for exceptional conditions, implementing the push operation. Example: Infix, postfix and prefix, Basic definitions and examples. Evaluating a postfix expression, Program to evaluate a postfix expression, converting an expression from infix to postfix, Program to convert an expression from infix to postfix.

Queue: The queue and its sequential representation, C implementation of queues, Priority queue, Array implementation of a priority queue, circular queue and its implementation, de-queue (doubly ended queue) implementation.

**Self-learning Topics:** Program to convert an expression from infix to prefix, from prefix to postfix, postfix to infix. Implement stack and queue using dynamic memory allocations.

### UNIT-III 11 Hrs.

**THE LISTS:** Linked lists, Inserting and removing nodes from a list, Linked implementation of stacks, Linked implementation of queues, Linked list as a data structure, Example of list operation, Header nodes, Array implementation of lists, Limitations of array implementation, Allocating and freeing dynamic variables, Linked lists using dynamic variable, Other list structures, Circular lists, Stack as a circular list, Queue as circular list, Primitive operations on circular lists, doubly linked lists.

**Self-learning Topics:** Compare arrays and lists. Lists using header node.

### UNIT-IV 10 Hrs.

**BINARY TREES:** Binary trees, Operations on binary trees, Applications of binary trees. Binary tree representation, Node representation of binary tree, Internal and external nodes, implicit array representation of binary trees, choosing a binary tree representation, binary tree traversal using C, threaded binary trees. Representing list as binary tree: finding the $K^{th}$ element, deleting an element, finding minimum and maximum element in a tree.

**Self-learning Topics:** AVL tree, Read and black tree, forests.

### UNIT-V 10 Hrs.

**Searching and Sorting:** Searching: Sequential search, binary search, Binary Tree search, Exchange sort: Bubble sort, Quick sort. Selection sort and Tree sorting: Straight, selection sort, Binary tree sorts, sorting using a heap. Insertion sorts: Simple Insertion, Shell sort, Merge and Radix sorts. Tree Searching: Insertion into a Binary search tree, Deleting from a BST.
**Self-learning Topics:** Compare time complexity for prescribed sorting techniques.

**Reference Books:**
1. Yedidyah Langsam and Moshe J. Augenstein and Aaron M. Tenanbaum, Data structures using C , PHI. Reference books

**Course Outcomes:**

After going through this course the student will be able to:

1. Define ADT (Abstract Data Types) and classify the basic techniques of algorithm analysis and implementation. [L1, L2]
2. Analyze recursive methods. [L4]
3. Access, analyze and construct various operations on stacks and queues. [L4,L5,L6]
4. Evaluate and translate asymptotic notations. [L2, L5]
5. Create linked data structures such as linked lists and binary trees. [L6]
6. Appraise, analyze, and design advanced data structures such as balanced search trees, hash tables. [L4, L5, L6]

**Program Outcomes (PO’s):**

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
5. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
6. Postgraduates will develop confidence for self education and ability for life-long learning. [PO10]

**Program Specific Outcomes (PSO’s):**

1. Professional Skills: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity[PSO1]
2. **Problem-Solving Skills**: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success [PSO2]

**Scheme of Continuous Internal Evaluation (CIE):**

<table>
<thead>
<tr>
<th>Components</th>
<th>Average of best of two tests out of three</th>
<th>Average of two assignments/ Course Seminar/ Course Project,</th>
<th>Quiz</th>
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<tr>
<td>Maximum</td>
<td>30</td>
<td>10</td>
<td>10</td>
<td>50</td>
</tr>
</tbody>
</table>

**Scheme of Continuous Internal Evaluation (CIE):**

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours’ duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

<table>
<thead>
<tr>
<th>Semester-II</th>
<th>Database Management Systems</th>
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<tr>
<td>Total Hours:</td>
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**Course Learning Objectives:**

The course aims at

1. Providing a clear knowledge of the nature of Database Management System including their structure, design, and evaluation.
2. Correlating the relationship between DBMS and information systems used in libraries and business.
3. Imparting knowledge on designing Entity-Relationship (ER) diagram.
4. Analyzing the process of normalization in relational databases.
5. Providing knowledge on writing Structured Query Language (SQL) and its standards in the current and future development of DBMS.
6. Developing introductory level of skill set required in the use of selected microcomputer Database Management Systems.

<table>
<thead>
<tr>
<th>UNIT – I</th>
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<tbody>
<tr>
<td><strong>Introduction:</strong></td>
<td>Introduction; An example; Characteristics of Database approach; Actors on the screen; Workers behind the scene; Advantages of using DBMS approach; A brief history of database applications; when not to use a DBMS. Data models, schemas and instances; Three-schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client-server architectures; Classification of Database Management systems.</td>
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<table>
<thead>
<tr>
<th>UNIT - II</th>
<th>10 Hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Entity-Relationship Model and Relational Model:</strong></td>
<td>Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues; Relationship types of degree higher than two. Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions and dealing with constraint violations;</td>
</tr>
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<table>
<thead>
<tr>
<th>UNIT-III</th>
<th>10 Hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Relational Algebra:</strong></td>
<td>Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Additional Relational Operations; Examples of Queries in Relational Algebra; Relational Database Design Using ER- to-Relational Mapping.</td>
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</table>

<table>
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<tr>
<th>UNIT– IV</th>
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<tbody>
<tr>
<td><strong>SQL:</strong></td>
<td>SQL Data Definition and Data Types; Specifying basic constraints in SQL; Schema change statements in SQL; Basic queries in SQL; More complex SQL Queries, Insert, Delete and Update statements in SQL; Specifying constraints as Assertion and Trigger; Views (Virtual Tables) in SQL; Additional features of SQL; Database programming issues and techniques; Embedded SQL, Dynamic SQL; Database stored procedures and SQL / PSM.</td>
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</table>

<table>
<thead>
<tr>
<th>UNIT–V</th>
<th>12 Hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Database Design and PL/SQL:</strong></td>
<td>Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form.</td>
</tr>
</tbody>
</table>
Introduction to PL/SQL, Language fundamentals, conditional and sequential control, Iterative processing and loops. Exception handlers, triggers. Functions, procedures. Creating and planning PL/SQL.

**Self-learning Topics:** Indexes

**Reference Books:**

**Course Outcomes:**

After going through this course the student will be able to:
1. Explain the characteristics and functions of Database Management System. [L 2]
2. Explain types of Database Users. [L 2]
4. Design Entity-Relationship (ER) modeling. [L 6]
5. Define the concept of Relational Algebra and contrast the Relational Operations from Set Theory. [L 1, L 4]
6. Design queries in SQL. [L 6]
7. Illustrate the definition of Functional Dependencies, Inference Rules, and Equivalence of Sets of Functional Dependencies FDs, Minimal Sets of FDs. [L 2]
8. Plan the three Normal Forms based on Partial and Transitive Dependencies. [L3]
9. Apply normalization techniques to normalize a database. [L 3]
10. Demonstrate the use of PL/SQL for database. [L 2]

**Program Outcomes (PO’s):**
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
5. Postgraduates will demonstrate an ability to analyze and build computer applications for
multiple domains. [PO5]
6. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
7. Postgraduates can participate and succeed in competitive examinations. [PO11]
8. Postgraduates will demonstrate research-based knowledge and research methods for addressing current issues in research trends. [PO12]

**Program Specific Outcomes (PSO’s)**
1. **Problem-Solving Skills**: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO2]

**Scheme of Continuous Internal Evaluation (CIE):**

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**Scheme of Continuous Internal Evaluation (CIE):**
Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

**Semester-II**

**Operating Systems**

<table>
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<th>Subject Code:</th>
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<th>04</th>
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<tbody>
<tr>
<td>Course Type:</td>
<td>CC</td>
<td>CIE Marks:</td>
<td>50</td>
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</tbody>
</table>
Course Learning Objectives:
The course aims at
1. Providing a clear understanding of the functions of operating system with respect to convenience, efficiency and its ability to evolve.
2. Highlighting the different process states and data structures needed to support the management of many tasks.
3. Summarizing the various approaches to solving the problem of mutual exclusion in an operating system.
5. Discussing the concept of thrashing, both in terms of reasons it occurs and the techniques used to recognize and manage the problem.

Prerequisite:
A course on Digital Systems and Computer Organization (15MCA13)

UNIT-I  10 Hours
Introduction to Operating Systems, System structures: Introduction to operating systems; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and security; Distributed system; Special-purpose systems; Computing environments. Operating System Services; User - Operating System interface; System calls; Types of system calls; System programs; Operating System design and implementation; Operating System structure; Virtual machines; Operating System generation; System boot. Process concept; Process scheduling; Operations on processes; Inter-process communication.
Self-Learning Topics:
Comparative study of different operating system and Architectures.

UNIT-II  11 Hours
Multi-Threaded Programming, Process Synchronization: Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms; Multiple-Processor scheduling; Thread scheduling.
Synchronization: The Critical section problem; Peterson’s solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.
Self-learning Topics:
Exploring the essential aspects of sharing the resources among the users.

UNIT-III  11 Hours
Deadlocks, Memory Management: Deadlocks: System model; Deadlock
characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand Copy-on-write; Page replacement; Allocation of frames; Thrashing.

**Self-learning Topics:**
Analyze theory and implementation of physical and virtual memory

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**UNIT-IV**

**10 Hours**

**File System, Implementation of File System, Secondary Storage Structures:**

File System: File concept; Access methods; Directory structure; File system mounting; Protection. Implementing File System: File system structure; Directory implementation; Free space management

Mass storage structures; Disk structure; Disk attachment; Disk management; Swap space management

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**UNIT-V**

**10 Hours**

**Protection, Case Study: The Linux Operating System:**

Goals of protection, Principles of protection, Domain of protection, Access control, Revocation of access rights, Capability-Based systems.

Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory management; File systems, Input and output; Inter-process communication.

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**Reference Books:**


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**Course Outcomes:**

At the end of the course student should be able to:

1. **Identify** systems calls and interrupts of any operating system. [L3]
2. **Explain** Input/output, disk access, and file system facilities. [L2]
3. **List** the features and limitations of an operating system used to provide protection. [L4]

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**Program Outcomes (PO’s):**

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and
management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]

Program Specific Outcomes (PSO’s):

1. **Professional Skills**: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

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**Semester-II**

**Object Oriented Programming – 1 (C++)**

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<td>Hrs/Week :L:T:P</td>
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<td>SEE Marks:</td>
<td>100</td>
</tr>
<tr>
<td>Total Hours:</td>
<td>52</td>
<td>SEE Duration:</td>
<td>3 Hrs.</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
The course aims at
1. Providing knowledge of basic Object Oriented Programming concepts.
2. Comparing Modular programming with Object Oriented Programming and analyze the strengths and weaknesses of Object Oriented Programming.
4. Developing skills to write program in C++ using Classes and Objects and implement Encapsulation, Polymorphism and Inheritance.
5. Handling run-time errors in a program and deal with files and input/output streams in C++.

**Prerequisites:**
A course on C Programming (15MCA14).

- **UNIT-I**
  - **10 Hrs.**
  - **Introduction:** Introduction to object oriented programming, Structured vs Object Oriented Paradigm, Characteristics of object-oriented programming, Elements of Object Oriented Programming: Object, Classes, Encapsulation & data abstraction, Inheritance, Polymorphism etc., C++ Overview, different data types, operators, expressions, const & volatile qualifiers, arrays and strings, reference variables, scope resolution operator.

- **UNIT-II**
  - **10 Hrs.**
  - **Classes & Objects:** Introduction to Class specification, Class Objects, access members, defining member functions, data hiding, constructors, destructors, parameterized constructors, static data members, functions, passing objects as arguments, returning objects, friend functions & classes, arrays of objects, Dynamic objects – Pointers to objects.

- **UNIT-III**
  - **10 Hrs.**
  - **Modular Programming with Functions:** Function Components, argument passing, inline functions, function overloading, recursive functions, function templates and Class templates, Operator overloading using friend functions such as ++, --, [] etc.

- **Self-Learning Topics:** STL: An overview, containers, vectors, lists maps

- **UNIT-IV**
  - **11 Hrs.**
  - **Inheritance, Virtual functions & Polymorphism:** Base Class, Types of Inheritance, Inheritance & protected members, protected base class inheritance, inheriting multiple base classes, Constructors, Destructors & Inheritance. Passing parameters to base Class Constructors, granting access, Virtual base classes, Virtual function -Calling a Virtual function through a base class reference, Virtual attribute is inherited, Virtual functions are hierarchical, pure virtual functions, abstract classes, using Virtual functions, Early & late binding.

- **UNIT-V**
  - **11 Hrs.**
  - **I/O Streams & Exception Handling:** IO Stream basics, output operator <<, input >>, additional I/O operators, overloading the output operator <<, overloading the input operator >>, file input & output, manipulators, Exception handling fundamentals, Exception handling
options.

**Self-learning Topics:** Data File handling

**Reference Books:**
3. E. Balaguruswamy: Object oriented programming with C++, TMH

**Course Outcomes:**
After going through this course the student will be able to:

1. **Explain** Object Oriented Programming Concepts. [L2]
2. **Distinguish** between procedure oriented programming and object oriented programming. [L4]
3. **Illustrate** concepts such as classes, objects, constructors, destructors, function overloading, operator overloading, generic functions and generic classes. [L2]
4. **Explain** the use of Friend Functions and Friend Classes. [L 2]
5. **Develop** Programs using Encapsulation, Inheritance, and Polymorphism. [L 6]
6. **Explain** the use of dynamic memory allocation, virtual functions, pure virtual functions, and abstract classes in C++. [L2]
7. **Design** a mechanism to handle run-time errors in C++. [L 6]
8. **Illustrate** the use input/output streams and file handling mechanisms in C++. [L2]

**Program Outcomes (PO’s):**

1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
3. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
4. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]

**Program Specific Outcomes (PSO’s):**

**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

**Scheme of Continuous Internal Evaluation (CIE):**
**Curriculum Structure with Content- Course wise**

<table>
<thead>
<tr>
<th>Components</th>
<th>Average of best of two tests out of three</th>
<th>Average of two assignments/ Course Seminar/ Course Project,</th>
<th>Quiz</th>
<th>Total Marks</th>
</tr>
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<tr>
<td>Maximum</td>
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<td>10</td>
<td>10</td>
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</table>

**Scheme of Continuous Internal Evaluation (CIE):**

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA

**Semester-II**

**System Software**

<table>
<thead>
<tr>
<th>Subject Code:</th>
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<th>04</th>
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<td>Hrs/Week: L:T:P</td>
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</tr>
<tr>
<td>Total Hours:</td>
<td>52</td>
<td>SEE Duration:</td>
<td>3 Hrs.</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:**

The course aims at

1. Providing a clear understanding of design and implementation of various types of
system software.
2. Understanding the relationship between Machine architecture and System software.
4. Giving an insight into the programs for the machine being studied. The student should be exposed to the use of hypothetical computer (SIC) for instructional purposes. Firstly, because it avoids the problem of dealing with the irrelevant complexities and “quirks” found on most real computers. Secondly all students begin on equal footing. No student is at an unfair disadvantage because he or she happens to be unfamiliar with hardware and software system on which the text is based.
5. Exploring the need of Lex and Yacc to create compilers and interpreters.

Prerequisites:
Students must have the knowledge of the following topics:
1. A course on Digital systems and computer organization (15MCA13)
2. Data structures.

Unit – I
Machine Architecture and Assemblers - I: 11 Hours

Self-learning Topics:
Program Relocation.

Unit – II
Assemblers - II and Loaders 11 Hours

Unit –III
Linkers, Editors and Debugging Systems 10 Hours

Self-learning Topics:
Relationship with Other Parts of the System, User-Interface Criteria
Unit - IV
Macro Processors 10 Hours

Unit - V
Compilers, Lex and Yacc: 10 Hours
Language processors, The structure of a compiler, The evolution of programming languages. The simplest Lex program, recognizing words with Lex, Symbol tables, Grammars, the parts of speech Lexer, A Yacc parser, the rules section, Running Lex and Yacc, Using Lex– regular expressions, a word counting problem. Using Yacc- Grammers, Recursive rules, Shift/reduce parsing, A Yacc parser- definition section, the rules section, Symbol values and actions, The Lexer, Compiling and running a simple parser.

Self-learning Topics:
Implementation and execution of simple lex/yacc programs.

Reference Books:

Course Outcomes:
On successful completion of the course the student will be able to :
1. Identify and explain the architecture of SIC and SIC-XE machine with an illustration of the role of system programming in computer operation. [L2, L3]
2. Analyze and design working of assemblers in terms of their machine dependency. [L4, L6]
3. Compare between machine independent and machine specific details of Assemblers, Loaders, and Macroprocessors. [L4]
5. Explain the working of Text editors, Macro processor and their design options. [L2]
6. Identify and explain the phases of compilers. [L2, L3]
7. **Develop** simple Lex and Yacc programs [L6]

**Program Outcomes (PO’s):**
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates can participate and succeed in competitive examinations. [PO11]

**Program Specific Outcomes (PSO’s)**

1. **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

**Scheme of Continuous Internal Evaluation (CIE):**

<table>
<thead>
<tr>
<th>Components</th>
<th>Average of best of two tests out of three</th>
<th>Average of two assignments/Course Seminar/Course Project</th>
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</tr>
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<tr>
<td>Maximum</td>
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<td>10</td>
<td>10</td>
<td>50</td>
</tr>
</tbody>
</table>

**Scheme of Continuous Internal Evaluation (CIE):**

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
Semester-II

Data Structures Laboratory

<table>
<thead>
<tr>
<th>Subject Code:</th>
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</thead>
</table>

Course Type: CC
CIE Marks: 50
Hrs/Week :L:T:P 0 : 0 : 1
SEE Marks: 50
Total Hours: 42
SEE Duration: 3 Hrs.

Course Learning Objectives:

The course aims at
1. Inculcating programming strategy using Top-Down approach to solve complicated problems.
3. Developing skills to write algorithms implementing stacks, queues, linked lists, trees, and graphs.
4. Imparting knowledge on Hashing Techniques, Searching Techniques and Sorting Techniques.
5. Using the recursive algorithms in implementing trees and graphs.
6. Familiarizing the issues of Time complexity and examine various algorithms from time complexity perspective.

Prerequisites:
1. Knowledge of structured programming language.
2. Problem solving and analytical understanding using programming language
3. Exposure to Unix and related Editor

Laboratory Exercises:
Maximum 10 experiments can be framed on the following concepts:

Recursion, stack, queues, linked lists, trees, Searching and Sorting techniques

Reference Books:
Course Outcomes:

On completing this course student will be able to:

1. **Design** well-structured complex programs using the concepts of data structures. [L6]
2. **Construct** and **analyze** different sorting algorithms like Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Shell sort and Heap sort. [L4, L6]
3. **Appraise** and **Design** the Abstract Data Type (ADT) using both array based and linked-list based data structures, including single, double and circular linked-lists and its applications. [L5, L6]
4. **Appraise** and **Design** the Stack ADT using both array based and linked-list based data structures and also implement Stack applications. [L5, L6]
5. **Appraise** and **Design** the Queue ADT and Circular Queue ADT using both array based and linked-list based Data structures. [L5, L6]
6. **Appraise** and **Design** binary tree ADT using linked list based data structures. [L5, L6]
7. **Appraise** and **Design** AVL tree operations and implement graph traversal techniques. [L5, L6]

Program Outcomes:

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
5. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
6. Postgraduates will develop confidence for self education and ability for life-long learning. [PO10]

Program Specific Outcomes (PSO’s):

1. **Professional Skills**: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]

2. **Problem-Solving Skills**: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality applications for business success [PSO2]

Scheme of Continuous Internal Evaluation (CIE): 50 Marks
<table>
<thead>
<tr>
<th>CIE</th>
<th>Conduct of lab</th>
<th>20</th>
<th>50</th>
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**Scheme of Semester End Examination (SEE): 50 Marks**

<table>
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<th>50</th>
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<tbody>
<tr>
<td></td>
<td>Viva – voce</td>
<td>10</td>
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</table>

**NOTE: - Change of program during lab examinations is not permitted**
Semester-II

Database Management System Laboratory

<table>
<thead>
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<td>Hrs/Week :L:T:P</td>
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</tr>
<tr>
<td>Total Hours:</td>
<td>42</td>
<td>SEE Duration:</td>
<td>3 Hrs.</td>
</tr>
</tbody>
</table>

Course Level Objective:

The course aims at

1. Providing a clear understanding of Database Management System as a subject in its own right, rather than as a compendium of techniques and product-specific tools.
2. Familiarizing the participant with the nuances of database environments towards an information-oriented data processing oriented framework.
3. Giving a good formal foundation on the relational model of data and also to present SQL and procedural interfaces to SQL comprehensively.
4. Introducing systematic database design approaches covering conceptual design.

Laboratory Exercises:

Maximum 8 experiments can be framed on the following concepts:
Integrity rules and simple queries, nested queries, type of joins, views, aggregate functions, PL/SQL using triggers and procedures.

Reference Books:

2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems,
Course Outcomes:
After completion of this course, the students would be able to

1. **Design** a Database and **explain** the characteristics and functions of Database Management System along with types of Database Users. [L 2, L 6]
2. **Contrast** Data Models, Schemas, Instances, Three Schema Architecture and DBMS Component Modules. [L 4]
3. **Design** Entity-Relationship (ER) modeling. [L 6]
4. **Define** the concept of Relational Algebra and **contrast** the Relational Operations from Set Theory. [L 1, L 4]
5. **Design** queries in SQL. [L 6]
6. **Illustrate** the Definition of Functional Dependencies, Inference Rules, Equivalence of Sets of Functional Dependencies FDs, Minimal Sets of FDs. [L 2]
7. **Apply** normalization techniques to normalize a database. [L 3]
8. **Demonstrate** the use of PL/SQL for database. [L 2]

Program Outcomes (PO’s):

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
5. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
6. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
7. Postgraduates can participate and succeed in competitive examinations. [PO11]
8. Postgraduates will demonstrate research-based knowledge and research methods for addressing current issues in research trends. [PO12]

Program Specific Outcomes (PSO’s)

1. **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO2]
### Scheme of Continuous Internal Evaluation (CIE): 50 Marks

<table>
<thead>
<tr>
<th>Activity</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Conduct of lab</td>
<td>20</td>
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<tr>
<td>Journal writing</td>
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<tr>
<td>Attendance</td>
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<tr>
<td>Two lab tests of 10Marks will be conducted and average of the two tests will be considered for the calculation of CIE</td>
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### Scheme of Semester End Examination (SEE): 50 Marks

<table>
<thead>
<tr>
<th>Activity</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct of experiments</td>
<td>40</td>
</tr>
<tr>
<td>Viva – voce</td>
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**NOTE:** - Change of program during lab examinations is not permitted

### Semester –II

**Object Oriented Programming –1 Laboratory (C++)**

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<td>Hrs/Week :L:T:P</td>
<td>0-0-1</td>
<td>SEE Marks:</td>
<td>50</td>
</tr>
</tbody>
</table>

| Total Hours: | 42 | SEE Duration: | 3 Hrs. |

### Course Learning Objectives:

**The course aims at**

1. Providing knowledge of C++ Editors and writing programs using Classes and Objects.
2. Introducing concepts like operator overloading, function overloading, function templates and class templates and implement them using C++.
3. Implementing the three traits of Object Oriented Programming, namely, Encapsulation, Inheritance and Polymorphism using C++.
4. Inculcating the knowledge of handling Input/output Streams, Exceptions and Files in C++.

### Prerequisites:

Knowledge of C language.
**Laboratory Exercises:**

**Maximum 10 experiments can be framed on the following Concepts:**

Classes and objects, Overloading functions, Template function, Class template, Operator overloading, Copy constructor, Virtual base class and inheritance, Pure virtual function and polymorphism, Exception handling.

**Reference Books:**

3. E. Balaguruswamy: Object oriented programming with C++, TMH

**Course Learning Outcomes:**

At the end of the course the student should be able to:

1. Demonstrate the concept of Classes and Objects [L2].
2. Demonstrate function overloading, operator overloading, function templates and class templates [L2].
3. Develop programs to implement Encapsulation, Inheritance and Polymorphism. [L 6]
4. Develop programs that can handle exceptions, files and input/output streams. [L6]

**Program Outcomes (PO’s):**

1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
3. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
4. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]

**Program Specific Outcomes (PSO’s):**

1. Professional Skills: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]

**Scheme of Continuous Internal Evaluation (CIE): 50 Marks**

<p>| CIE         | Conduct of lab | 20 | 50 |</p>
<table>
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<tr>
<th>Course Type</th>
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<td>1</td>
<td>1:0:0</td>
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### Unit – I

#### Grammar and Vocabulary

1. Vocabulary – everyday words, people, the world, at home, workplace, leisure, social issues.

2. Grammar – usage of Articles, Prepositions, Adjectives, Adverbs,
Conjunctions.


4. Tenses, Subject Verb Agreement.

**Unit – II**

**Reading Skills**  
5 hrs

1. Data interpretation: Charts/ graphs.
2. Comprehension of texts.
3. Interpretation of Notices, short messages and email contents.

**Unit – III**

**Listening Skills**  
7 hrs

1. Interpretation of recorded audio - video script.
2. Listening for specific information.

**Unit – IV**

**Speaking Skills**  
8 hrs

1. General interaction.
2. Presentation on a business theme.
3. Sharing information and expressing opinions.

**Unit – V**

**Writing Skills**  
5 hrs

2. Writing business emails, memos, and reports.

Note: Most of the concepts will be taught with the aid of software - LearnSoft.

**Reference Material**

1. e-Material – LearnSoft
2. Reference Study Notes
3. Passage to English – Prof. M.B. Kudari
5. English for Technical Communication - K.R. Lakshminarayanan
6. Functional English - Prof. G.S. Mudambadithya
7. Cambridge English Business Benchmark – Norman Whitby

Course Outcomes:
After going through this course the student will be able to:
1. Students will be able to communicate effectively in both verbal and non-verbal forms.

Scheme of Continuous Internal Evaluation(CIE): 25 marks
Evaluation will be done through assignments, oral presentations and Language Lab activities
### Course Learning Objectives:
The course aims at:
1. Providing a clear understanding of the basics of Computer Networks and its applications in fast evolving technological world.
2. Exposing the real world applications using Computer Networks.
3. Distinguishing different types of networks.
4. Studying the different layers in TCP/IP and OSI reference model with their functionalities and services provided in networking.
5. Developing an intuitive understanding of the basic networking concepts, protocol design implementation, and performance issues.
6. Studying various network services and network management issues.
7. Enlightening the dynamic and evolving field of networking which will make them use the networking concepts and its utility in today’s fast changing networking environment.

### Prerequisites:
1. Basic knowledge of computer and logic building capabilities.
2. Knowledge of data representation and Data Structures

### Course Type:
<table>
<thead>
<tr>
<th>Course Type:</th>
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<tr>
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<tr>
<td>SEE Marks:</td>
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</tbody>
</table>

### Total Hours:
- Total Hours: 52
- SEE Duration: 3 Hrs.

### UNIT I
10 Hrs

**Introduction:**

**Self-Learning Topics:**
Network Standardization.

### UNIT II
10 Hrs

**Physical Layer:**

**Self-Learning Topics:**
The Mobile Telephone System.

### UNIT III
11 Hrs

**Data Link Layer and Medium Access Control Layer:**

**Self-Learning Topics:**
Multiple Access Protocols

### UNIT IV
11 Hrs

**Network Layer:**

### UNIT V
10 Hrs

**Transport Layer and Application Layer:**
The transport services, Elements of Transport Protocols, congestion control, The Internet
Transport Protocols: TCP, UDP.
DNS-Domain Name System, Email, Introduction to Streaming Audio and Video,

**Self-Learning Topics:**
WWW, Content Delivery.

**Reference Books:**

**Course Outcomes:**
At the end of the course student should be able to:
1. **Build** proficient knowledge of computer networking. [L3]
2. **Develop** models using Networking Protocols [L3].
3. **Distinguish** between different types of Network topologies. [L4]
4. **Evaluate** different performance issues related to networking. [L5].
5. **Explain** Functionalities and Working of networking devices. [L5]

**Program Outcomes (POs) of the course:**
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will develop confidence for self-education and ability for life-long learning. [PO10]
3. Postgraduates can participate and succeed in competitive examinations. [PO11]

**Program Specific Outcomes (PSO’s)**
2. **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

**Scheme of Continuous Internal Evaluation (CIE):**

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<td>50</td>
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</table>

**Scheme of Semester End Examination (SEE):**
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units.

<table>
<thead>
<tr>
<th>Semester -3</th>
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<tr>
<td><strong>Object Oriented Programming-2</strong></td>
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Course Type: CC  
CIE Marks: 50  
Hrs/Week: L:T:P 3-1-0  
SEE Marks: 100  
Total Hours: 52  
SEE Duration: 3 Hrs.

Course Learning Objectives:
The course aims at:
1. Providing the basics of Java Programming Language.
2. Imparting the knowledge of various OOPS concepts and its implementation in Java.
3. Educating the key aspects of Java like security, robustness, and platform independence.
4. Providing emphasis on the strengths of Java Language like Multithreading, Networking,
   Generics, Applets, and File handling.
5. Understanding how to design and implement standalone applications and to create and handle
   event-driven GUI using Swing components; and implement I/O functionality to read from and
   write to text files.

Prerequisites:
1. A course on computer programming language (15MCA14).
2. A course on object oriented programming-1 (15MCA24).

UNIT I  11 Hrs
Introduction to Java, Program Control Statements, arrays and Strings in Java:
The Java Language, Key Attributes of Object-Oriented Programming, The Java Development Kit, 
Class Libraries. Java’s Primitive Types, Literals, Variables, The Scope and Lifetime of Variables, 
operators, Type conversion in Assignments, Using Cast, Operator Precedence, Expressions, and Input 
characters from the Keyword.
The basic branching statements, and looping statements, break and continue.
Arrays, Multidimensional Arrays, Alternative Array Declaration Syntax, Assigning Array References, 
Using the Length Member, For-Each Style for Loop. String Fundamentals - String, String Buffer and 
String Builder classes.

UNIT II  11 Hrs
Class Fundamentals, inheritance and interfaces:
Creating Objects and reference Variables. Returning from a Method, Returning Value, Using 
Parameters, Constructors, Parameterized Constructors, The this Keyword. Method Overloading, 
Overloading Constructors, Recursion, Understanding Static.
Inheritance Basics, Member Access and Inheritance, Constructors and Inheritance, Using super to Call 
Superclass constructors, Using super to Access Superclass Members, Method Overriding, Overridden 
Methods support polymorphism, need for Overridden Methods, Using Abstract Classes, Using final. 
Interface Fundamentals, Creating an Interface, Implementing an Interface, Using Interface References, 
Implementing Multiple Interfaces.

UNIT III  10 Hrs
Exceptions, IO & file handling in Java:
The Exception Hierarchy, Exception Handling Fundamentals, using Multiple catch clauses, User 
defined exception - Throwing an Exception, A Closer look at Throwable, using finally.
The Java I/O Classes and Interfaces, File, The Closable and Flushable Interfaces, The Stream 
Self-Learning Topics:
Serialization, Stream Benefits.

UNIT IV  10 Hrs
Packages, Multithreaded Programming, Generics:
Package Fundamentals, Packages and Member Access, Importing Packages
Multithreading fundamentals, The Thread Class and Runnable Interface, Creating Thread, Thread Priorities, Synchronization, using Synchronization Methods, The Synchronized Statement, Thread Communication using notify(), wait() and notify All(), suspending, Resuming and stopping Threads.
Generics Fundamentals, Bounded Types, Generic Methods, Generic Constructors, and some Generic Restrictions.

UNIT V                                           10 Hrs

Applets, Swing Fundamentals and Networking with Java.net:

Self-Learning Topics:
Exploring Swing Controls-JLabel and ImageIcon, The Swing Buttons, Trees.

Reference Books :

Course Outcomes:
At the end of the course student should be able to:
1. List and demonstrate the implementation of key features of Object Oriented Programming [L1, L2]
2. Apply the exceptions handling, multithreading, and file handling mechanisms in software development using Java technology [L 3]
3. Design GUI for desktop based applications using swing and Internet based applet applications using Applet/JApplet [L 6]
4. Develop network based applications using Networking classes [L 6]

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
3. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
4. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
5. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
6. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]
7. Postgraduates can participate and succeed in competitive examinations. [PO11]
Program Specific Outcomes (PSO's)

1. **Problem-Solving Skills**: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO2]

**Scheme of Continuous Internal Evaluation (CIE):**

<table>
<thead>
<tr>
<th>Components</th>
<th>Average of best of two tests out of three</th>
<th>Average of two assignments/Course Seminar/Course Project,</th>
<th>Quiz</th>
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<tr>
<td>Maximum</td>
<td>30</td>
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**Scheme of Semester End Examination (SEE):**

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions.

SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

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**Semester -3**

<table>
<thead>
<tr>
<th><strong>Software Engineering</strong></th>
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<tbody>
<tr>
<td><strong>Course Code</strong></td>
</tr>
<tr>
<td><strong>Course Type:</strong></td>
</tr>
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</table>
## Course Learning Objectives:
The course aims at:
1. Providing a clear understanding of Software Engineering, Software Product Development Phases and its applications in real world.
2. Understanding recent trends in Software Engineering like extreme programming and evolutionary methods, Use of Component Based Software Engineering.
3. Applying testing techniques, viz. black box and white box testing, testing tools and methodology and analyze modeling techniques.
4. Applying analytical skills to justify planning methodology for software development.
5. Extracting information regarding software development, planning, modeling, implementation and testing a software product

### UNIT I
**Overview & Software Process & Agile Software Development**  
12 Hrs

### UNIT II
**Requirements Engineering, System Modeling, Architectural Design and implementation**  
10 Hrs
Functional and non-functional requirements, The software requirements document, Requirements specification, Requirements engineering processes, Requirement elicitation and analysis, Requirements validation, Requirements management.
Context models, Interaction models, Structural models, Behavioral models, Model-driven engineering, Software architecture: the role of software architecture, architectural views, component and connector view, Architectural styles for C&C view. Documenting architectural design. Design: Design concepts, Function oriented design, detailed design, verification, matrix (Complexity matrix for function oriented design)

### UNIT III
**Component-based software engineering & Distributed Software engineering**  
10 Hrs
Components and component model, CBSE process, Component composition. Distributed system issues, Client-server computing, Architectural patterns for distributed systems,  
**Self-Learning Topics:** Software as a service.

### UNIT IV
**Planning a software Project**  
10 Hrs
Process planning, Effort estimation, Project scheduling and staffing, Software configuration management plan, Quality plan, Risk Management, Project monitoring plan.

### UNIT V
**Planning a software Project**  
10 Hrs
Process planning, Effort estimation, Project scheduling and staffing, Software configuration management plan, Quality plan, Risk Management, Project monitoring plan.
Reference Books: IEEE/ ACM code of software engineering ethics, case studies

Course Outcomes:
At the end of the course student should be able to:
1. Illustrate ethical responsibilities of software engineer and extend IEEE/ ACM code of software engineering ethics with case studies. [L2]
3. Estimate properties of CBSE. [L5]
4. Assess risk involved in planning a software project. [L5]
6. Summarize Requirements Engineering Processes, Requirement Elicitation and Analysis, Requirements Validation, and Requirements Management. [L2]
7. Classify distributed software engineering methods for client server computing. [L4]

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
5. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
6. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
7. Postgraduates will demonstrate knowledge of professional and ethical responsibilities. [PO7]
8. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]
9. Postgraduates will show the understanding of impact of engineering solutions on the society as a successful entrepreneur or IT professional. [PO9]
10. Postgraduates will develop confidence for self education and ability for life-long learning. [PO10]
11. Postgraduates will demonstrate research-based knowledge and research methods for addressing current issues in research trends. [PO12]

Program Specific Outcomes(PSO’s):
1. Successful Career and Entrepreneurship: The ability to employ modern computer languages, technologies, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.[PSO3]

Scheme of Continuous Internal Evaluation(CIE):

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Semester -4

Internet Web Programming

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<td>SEE Duration:</td>
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</table>

Course Learning Objectives
The course aims at
1. Understanding Advanced Web tools and providing skills required to build and maintain server sites on the web.
2. Exploring the wide variety of server side scripting technologies used in the construction of a website.
3. Understanding the tools and techniques that may be used for the design and development of dynamic web.

Prerequisites:
Course on Web Programming (15MCA12).

UNIT I 08 Hours

Programming in Perl: Origins and uses of perl, scalars and their operations, Assignment statements and simple input and output, control statements, fundamentals of arrays, hashes, functions, pattern matching, file input and output.

UNIT II 08 Hours

Using Perl for CGI Programming: The common Gateway Interface, CGI Linkage, Query string format, the cgi.pm module, examples.

UNIT III 08 Hours

Introduction to PHP: Origins and uses of PHP, Overview of PHP, general syntactic characteristics, primitives, operations and expressions, output, control statements, arrays, functions, pattern matching, form handling, files.

UNIT IV 08 Hours

Building Web applications with PHP: Tracking users, Using Databases, Handling XML. Database Access through the web: Relational databases, introduction to SQL, Architectures for database access, The mysql database system.

Self-Learning Topics:
Database access with PHP and mysql.

UNIT V 08 Hours

Introduction to Ruby: Origins and uses of Ruby, Scalar types and their operations, Simple input and output, Control statements, Arrays, Hashes, Methods, Classes, Code blocks and iterators, pattern matching.

Self-Learning Topics:
File Handling with Ruby
Reference Books

Course outcomes:
At the end of the course student should be able to:

1. **Describe** several tools and/or techniques involved in developing professional level Websites. [L2]
2. **Recognize** one or more of the tools deemed appropriate for a given task well enough to deploy and utilize those tools in implementing solutions to specific problems and **evaluate** the effectiveness of those solutions. [L1, L6]
3. **Demonstrate** an understanding of the web and related delivery systems. [L3]
4. **Demonstrate** an understanding of the role of CGI scripting all aspects of IT. [L3]
5. **Demonstrate** an understanding of the basic principles of Perl programming capabilities. [L3]
6. **Apply** web technology tools effectively in the web development. [L3]
7. **Compare** and **contrast** those tools and/or techniques while analyzing their appropriateness for solving specific problems. [L4]
8. **Appraise** the importance of PHP and its use as a server side scripting language. [L6]

Program Outcomes (PO’s):
1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
3. Postgraduates will demonstrate knowledge of professional and ethical responsibilities. [PO7]

Program Specific Outcomes(PSO’s):

**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success[PSO2]

Scheme of Continuous Internal Evaluation (CIE):

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**Scheme of Semester End Examination(SEE):**
Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions.
SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
| KLS’s Gogte Institute of Technology  
Department of Master of Computer Applications (M.C.A.) | Ver: 1.5 |
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SEMESTER – 3

MIS and E-COMMERCE

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<td>Total Hours:</td>
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<td>SEE Duration:</td>
<td>3 Hrs.</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
The course aims at
1. Providing a clear understanding of Management Information Systems in Real world.
2. Representation of the solution in the form of E-commerce application.
3. Exploring key challenges in Managing Information.

Prerequisites:
A course on software engineering (15MCA33).

UNIT I 8 Hours

Information and Knowledge, Introduction of MIS:
Information concepts, classification of information, methods of data and information collection, value of information, information: A quality product, General model of a human as information processor, Knowledge.

MIS: Concept, Definition, Role of the MIS, Impact of MIS, MIS and the user, Management as a control system, MIS support to the management, Management effectiveness and MIS,

Self-Learning Topics:
Organization as system. MIS: organization effectiveness.

UNIT II 8 Hour

Decision Making and DSS, Electronic Business systems:
Decision making concepts; decision making process, decision-making by analytical modeling, Behavioral concepts in decision making, organizational decision-making, Decision structure, DSS components, Management reporting alternatives.
Enterprise business system – Introduction, cross-functional enterprise applications, real world case, Functional business system, - Introduction, marketing systems, sales force automation, CIM, HRM, online accounting system

Self-Learning Topics:
Customer relationship management, ERP, Supply chain management (real world cases for the above.

UNIT III 8 Hours

Client Server Architecture and E-business Technology, Introduction to E-Commerce:

Course overview; Introduction to e-commerce, E-commerce Business Models and Concepts, E=Commerce Infrastructure: The Internet and World Wide Web, Web design, JavaScript Internet
Information Server (IIS); Personal Web Server (PWS),

UNIT IV 8 Hours

E-Commerce techniques and Issues
Introduction to Active Server Pages (ASP), Building an E-Commerce Web Site, E-Commerce Payment Systems, E-Commerce Marketing Techniques, Building product catalogue, Search product catalogue, Web Spider and search agent, Ethical.

Self-Learning Topics:
Social and Political Issues in E-commerce

UNIT V 8 Hours

Internet Communication

Reference Books:

Course Outcomes:
At the end of the course student should be able to:
1. Appraise fundamental knowledge of managing information systems. [L5]
2. Compare Commerce Techniques and Issues with Internet Communication. [L4]
3. Inspect the real world enterprise resource planning system development. [L4]
4. Evaluate development of ecommerce web sites. [L6]
5. Develop proficient knowledge of supply chain management systems in organization. [L6]

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
2. Postgraduates will demonstrate knowledge of professional and ethical responsibilities. [PO7]
3. Post graduates will develop confidence for self-education and ability for life-long learning. [PO10]

Program Specific Outcomes (PSO’s):
1. Successful Career and Entrepreneurship: The ability to employ modern computer languages, technologies, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies[PSO3]

Scheme of Continuous Internal Evaluation (CIE):

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Scheme of Semester End Examination (SEE):
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SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
Semester-3

Computer Networks Laboratory

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<tr>
<td>SEE Duration:</td>
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</table>

**Course Learning Objectives (CLO’s):**

The course aims at

1. Providing a clear understanding of network simulators.
2. Introducing the basic design and implementation of various types of network topologies.
3. Understanding the four major concepts: data communications, networking, protocols and its standards, and networking models.
5. Using higher programming languages like C/C++ to learn and explore the implementation of error detection codes, routing algorithms, TCP/IP sockets and congestion control mechanisms.

**Prerequisites:**

Students must have the knowledge of the following topics:

2. Students should have basic knowledge of C/ C++ programming constructs and should be able to write basic C / C++ programs.
3. Knowledge of UNIX / Linux Operating system.
4. Data structures.

**Laboratory Exercises:**

**SIMULATION EXERCISES**

The following experiments shall be conducted using network free and open source software simulators like NS2 / NS3 could be used. If NS2 is used ‘tcl’ scripting should be introduced. If NS3 is used C++ with PYTHON has to be introduced during first two weeks of the labs:

**Implement the following concepts in NS2 / NS3 (6 Experiments):**

Designing a network with various node and line properties and observing the network behavior, buffer capacity designs, LAN designs, Bottleneck networks, flow and congestion control, Routing algorithms, Wireless mobile experiments.

**Assumptions to be made by the student for the TCL programs for the above exercises:**

Packet size, bandwidth of a link, propagation delay between the links, packets generated interval time, units for start time and end time of the traffic, packet discard strategy, type of application that uses TCP and UDP and total simulation time.

**PROGRAMMING EXERCISES**
Implement the following concepts in C / C++ (4 Experiments):

Error detecting codes, Routing algorithms, TCP/IP sockets for client/server program error detection/correction techniques, congestion control algorithms.

NOTE: In the examination, any one problem has to be asked from above EXERCISES. The choice must be based on random selection from the entire lots.

Reference Books:

Course Outcomes (Cos):
On successful completion of the course the student will be able to:
1. Identify and utilize NS2 simulator or equivalent simulators. [L2, L3]
2. Identify and explain the architecture of network topologies and concepts. [L2, L3]
3. Utilize Grep command or AWK script to extract features from the trace file to determine the various Networking factors. [L3]
4. Develop knowledge to write TCL script, understand linking of nodes, agents, and to connect application protocol on them. [L3]
5. Construct Network Simulations using NS2 or equivalent simulators in world scenarios in a project-based approach. [L3]
6. Analyze wired and wireless topology with features like trace files, Xgraph, NAM of NS2. [L4]
7. Analyze and design working of network protocols. [L4, L6]
8. Plan a simulation program for given network scenario. [L6]

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
5. Postgraduates will develop confidence for self education and ability for life-long learning. [PO10]
## Program Specific Outcomes (PSO’s)

1. **Professional Skills**: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

2. **Successful Career and Entrepreneurship**: The ability to employ modern computer languages, technologies, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies. [PSO3]

### Scheme of Continuous Internal Evaluation (CIE): 50 Marks

<table>
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<td>Journal writing</td>
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</tr>
<tr>
<td>Attendance</td>
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<tr>
<td>Two lab tests of 10 Marks will be conducted and average of the two tests will be considered for the calculation of CIE</td>
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Total: 50 marks

### Scheme of Semester End Examination (SEE): 50 Marks

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Total: 50 marks

**Practical examination (SEE) of 3 hours duration will be conducted for 50 marks.**

**NOTE:** Change of program during lab examinations is not permitted
### Semester – 3

**Object Oriented Programming-2 Laboratory (Java)**

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<td>SEE Duration:</td>
<td>3 Hrs.</td>
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**Course Learning Objectives:**

The course aims at

1. Providing a clear understanding of Object Oriented (OO) concepts/philosophy and the major aspects of software development with emphasis to be given on implementing.
2. Imparting the knowledge of implementing Object Oriented key concepts like ADT/Encapsulation, Inheritance, Polymorphism etc.
3. Providing an insight on designing and developing software with requirements such as multithreading, GUI based applications, and network based.
4. Providing a platform for learning advanced features of Java Language.

**Prerequisites:**

A course on computer programming language (15MCA14).

**Laboratory Exercises:**

The following experiments shall be conducted using JDK latest version using text editor and executed on command prompt. GUI concepts can be implemented using IDE.

**Implement 8 programs on the following concepts:**
Polymorphism (Overloading and overriding), dynamic method dispatch (interfaces), multithreading and inter-thread communications, multithreading with priorities, packages with member of different access levels, exception handling, File (FileInputStream & FileOutputStream), to handle TCP/IP or Datagram Socket Connection.

**Implement 2 programs on the following concepts using IDE:**
Applet program with user interactions by Keyboard / mouse and a simple swing GUI interface.

**Coding Practice**

1. Use of Good Programming practices: Use of standard naming conventions, Declaration of variables, Indentation, Documentation, Simplicity of logic, Efficiency of logic, uniformity etc.
2. Generic and Reusable code.
3. Inclusions of exceptional cases. Better usability

**Reference Books:**

Course Outcomes:
At the end this course the student should be able to:

1. **Apply** built-in Classes like String, Enumerations, Arrays, and Generic Classes etc. [L 3]
2. **Apply** Object Oriented concepts like Classes, Objects, Inheritance and Polymorphism in software design and development [L 3]
3. **Design** and **build** robust systems with event handling and multithreading concepts in problem solving. [L 6]
4. **Develop** GUI based systems using applets and Swings components. [L 6]
5. **Design** and **develop** network based applications using Network Classes. [L 6]

Program Outcomes (POs) of the course:

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
3. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]

Program Specific Outcomes(PSO’s):

1. **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success[PSO2]

Scheme of Continuous Internal Evaluation (CIE): 50 Marks

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<td>Two lab tests of 10 marks will be conducted and average of the two tests will be considered for the calculation of CIE</td>
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Scheme of Semester End Examination (SEE): 50 Marks

<table>
<thead>
<tr>
<th>SEE</th>
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<tr>
<td>Conduct of experiments</td>
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<tr>
<td>Viva – Voce</td>
<td></td>
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</tr>
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</table>

**NOTE:** Change of program during lab examinations is not permitted
Semester – 4
Internet Web Programming Laboratory

<table>
<thead>
<tr>
<th>Course Code:</th>
<th>15MCA38</th>
<th>Credits:</th>
<th>02</th>
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<tbody>
<tr>
<td>Course Type:</td>
<td>CC</td>
<td>CIE Marks:</td>
<td>50</td>
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<tr>
<td>Hrs/Week : L:T:P</td>
<td>0-0-1</td>
<td>SEE Marks:</td>
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</tr>
<tr>
<td>Total Hours:</td>
<td>42</td>
<td>SEE Duration:</td>
<td>3 Hrs.</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
The course aims at
1. Understanding advanced web tools and inculcating the skills required to build and maintain server sites on the web.
2. Exploring a wide variety of technologies used in the construction of website.
3. Understanding the tools and techniques that may be used for the design and development of dynamic web.

Prerequisites:
Course on Web Programming (15MCA12) and Web Programming Laboratory (15MCA17).

Laboratory Exercises:
Maximum 5 exercise scan be framed on the following topics:
Perl, Database access with perl and mysql, PHP, Database access with PHP and mysql, Ruby.

Mini Project:
Develop a web application project using the languages and concepts learnt in the theory with a good look and feel effects. Student can use any web technologies and frameworks and databases.

Coding Practice
1. Use of Good Programming practices: Declaration of variables, Indentation, Documentation, Simplicity of logic, Efficiency of logic, uniformity etc.
2. Generic and Reusable code.
3. Inclusions of exceptional cases. Better usability
4. Building web applications with Perl, PHP.

Note:
1. A team of maximum two students must develop the mini project. However during the examination, each student must demonstrate the project individually.
2. The team must submit a brief project report (25-30 pages) that must include the following
   a. Introduction
   b. Literature Survey
   c. Software Requirement Specification
   d. Analysis and Design
   e. Implementation
   f. Testing
   g. Conclusion
   h. Future Enhancements
   i. References
3. The report must be evaluated for 10 Marks. Demonstration and Viva for 15 Marks.

Instructions:
1. In the examination, one exercise out of 5 to be asked for 25 marks.
2. The mini project has to be evaluated for 25 marks.
3. Project report duly signed by the Guide need to be submitted during the examination.

Reference Books :

Course Outcomes:
At the end this course the student should be able to:
1. Describe several tools and/or techniques involved in developing Professional Level Web sites. [L2]
2. Demonstrate an understanding of the web and related delivery systems. [L3]
3. Demonstrate an understanding of the role of CGI scripting in aspects of IT. [L3]
4. Apply web technology tools effectively in the web development. [L3]
5. Demonstrate an understanding of the basic principles of Perl programming capabilities. [L3]
6. Compare and contrast the tools and/or techniques by analyzing their appropriateness for solving specific problems. [L4]
7. Recognize one or more of the tools deemed appropriate for a given task well enough to deploy and utilize those tools in implementing solutions to specific problems; and evaluate the effectiveness of those solutions. [L1, L6]
8. Appraise the importance of PHP and its use as a server side scripting language. [L6]

Program Outcomes (PO's):
1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
3. Postgraduates will demonstrate knowledge of professional and ethical responsibilities. [PO7]

Program Specific Outcomes (PSO's):
Problem-Solving Skills: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality applications for business success[PSO2]

Scheme of Continuous Internal Evaluation (CIE) : 50 Marks

| Conduct of Lab | 20 |

Scheme of Semester End Examination (SEE) : 50 Marks
### Semester-3

#### AUDIT COURSE

<table>
<thead>
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<td>Hrs/Week :L:T:P</td>
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<td>SEE Marks:</td>
</tr>
<tr>
<td>Total Hours:</td>
<td></td>
<td>SEE Duration:</td>
</tr>
</tbody>
</table>

#### Course Learning Objectives:

The course aims at

4. Providing knowledge of fundamentals of DM, DS, OOP, DBMS & SP

#### Prerequisite:

Basic knowledge of related topics

#### UNIT – I

10 hours

Fundamentals of Discrete Mathematics


#### UNIT- II

8 hours


#### UNIT- III

10 hours

Essentials of DBMS: Characteristics of Database approach; Actors on the screen; Data models, schemas and instances; Three-schema architecture and data independence; Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues; Relationship types of degree higher than two. Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions and dealing with constraint violations;

Relational Algebra: Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Additional Relational Operations; Examples of
Queries in Relational Algebra; Relational Database Design Using ER- to-Relational Mapping.

UNIT- IV 08 hours

Fundamentals of OOP: Introduction to Class specification, Class Objects, access members, defining member functions, data hiding, constructors, destructors, parameterized constructors, static data members, functions, passing objects as arguments, returning objects, friend functions & classes, arrays of objects, Dynamic objects – Pointers to objects, function overloading, recursive functions, function templates and Class templates, Operator overloading using friend functions such as ++, --, [] etc. Base Class, Types of Inheritance, Inheritance & protected members, protected base class inheritance, inheriting multiple base classes, Constructors, Destructors & Inheritance. Passing parameters to base Class Constructors, Granting access, Virtual base classes, Virtual function, pure virtual functions, abstract classes, exception handling

UNIT- V 09 hours


Reference Books:
2. Yedidyah Langsam and Moshe J.Augenstein and Aaron M. Tenenbaum, Data structures using C , PHI. Reference books

Course Outcomes:
After going through this course the student will be able to:

7. **Analyze** set theory and operations [L1, L2]

8. **Analyze & implement** searching and sorting techniques [L4]

9. **Access, analyze** and **construct** various operations on classes objects and related operations on data [L4, L5, L6]

10. **Define and analyze** data models and operations on it [L1, L4]

11. **Appraise & analyze** [L4, L5, L6]

Program Outcomes (PO’s):

7. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]

8. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
9. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
10. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
11. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
12. Postgraduates will develop confidence for self-education and ability for life-long learning. [PO10]

Program Specific Outcomes (PSO’s):

3. **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]

4. **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success [PSO2]

**Scheme of Continuous Internal Evaluation (CIE):**

<table>
<thead>
<tr>
<th>Components</th>
<th>Average of best of two tests out of three</th>
<th>Average of two assignments, Course Seminar, Course Project, Subject Proficiency test</th>
<th>Quiz</th>
<th>Total Marks</th>
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<tr>
<td>Maximum</td>
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<td>50</td>
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</table>

**Scheme of Continuous Internal Evaluation (CIE):**

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
Semester – 4

Analysis and Design of Algorithms

<table>
<thead>
<tr>
<th>Course Code</th>
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<td>15MCA41</td>
<td>04</td>
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Course Type: CC

CIE Marks: 50

Hrs/Week :L:T:P 3-1-0

SEE Marks: 100

Total Hours: 52

SEE Duration: 3 Hrs.

Course Learning Objectives:

The course aims at
1. Getting a clear understanding of algorithms.
2. Understanding concepts of parallel programming.
3. Designing algorithms, manipulating algorithms, understanding algorithms, analyzing algorithms, comparing algorithms, and appreciating the working of an efficient algorithm.
4. Focusing on the limitations of algorithmic power and how this limitation can be coped up by using design techniques like backtracking and branch-and-bound, and finally concludes with a discussion of few approximation algorithms.
5. Developing analytical skills and problem-solving skills.

Prerequisites:
3. A basic knowledge of mathematics including mathematical induction.
4. Knowledge of graph theory

UNIT I 11 Hrs

Introduction, Analysis of algorithmic efficiency:
Notion of Algorithm, Fundamentals of algorithmic problem solving, important problem types, fundamental data structures, Analysis Framework, Asymptotic Notations and Basic efficiency classes, Mathematical Analysis of Non-Recursive and Recursive Algorithms, Examples.

UNIT II 11 Hrs

Brute Force, Divide and Conquer:
Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching, Introduction to divide and conquer technique, Merge Sort, Quick Sort, Binary Search, multiplication of large integers, Strassen’s Matrix Multiplication.

Self-Learning Topics: Exhaustive Search for Travelling Salesman Problem, Knapsack Problem and Assignment Problem.

UNIT III 10 Hrs

Decrease and Conquer, Space and Time Tradeoffs:
Insertion sort, Depth First Search, Breadth First Search, Topological Sorting, Sorting by
counting, Input Enhancement in string matching, Hashing.

**Self-Learning Topics:** Johnson-Trotter algorithm for generating combinatorial objects.

**UNIT IV**

**10 Hrs**

**Dynamic Programming, Greedy Method:**
Warshall’s Algorithm, Floyd’s Algorithm, 0/1 Knapsack, Greedy Knapsack Problem, Prim’s Algorithm, Kruskal’s Algorithm, Dijkstra’s Algorithm, Huffman Trees.

**UNIT V**

**10 Hrs**

**Coping with Limitations of Algorithmic Power:**
Lower-Bound Arguments, Decision Trees, P, NP, and NP-Complete Problems.
Backtracking: n - Queens’s problem, Hamiltonian Circuit Problem, Subset – Sum Problem.
Branch-and-Bound: Assignment Problem, Knapsack Problem, Traveling Salesperson Problem.

**Self-Learning Topics:** Approximation algorithms for NP hard problems

**Reference Books:**

**Course Outcomes:**
At the end of the course student should be able to:
14. Discuss the general framework for analyzing algorithm efficiency. [L1]
15. Discuss general method to solve problems like Knapsack and Job sequencing with Deadlines. [L1]
16. Discuss and apply different strategies for searching and sorting the elements in given list. [L1, L3]
17. Apply different strategies like Dynamic Programming and Greedy Techniques to solve graphical problems. [L3]
18. Demonstrate the mathematical analysis of recursive algorithms and non-recursive algorithms with relevant examples. [L3]

**Program outcomes(PO’s):**
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
5. Postgraduates can participate and succeed in competitive examinations. [PO11]

**Program Specific Outcomes(PSO’s):**
1. Professional Skills: The ability to understand, analyze and develop computer
programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

2. Problem-Solving Skills: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success[PSO2]

**Scheme of Continuous Internal Evaluation (CIE):**

<table>
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<tr>
<th>Components</th>
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<tbody>
<tr>
<td>Maximum</td>
<td>30</td>
<td>10</td>
<td>10</td>
<td>50</td>
</tr>
</tbody>
</table>

**Scheme of Semester End Examination (SEE):**

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions.

SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
### Semester – 4

**Topics in Enterprise Architecture-1 (J2EE)**

<table>
<thead>
<tr>
<th>Course Code</th>
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<tr>
<td>Total Hours:</td>
<td>52</td>
<td>SEE Duration:</td>
<td>3 Hrs.</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:**

**The course aims at**

1. Understanding the core components of advanced Java programming language like JSP, Servlets, JDBC, Java Beans and EJB.
2. Understanding the core components of Advanced Java technologies.
3. Understanding and implementing Servlet life cycle and handling request headers, response headers, and status codes in servlets.
4. Understanding JSP and life cycle of JSP with the advantages of JSP and make use of action tags, implicit objects, directive tags, and scriplet tags.
5. Exploring JAR file and implementation of Annotations.
6. Understanding Java Beans and API.
7. Exploring database connectivity using JDBC connection API.
8. Understanding types of EJB’s, life cycle of Server Side and Client Side EJB components.

**Prerequisites:**

A course on Java Programming (15MCA32) and basic programming Skills.

### UNIT-I

**Servlets**

Servlet Structure, Servlet packaging, HTML building utilities, Lifecycle, Single Thread

**Self-Learning Topics:** Servlet API

### UNIT II

**Java Server Pages**

<table>
<thead>
<tr>
<th>10 Hrs</th>
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</thead>
<tbody>
<tr>
<td>Overview of JSP Technology, Need of JSP, Benefits of JSP, Advantages of JSP, Basic syntax, Invoking java code with JSP scripting elements, Invoking java code from JSP, limiting java code in jsp, using jsp expressions, comparing servlets and jsp, writing scriptlets, scriptlet example Using Scriptlets to make parts of jsp conditional, using declarations, declaration example.</td>
</tr>
</tbody>
</table>

### UNIT III

**Controlling the Structure of generated servlets**

<table>
<thead>
<tr>
<th>10 Hrs</th>
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</thead>
<tbody>
<tr>
<td>the JSP page directive, import attribute, session attribute, is Elignore attribute, buffer and auto flush attributes, info attribute, errorPage and is errorPage attributes, is Thread safe Attribute, extends attribute, language attribute, Including files and applets in jsp Pages, using java beans components in JSP documents.</td>
</tr>
</tbody>
</table>

**Java Beans and Annotations**

Java Beans, advantages java beans, properties of beans, java bean API, Creating Packages, Interfaces, JAR files and Annotations. The core java API package, New java. Lang Sub package, Built-in Annotations

### UNIT IV

**JDBC**

<table>
<thead>
<tr>
<th>10 Hrs</th>
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</thead>
<tbody>
<tr>
<td>Talking to Database, Types of JDBC, Essential JDBC program, JDBC Drivers, packages, Callable Statement, Statement Objects, using Prepared Statement JDBC in Action Result sets, Batch updates, Mapping, Basic JDBC data types, Advanced JDBC data types.</td>
</tr>
</tbody>
</table>

**Self-Learning Topics:** JDBC API, Stored procedure and stored function in DBMS

### UNIT V

**Introduction to EJB and Server side Components Model**

<table>
<thead>
<tr>
<th>10 Hrs</th>
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</thead>
</table>

**Self-Learning Topics:**

**MVC (Model View Controller) Architecture.**

### Reference Books:


Course Outcomes: At the end of the course student should be able to:
1. Develop web Related aspects through Servlets and Java Server Pages. [L2, L3]
2. Develop Applications, which are distributed in nature like banking applications through EJB. [L2, L3]
3. Demonstrate comprehension in fundamental topics of computing, including the intellectual core of computing, software design and development, algorithms, computer organization and architecture, and software systems. [L3]
4. Develop many applications using JDBC to connect to a Database. [L2, L3]

Program Outcomes (PO’s):
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
5. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
6. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
7. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]
8. Postgraduates can participate and succeed in competitive examinations. [PO11]

Program Specific Outcomes(PSO’s):
2. Problem-Solving Skills: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO2]

Scheme of Continuous Internal Evaluation(CIE):

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Scheme of Semester End Examination (SEE):
Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions.

SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

<table>
<thead>
<tr>
<th>Semester-4</th>
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<tr>
<td><strong>Computer Graphics and Visualization</strong></td>
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<tr>
<td><strong>Subject Code:</strong></td>
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<td><strong>Course Type:</strong></td>
</tr>
<tr>
<td><strong>Hrs/Week :L:T:P</strong></td>
</tr>
<tr>
<td><strong>Total Hours:</strong></td>
</tr>
</tbody>
</table>

**Course Learning Objectives (CLOs):**

The course aims at:

1. Providing a clear understanding of computer graphics to give hands-on experience at developing interactive, real-time graphics applications using OpenGL.
2. Familiarizing with tools that open up a whole new world of 3D visualization.
3. Understanding all aspects of computer graphics such as writing application programs that generate graphical output.
4. Understanding how the underlying graphics library and the hardware are implemented.

**Prerequisites:**

1. Basic Mathematics and Geometrical concepts.
2. A course on computer programming (15MCA14) and Object oriented programming-1 (15MCA24)

**UNIT-I**

**Introduction and Line Generation:** 10 Hrs.

Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller, Points and lines, Line drawing algorithms, Circle generating algorithms, Ellipse generation algorithms, Fill area primitives, Polygon fill areas, OpenGL polygon fill area functions, General scan line polygon fill algorithm, Fill methods for areas with irregular boundaries.
### UNIT-II

**Introduction to OpenGL:**
Introduction to OpenGL, Coordinate reference frames, Specifying two dimensional world coordinate reference frame in OpenGL, OpenGL point functions, OpenGL line functions, OpenGL fill area attribute functions.

### UNIT-III

**Two Dimensional Transformations:**
Basic transformation, Matrix representations and homogenous coordinates, composite transformations, Reflections and shearing, Affine transformations, OpenGL geometric transformation functions. Windowing and Clipping: Viewing pipeline, Viewing transformations, 2-D Clipping algorithms- Line clipping algorithms such as CohenSutherland line clipping algorithm, Liang Barsky algorithm, Line clipping against non-rectangular clip windows; Polygon clipping –Sutherland Hodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Text clipping.

### UNIT-IV

**Three Dimensional Transformations:**
3-D geometric primitives, 3-D Object representation, 3-D Transformation, The three dimensional viewing concepts, Three dimensional viewing pipeline, Three dimensional viewing coordinate parameters, Transformation from world to viewing coordinates, 3-D Clipping.

**Self-Learning Topics:** Curves

### UNIT-V

**Projections, Surfaces and Computer Animation:**

**Self-Learning Topics:** Rendering, Animation using user interactions

### Reference Books:

### Course Outcomes:

After going through this course the student will be able to:

1. **Identify and explain** the structure of OpenGL-API and describe the abstractions of OpenGL-API and demonstrate its use by writing simple 2D and 3D graphics applications that do not require user interaction [L2, L3].
2. **Classify** the views used in classical viewing and **demonstrate** the techniques of computer viewing in application programs using functionalities of OpenGL [L2].
3. **Illustrate** the different Clip lines views and **demonstrate** the technique of Clip lines algorithm in application programs using functionalities of OpenGL [L2].

4. **Identify** the various applications of computer graphics and **discuss** the working of graphics system and its analogy with physical imaging systems. **Identify** the different graphics architectures. [L 3, L6]

5. **Construct** a simple 2D graphics program using minimal OpenGL-API [L6].

6. **Illustrate** the basic tools of user interaction and animation defined in OpenGL-API. [L 2]

7. **Design** and **develop** simple interactive and animating graphics programs using the tools available in OpenGL-API [L6].

8. **Demonstrate** the mathematical abstractions of geometric objects and their graphical representations. **Evaluate** the mathematical abstractions for applying transformations on objects. **Design**, **develop** and **implement** the graphics application programs involving transformations using OpenGL-API [L2, L 5 & L 6].

9. **Construct** the algorithms of graphics pipeline and the basic implementation strategies used in OpenGL [L6].

**Program Outcomes (POs) of the course:**

1. Post graduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Post graduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Post graduates can participate and succeed in competitive examinations. [PO11]

**Program Specific Outcomes (PSO’s):**

1. **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

**Scheme of Continuous Internal Evaluation (CIE):**

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<td>10</td>
<td>10</td>
<td>50</td>
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**Scheme of Semester End Examination (SEE):**

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions.

SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
### Semester – 4

#### Algorithms Laboratory

<table>
<thead>
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<th>Course Code:</th>
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<th>Credits:</th>
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<tr>
<td>Hrs/Week :L:T:P</td>
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<td></td>
</tr>
<tr>
<td>Total Hours:</td>
<td>42</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CIE Marks:** 50  
**SEE Marks:** 50  
**SEE Duration:** 3 Hrs.

**Course Learning Objectives:**

The course aims at
1. Understanding the application of various algorithms, design strategies to solve real life problems like searching, sorting, string processing, graph problems, combinatorial problems, geometric problems and numerical problems.
2. Exploring the capability to analyze the efficiency of the algorithm, compare and comments on the behavior of the algorithm, and appreciate the working of an algorithm.
3. Finding means to develop analytical skills and problem-solving skills.

Prerequisites:
1. A course on Computer programming language (15MCA14).
2. Knowledge of basic mathematics and Graph Theory

Laboratory Exercises:
Maximum 10 programs can be framed on the following concepts / strategies:
Recursion, Divide and conquer, Decrease and conquer, Dynamic Programming, Backtracking, String matching, Greedy technique.

Coding Practice
1. Use of Good Programming practices: Declaration of variables, Indentation, Documentation, Simplicity of logic, Efficiency of logic, uniformity etc.
2. Generic and Reusable code.
3. Inclusions of exceptional cases. Better usability

Reference Books :

Course Outcomes:
At the end this course the student should be able to:
1. Explain the fundamentals of algorithmic problem solving. [L2]
2. Explain and analyze any given problem to derive at a best solution. [L2, L4]
3. Apply algorithmic strategies on different problems [L3].
4. Assess a given problem and derive at a solution by writing an efficient algorithm. [L6]

Program outcomes(PO’s):
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
5. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
Program Specific Outcomes (PSO’s):

**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success [PSO2]

### Scheme of Continuous Internal Evaluation (CIE) : 50 Marks

<table>
<thead>
<tr>
<th>CIE</th>
<th>Conduct of Lab</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Journal Writing</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Attendance</td>
<td>10</td>
</tr>
<tr>
<td>Two lab tests of 10 marks will be conducted and average of the two tests will be considered for the calculation of CIE</td>
<td></td>
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</table>

50 Marks

### Scheme of Semester End Examination (SEE) : 50 Marks

<table>
<thead>
<tr>
<th>SEE</th>
<th>Conduct of experiments</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td>10</td>
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</table>

50 Marks

**NOTE:** Change of program during lab examinations is not permitted

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### Semester – 4

**Topics in Enterprise Architecture-I Laboratory**

<table>
<thead>
<tr>
<th>Course Code: 15MCA45</th>
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<tr>
<td><strong>Course Type:</strong> C</td>
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<td><strong>Hrs/Week :L:T:P</strong> 0-0-1</td>
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<tr>
<td><strong>Total Hours:</strong> 42</td>
<td>SEE Duration: 3 Hrs.</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:**

**The course aims at**

1. Understanding the importance of Java and Advanced Java technologies.
2. Developing knowledge of distributed applications using advanced server side
programming like JSP, Servlet, and Java Beans.
3. Understanding the need and importance of NetBeans IDE to write, debug and execute Servlets, Server Pages, and EJB applications.
4. Getting knowledge about Development of real time enterprise applications for any business purpose which will be very secure in nature.

Prerequisites:
A course on Java programming language (15MCA32).

Laboratory Exercises:
Maximum 10 experiments can be framed on the following topics:
Servlet life Cycle, handling data from client.(Client request), Servlet HTTP request Header. (Get () and Post() methods), Servlet cookies, JSP Scripting tags, All attributes of JSP Page directive tag, JSP Action tags(JSP: include, JSP: forward), JSP Using Java Bean class, JDBC.(Java Database Connectivity), JSP directive tags. (include, Page, taglib), EJB Application demonstrating Session Bean.

Note: Net beans IDE (Latest version), Specific/Generalize d JAR files, Eclipse IDE may be used.

Reference Books :

Course Outcomes:
At the end this course the student should be able to:
1. Write Applications in JSP and Servlets using NetBeans IDE. [L3]
2. Develop and deploy Web Services on the Java platform. [L5]
4. Develop and implement web related aspects using Servlets and JSP. [L 5]
5. Develop GUI based applications using Applet Components. [L 5]

Program Outcomes (PO’s):
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
5. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
6. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
7. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]
8. Post graduates can participate and succeed in competitive examinations. [PO11]

Program Specific Outcomes(PSO’s):
1. **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality applications for business success.[PSO2]

Scheme of Continuous Internal Evaluation (CIE) : 50 Marks

<table>
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<tr>
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<th>Attendance</th>
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### Scheme of Semester End Examination (SEE) : 50 Marks

<table>
<thead>
<tr>
<th>SEE</th>
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<th>Viva – Voce</th>
<th>Total Marks</th>
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**NOTE:** Change of program during lab examinations is not permitted

### Semester –4

**Computer Graphics Laboratory**

<table>
<thead>
<tr>
<th>Subject Code:</th>
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</tr>
<tr>
<td>Total Hours:</td>
<td>42</td>
<td>SEE Duration:</td>
<td>3 Hrs.</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:**

The course aims at:
1. Providing a clear understanding of the structure of OpenGL-API and its interface.
2. Emphasizing on the syntax of graphics functions available from OpenGL library and to introduce the GLUT (Graphics Library Utility Toolkit) of OpenGL.
3. Making the students acquainted with most common library functions of OpenGL for designing the graphics application programs.
4. Gaining the in-depth knowledge of using the graphics functions of OpenGL and to design, develop, and execute the graphics programs using ‘C/C++’ language under Windows XP operating system.
5. Understanding the techniques of designing and developing the graphics programs from the major topics of computer graphics involving both 2D and 3D objects.

**Prerequisites:**
1. Basic Mathematics and Geometrical concepts.
2. A course on computer programming (15MCA14) and Object oriented programming-1 (15MCA24)

**Laboratory Exercises:**
**Maximum 10 experiments can be framed on the following topics:**
- OpenGL functions, graphics output primitive algorithms, boundary fill algorithm, 2D transformation, Clipping, 3D transformation, animation.

**Reference Books:**

**Course Outcomes:**
At the end of the course the student should be able to:
1. **Demonstrate** the use of OpenGL line and circle drawing functions [L2].
2. **Analyze** the construction and display of animated object [L4].
3. **Construct** a graphic program in building simple 2D object transformation [L6].
4. **Develop** a basic graphics program using commonly used functions of OpenGL-API [L6].
5. **Design** a graphics program in building simple 3D objects transformation [L6].
6. **Construct** a graphic program for boundary fill algorithm [L6].
7. **Propose** the construction and display of clipping algorithm [L6].

**Program Outcomes (POs) of the course:**
1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
3. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
4. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]

**Program Specific Outcomes (PSO’s):**
1. **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data
analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

Scheme of Continuous Internal Evaluation (CIE): 50 Marks

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**Total:** 50 Marks

Scheme of Semester End Examination (SEE): 50 Marks

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</table>

**Total:** 50 Marks

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<table>
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<tr>
<th>Course Learning Objectives (CLO’s):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The course aims at:</strong></td>
</tr>
<tr>
<td>1. Providing a clear understanding of advanced topics and techniques in database systems, with a focus on the system and algorithmic aspects.</td>
</tr>
<tr>
<td>2. Acquiring knowledge about advanced database with the concepts of storage, indexing, transaction management, structure, relational operators and query optimization.</td>
</tr>
<tr>
<td>3. Emphasizing on survey of recent development and progress in selected areas. Topics include: query optimization, multimedia and time-series data management.</td>
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</table>

<table>
<thead>
<tr>
<th>Prerequisites:</th>
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</thead>
<tbody>
<tr>
<td>1. A course on Operating systems (15MCA23).</td>
</tr>
<tr>
<td>2. A course on Database management system (15MCA22).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT I</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overview of Storage, Indexing and Transaction Management:</strong></td>
</tr>
<tr>
<td>Overview of Storage, Indexing, Disks and Files, Data on external storage; File organizations and indexing; Index data structures; Comparison of file organizations; Indexes and performance tuning Memory hierarchy; RAID; Disk space management; Buffer manager; Files of records; Page formats and record formats.</td>
</tr>
<tr>
<td>Transaction Management Introduction to Transaction Processing; Transaction and System Concepts; Desirable Properties of Transactions; Characterizing Schedules based on Recoverability; Characterizing Schedules based on Serializability; Two-Phase Locking Techniques, Concurrency Control based on Timestamp Ordering. Granularity of Data Items and Multiple Granularity Locking; Recovery Concepts, Recovery Techniques based on Deferred Update; Recovery Techniques based on Immediate Update; Shadow Paging; The ARIES Recovery Algorithms; Recovery in Multi-database Systems; Database Backup and Recovery from Catastrophic Failures.</td>
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<table>
<thead>
<tr>
<th>UNIT II</th>
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<tbody>
<tr>
<td><strong>Tree Structured Indexing and Hash-Based Indexing:</strong></td>
</tr>
<tr>
<td>Intuition for tree indexes; Indexed sequential access method; B+ trees, Search, Insert, Delete, Duplicates, B+ tress in practice Hash-Based Indexing: Static hashing, Extendible hashing, Linear hashing, comparisons</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT III</th>
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</thead>
<tbody>
<tr>
<td><strong>Overview of Query Evaluation and External Sorting:</strong></td>
</tr>
<tr>
<td>The system catalog, Introduction to operator evaluation; Algorithm for relational operations; Introduction to query optimization; Alternative plans; A motivating example; what a typical</td>
</tr>
</tbody>
</table>
optimizer does. DBMS sort data, A simple two-way merge sort; External merge sort

UNIT IV 10 hrs
Evaluation Relational Operators:
The Selection operation; General selection conditions; The Projection operation; The Join operation; The Set operations; Aggregate operations; The impact of buffering.
A Typical Relational Query Optimizer: Translating SQL queries in to Relational Algebra; Estimating the cost of a plan; Relational algebra equivalences; Enumeration of alternative plans; Nested sub-queries; other approaches to query optimization.

UNIT V 10 hrs
Physical Database Design and Tuning:
Introduction; Guidelines for index selection, examples; Clustering and indexing; Indexes that enable index-only plans, Tools to assist in index selection; Overview of database tuning; Choices in tuning the conceptual schema; Choices in tuning queries and views; Impact of concurrency; DBMS benchmarking. More Recent Applications

Self-Learning Topics: Comparative study with different DBMS architecture.

Reference Books

Course Outcomes
After going through this course the student will be able to:
7. Explain the fundamental storage concepts, architecture and features of space management. [L2]
8. Interpret and summarize the large volume data with its design and performance tuning. [L2]
9. Analyze the concepts of query evaluation, external sorting and relational operators. [L4]
10. Analyze the different indexing structures and evaluate it. [L4, L5]
11. Assess the transaction management concepts and recovery techniques. [L5]

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to analyze and build computer applications for
multiple domains. [PO5]  
5. Postgraduates can participate and succeed in competitive examinations. [PO11]

Program Specific Outcomes (PSO’s)
2. **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO2]

Scheme of Continuous Internal Evaluation (CIE):

<table>
<thead>
<tr>
<th>Components</th>
<th>Average of best of two tests out of three</th>
<th>Average of two assignments/ course seminar / course project</th>
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<td>Maximum</td>
<td>30</td>
<td>10</td>
<td>10</td>
<td>50</td>
</tr>
</tbody>
</table>

Scheme of Semester End Examination (SEE):

*Question paper contains 08 questions* each carrying 20 marks. Students have to answer FIVE full questions.

SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hrs duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
Course Code: 15MCAX02  
Credits: 04

Course Type: GE  
CIE Marks: 50

Hrs/Week :L:T:P 4-0-0  
SEE Marks: 100

Total Hours: 52  
SEE Duration: 3 Hrs.

Course Learning Objectives (CLO’s):

The course aims at:

1. Introducing the concepts of big data and need of NoSQL.
2. Introducing different flavors of NoSQL like Redis, Hyper Table, MongoDB/CouchDB/Cassandra. Store.
3. Accessing the data using cloud, implement MapReduce to store using Hive, analyze the Big Data using Apache Pig High level language.
4. Designing, storing and accessing the Big Data using NoSQL.
5. Designing and Developing web application using NoSQL.
6. Interpreting the administrative tasks and implementing administration of NoSQL while maintaining the web applications

Prerequisites:

1. A course on Database management system (15MCA22).
2. Knowledge of database RDBMS.

UNIT I

10 Hours

Introduction to NoSQL

Definition of NoSQL, History of NoSQL and Different NoSQL products, Exploring MondoDB Java/Ruby/Python, Interfacing and Interacting with NoSQL.

UNIT II

12 Hours

NoSQL Basics

NoSQL Storage Architecture, CRUD operations with MongoDB, Querying, Modifying and Managing NoSQL Data stores, Indexing and ordering datasets (MongoDB/CouchDB / Cassandra)

UNIT III

10 Hours

Advanced NoSQL

NoSQL in CLOUD, Parallel Processing with Map Reduce, BigData with Hive


UNIT IV

10 Hours

Working with NoSQL

Surveying Database Internals, Migrating from RDBMS to NoSQL, Web Frameworks and NoSQL, using MySQL as a NoSQL-Coexistence.

Self-Learning Topics: Choosing among NoSQL Flavors, Tools and Utilities

UNIT V

10 Hours

Developing Web Application with NoSQL and NoSQL Administration  
Php and
MongoDB, Python and MongoDB, Creating Blog Application with PHP, NoSQL Database Administration

Reference Books:

Course Outcomes:
At the end of the course student should be able to:
1. **Define** and **Express** the limitations of RDBMs, need of NoSQL for Big Data, different NoSQL products available in market. [L1]
2. **Apply** CRUD operations with MongoDB, storing data and accessing data with MongoDB/CouchDB/Cassandra. [L3]
3. **Construct** MapReduce – parallel programming model for distributed processing on large data sets, on a cluster of computers. [L3]
4. **Create** Apache Hive – data warehouse infrastructure on Hadoop and Analyze Big Data with Hive using Apache Pig. [L6].
5. **Develop** Web applications using NoSQL, Python and PHP. [L6]

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
3. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]

Program Specific outcomes (PSO’s):
1. **Professional Skills**: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]
2. **Problem-Solving Skills**: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO2]

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Scheme of Semester End Examination (SEE):
**Question paper contains 08 questions** each carrying 20 marks. Students have to answer
FIVE full questions.

SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hrs duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

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### Elective (Specialization: Database Systems)

<table>
<thead>
<tr>
<th>Data Mining and Data Warehousing</th>
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<tr>
<td><strong>Course Code</strong></td>
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<tr>
<td><strong>Course Type</strong>:</td>
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<tr>
<td><strong>Hrs/Week :L:T:P</strong></td>
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<tr>
<td><strong>Total Hours</strong>:</td>
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</table>

**Course Learning Objectives:**

The course aims at:

1. Introducing Data Mining, Data Warehousing and its applications in real world.
2. Understanding OLAP (OnLine Analytical Processing) and Knowledge Discovery form Data (KDD).
3. Extracting of patterns representing knowledge stored in large databases using KDD.
4. Applying data processing techniques, visualization, predictive modeling, association analysis, and clustering etc.
5. Constructing decision tree -classification, association analysis-frequent item set and clustering.
6. Applying Data Mining methods to handle object, spatial, multimedia, text and web data.
7. Extracting hidden information, patterns from large data repository.
8. Interpreting multidisciplinary projects contributing to various topics such as statistics, visualization, artificial intelligence and machine learning.

**Prerequisites:**

A course on Database management system (15MCA22).

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**UNIT I**

**Data Warehousing and OLAP**  12Hrs

Introduction, Operational Data Store(ODS), Extraction Transformation and Loading(ETL), Data Warehouse basic concepts, design issues, Guidelines, metadata, Data
Warehouse Modeling, Data Cube and OLAP, Introduction, Data cube implementations and operations, OLAP Software’s

UNIT II
Data Mining 10Hrs
Introduction, Motivating Challenges, Data Mining Tasks, Types of Data, Data Preprocessing, Measures of similarity and dissimilarity, Data Mining Applications

UNIT III
Association Analysis: Basic Concepts and Algorithms 10Hrs
Frequent Item set Generation, Rule Generation, Compact Representation of Frequent Item sets, Alternative methods for generating Frequent Item sets, FP Growth Algorithm, Evaluation of Association Patterns

UNIT IV
Classification Technique 10 Hrs
Self-Learning Topics: Artificial neural network(ANN)

UNIT V
Clustering Techniques 10Hrs
Overview, Features of cluster analysis, Types of Data and Computing Distance, Types of Cluster Analysis Methods, Partitional Methods, Hierarchical Methods, Density Based Methods, Quality and Validity of Cluster Analysis.
Self-Learning Topics: Outlier Analysis, Web mining

Reference Books:
2. Jiawei Han and Micheline Kamber: Data Mining - Concepts and Techniques, 2nd Edition, Morgan Kaufmann Publisher, 2006.

Course Outcomes:
At the end of the course student should be able to:

1. **Define** Data warehousing process and the ETL process. **Design** issues of Data Warehousing [L1, L6].
2. **Explain** characteristics of OLTP and OLAP. **Define** and **explain** the Data cube operations in detail. [L2, L1]
3. **Define** Data Mining process and Knowledge Discovery Process (KDD). **Explain** about data measurement and collection issues [L1, L2].
4. **Explain** issues in data processing proximity calculation. **Assess** selection of proximity measure for given application problem [L2, L5].
5. **Illustrate** the concept of Association Rules, importance of support and confidence terms in mining association rules for a given sample data set. **Assess** about alternate approaches for generation of frequent item sets. [L2, L5]
6. **Create** clusters on a given data set using clustering techniques. [L3]
7. **Analyze** and **construct** decision tree for a given snapshot of problem. **Evaluate** the performance of specific classification model [L4, L3, L5]
8. **Discuss** classification and classification models for input data set. [L6]
9. **Demonstrate** FP-Growth algorithm for discovering frequent item sets. **Construct** FP-tree for given set of transactions. [L2, L6]

**Program Outcomes (POs) of the course:**

1. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
2. Postgraduates will demonstrate research based knowledge and research methods for addressing current issues in research trends. [PO12]

**Program Specific outcomes (PSO’s):**

1. **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]

2. **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO2]

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Elective (Specialization: Database Systems)

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<td><strong>CIE Marks:</strong></td>
</tr>
<tr>
<td><strong>Hrs/Week :L:T:P</strong></td>
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<tr>
<td><strong>SEE Duration:</strong></td>
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</table>

**Course Learning Objectives:**

**The course aims at:**
1. Providing a clear understanding of big data and need of NoSQL.
2. Understanding the contrast between Big Data platforms.
3. Exploring web data evolution and interpreting regression modeling.
5. Describing data model architecture and elaborating Hadoop concepts.

**Prerequisites:**
1. A course on Database management system (15MCA22).
2. Knowledge RDBMS, NOSQL.

**UNIT I** 10 Hrs

INTRODUCTION TO BIG DATA

**UNIT II** 12 Hrs

DATA ANALYSIS
Regression Modeling - Multivariate Analysis - Bayesian Modeling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction - Neural Networks: Learning And Generalization - Competitive Learning - Principal Component Analysis and Neural Networks

UNIT III 10 Hrs
MINING DATA STREAMS

UNIT IV 10 Hrs
FREQUENT ITEMSETS AND CLUSTERING
Mining Frequent Itemsets - Market Based Model – Apriori Algorithm – Handling Large Data Sets in Main Memory – Limited Pass Algorithm – Counting Frequent Itemsets in a Stream – Clustering Techniques – Hierarchical – K-Means – Clustering High Dimensional Data – CLIQUE And PROCLUS – Frequent Pattern based Clustering Methods – Clustering in Non-Euclidean Space – Clustering for Streams and Parallelism.

UNIT V 10 Hrs
FRAMEWORKS AND VISUALIZATION
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques; Systems and Analytics Applications - Analytics using Statistical packages- Approaches to modeling in Analytics – correlation, regression, decision trees, classification, association-Intelligence from unstructured information-Text analytics-Understanding of emerging trends and technologies
Self-Learning Topics: Industry challenges and application of Analytics

Reference Books:

Course Outcomes:
At the end of the course student should be able to:
1. Define and Rephrase the limitations of RDBMs , need of NoSQL, Big Data and different NoSQL products available in market.[L1,L2]
2. Apply CRUD operations with MongoDB, storing data and accessing data with MongoDB/CouchDB/Cassandra.[L3]
3. Construct MapReduce –parallel programming model for distributed processing on large
data sets on a cluster of computers. [L6]

4. Analyze infrastructure on Hadoop and Analyze Big Data with Hive using Apache Pig. [L4].

5. Develop Web applications using NoSQL, Python and PHP. [L3]

6. Construct MapReduce – parallel programming model for distributed processing on large data sets on a cluster of computers. [L6]

7. Create Apache Hive – data warehouse infrastructure on Hadoop and Analyze Big Data with Hive using Apache Pig. [L6, L4].

8. Develop Web applications using NoSQL, Python and PHP. [L3]

**Program Outcomes (POs) of the course:**

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]

2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]

3. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]

4. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]

5. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]

6. Postgraduates will show the understanding of impact of engineering solutions on the society as a successful entrepreneur or IT professional. [PO9]

**Program Specific outcomes (PSO’s):**

1. **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]

2. **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO2]

**Scheme of Continuous Internal Evaluation (CIE):**

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**Scheme of Semester End Examination (SEE):**

**Question paper contains 08 questions** each carrying 20 marks. Students have to answer FIVE full questions.
SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hrs duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

Elective (Specialization: Operating Systems)

<table>
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<th>Unix System Programming</th>
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Course Learning Objectives:

The course aims at:

1. Providing a clear understanding of developing complex system-level software in C programming language while gaining an intimate understanding of the UNIX operating system and its programming environment.

2. Exploring the aspects of user/kernel interface, fundamental concepts of UNIX, user authentication, basic and advanced I/O, file systems, signals, process relationships.

3. Providing the concepts of inter-process communication, software development and maintenance on UNIX systems.

Prerequisites:

A course on:

1. UNIX and shell Programming (15MCA11)
2. Programming in C / C++ (15MCA14 / 15MCA24)
3. Operating systems (15MCA23).

UNIT I 10 Hours

Introduction to Unix system Programming:


UNIT II 11 Hours

UNIX Files and APIs:

FIFO File APIs, Symbolic Link File APIs.

**UNIT III**  
10 Hours  

**UNIX Processes:**  

**UNIT IV**  
11 Hours  

**Process Control and Relationships:**  

*Self-Learning Topics:* Job Control, Orphaned Process Groups.

**UNIT V**  
10 Hours  

**Signals and Daemon Processes:**  

*Self-Learning Topics:* Client-Server Model.

**Reference Books :**

**Course Outcomes:**

**At the end of the course students should be able to:**
1. **Explain** the role of systems programming and standardization. [L2]
2. **Demonstrate** the use of Unix system calls. [L2]
3. **Discuss** how UNIX supports Unix file system, Process and process control. [L6]
4. **Illustrate** Unix Signals and Daemon Processes [L2]

**Program Outcomes (POs) of the course:**
1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze
2. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
3. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]
4. Postgraduates will develop confidence for self education and ability for life-long learning. [PO10]

Program Specific Outcomes (PSO’s):
Problem-Solving Skills: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO 2]

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## Course Learning Objectives:

The course aims at:

1. Providing a clear understanding of the theoretical foundations and basic principles of Computer Science like Automata, Formal languages and Computability and Complexity.
2. Encouraging the students to gain the logic building capabilities for various mathematical arguments and scientific problems.
3. Making the students to understand the concepts like Finite Automata and certain kinds of Formal languages which are used in the design and construction of Computer hardware/software.
4. Making the students to understand and appreciate the properties of Regular languages and Context Free languages and proving certain languages are Non regular and Non Context Free languages by the application Pumping lemma to perform various operations on Formal languages and take decision to solve varieties of problems that are of practical importance.
5. Making the students aware of use of Context Free grammar in specifying programming languages and be able to understand the relation between Context Free grammar and a class of Automata called Push Down Automata which is found immediate application in programming language specification and building an efficient Compiler for some languages.
6. Understanding important concepts like Turing Machine, Multiple Turing Machine and Non Deterministic Turing machine, helps to conclude that the Turing machine is the ultimate among different models of computation.

## Prerequisites:

1. Knowledge of programming constructs
2. A course on Discrete Mathematics (15MCA14), Data Structures (15MCA21)

### UNIT – I

**Introduction to Finite Automata:**

Introduction to Finite Automata; The central concepts of Automata theory; Deterministic finite automata; Nondeterministic finite automata; An application of finite automata; Finite automata with Epsilon-transitions.

**Self Learning Topics:** Moore Mealy Machines

### UNIT – II

**Regular Expressions and Regular Languages:**

Regular expressions; Finite Automata and Regular Expressions; Applications of Regular Expressions Regular languages; Proving languages not to be regular languages; Closure properties of regular languages; Decision properties of regular languages; Equivalence and minimization of automata.

**Self-Learning Topics:** Regular Grammar and implementation
### Year: 2015-18

#### UNIT – III 10 Hours

**Context-Free Grammars And Languages:**

- Context –free grammars; Parse trees; Applications; Ambiguity in grammars and Languages.
- Normal forms for CFGs; The pumping lemma for CFGs; Closure properties of CFLs

**Self-Learning Topics:** Context Sensitive Grammar

#### UNIT – IV 10 Hours

**Pushdown Automata:**

- Definition of the Pushdown automata; the languages of a PDA; Equivalence of PDA’s and CFG’s; Deterministic Pushdown Automata.

#### UNIT – V 10 Hours

**Introduction To Turing Machine:**

- Problems that Computers cannot solve; The turning machine; Programming techniques for Turning Machines;

**Self-Learning Topics:** Turing Machine to check for wrong spelling

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### Reference Books :


### Course Outcomes:

1. **Identify and explain** concept and importance of Automata Theory. Analyze the problem and identify the use of Deterministic Finite Automata and Nondeterministic Automata. [L2, L3].
2. **Identify** the applications of Finite Automata and Regular expression, achieve proficiency in the design of Finite Automata with Epsilon transitions and **apply** software tools based on Formal languages and models of computation [L2, L3].
3. **Identify and explain** the problems that computers cannot solve. **Explain** the working principle of Turing Machine. Achieve the proficiency in the programming techniques of Turing machines, **Identify** the extensions to the basic Turing Machines, Turing Machines and Computer [L2, L3].
4. **Design**, and **prove** certain languages are not Regular languages by applying Pumping lemma, Closure properties of Regular languages and decision properties of regular languages.
languages. Simplify the equivalence and minimization of Automata [L4,L5,L6].

5. Identify and simplify certain Context Free Grammars and languages to be ambiguous also the application of Context Free Grammars [L3,L4].

6. Discuss the limitation of Regular languages and the working principle of Push Down Automata (PDA) and achieve proficiency in the design of PDA for Context Free Languages (CFL). Explain the language of a PDA and simplify the equivalence of PDA’s, CFG’s and Deterministic Push Down Automata [L2,L4,L6].

7. Discuss and prove certain languages not to be Context Free Languages by applying Pumping lemma and Closure properties of context free languages. Distinguish the different Normal forms of Context free languages with illustrative examples. [L4,L5,L6].

Program Outcomes (POs) of the course:

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
5. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]
6. Postgraduates can participate and succeed in competitive examinations. [PO11]

Program Specific Outcomes (PSO’s):

1. Professional Skills: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity[PSO1]

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Elective (Group-Operating Systems )

COMPILER DESIGN
Course Code: 15MCAX07  
Credits: 04

Course Type: GE  
CIE Marks: 50

Hrs/Week :L:T:P  4-0-0  
SEE Marks: 100

Total Hours: 52  
SEE Duration: 3 Hrs.

Course Learning Objectives:

The course aims at:

1. Providing a clear understanding of different forms of language translators, overview of the structure of typical Compiler and the trends in programming languages and machine architecture that are shaping Compilers.
2. Encouraging the students to gain the in depth knowledge of the different phases of compilation process and implementation approach of each of the phases.
3. Making the students aware of use of modern software development environments containing tools such as language editors, debuggers version managers and so on.
4. Getting acquainted with more specialized tools to help implementation of various phases of Compiler such as Parser generators, Scanner generators, syntax directed translation engines, Code generator tools, Data flow analysis engines and compiler construction toolkits.
5. Making students to understand and appreciate the capability of designing any new language interface based on real time industry requirements.

Prerequisites:

1. Knowledge of Formal Languages and Automata Theory,  
2. A course on Data structures (15MCA21) and System software (15MCA25)

UNIT 1  
11 Hours

Introduction: Lexical and Syntax Analysis:


Self-Learning Topics: Operator Precedence Parser

UNIT II  
11 Hours

Syntax Analysis:

Bottom-up Parsing, Introduction to LR Parsing, Simple LR. More powerful LR parsers, Using ambiguous grammars, Parser Generators.


UNIT III  
10 Hours

Syntax-Directed Translation:

Syntax-Directed definitions, Evaluation order for SDDs, Applications of Syntax-directed translation, Syntax-directed translation schemes
UNIT IV

Intermediate Code Generation:
Variants of syntax trees, Three-address code; Types and declarations, Translation of expressions, Control flow, Back patching, Switch statements, and Intermediate code for procedures.

Self Learning Topics: Translation with Type checking

UNIT V

Run-Time Environments and Code Generation:

Reference Books:

Course Outcomes:
At the end of the course student should be able to:
1. Identify and explain the different phases of Compilation process and Complier construction tools. [L2, 3]
2. Identify and explain the precise rules (GRAMMAR) that prescribes the syntactic structure of programming language constructs. Identify and classify the parsing techniques. Design and implement Top Down parsing. And Bottom up parsing [L2,3,4].
3. Identify the issues involved in the runtime environments. [L3]
4. Identify the issues in the design of Code Generator and list the primary tasks [L3].
5. Identify and simplify the use of ambiguous Grammar in the design of LR parsers. Analyze the Error recovery in LR parser. [L 2, 4]
6. Compare Syntax Directed Definitions and Syntax Directed Translation Schemes. List the Attributed Definitions and Identify the evaluation orders for the Attributes. [L1, 3, 4].
7. Design Syntax Directed Translation Schemes to generate the Intermediate Representations namely Syntax tree, Directed Acyclic Graph(DAG), Three Address Codes for Expressions, Control Flow, Switch statements and Procedures. [L6].

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate knowledge of mathematics, computer applications,
and management. [PO1]

2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]

3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]

4. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]

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**Program Specific Outcomes (PSO’s):**

**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity [PSO1]

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**Elective (Specialization: Web Technology)**

**Web 2.0 and Rich Internet Applications**

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<td>52</td>
<td>GE</td>
<td>50</td>
<td>100</td>
<td>3 Hrs.</td>
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**Course Learning Objectives:**

**The course aims at:**

1. Training a learner to initiate client-server communication using various Asynchronous JavaScript and XML (Ajax) techniques and patterns.

2. Enabling a learner to implement web applications using Hypertext Preprocessor (PHP), Cascading Style Sheets (CSS), Extensible Markup Language (XML), and Document Object Model (DOM) using Ajax.
3. Focusing on knowledge of Flex Framework, Flex technologies and designing Rich Internet Applications rapidly using Flex by assembling off-the-shelf components including: User Interface (UI) controls, layout containers, and data models.

4. Using Macromedia Flex Markup Language (MXML), Actionscript, and the Flex class library to model data, validate data, format data, and manage states in a Flex Application.

Prerequisites:
1. Web Programming (15MCA12).
2. Internet Web Programming (15MCA43).

UNIT I 10 Hrs
Introduction to Ajax Technologies, Ajax Patterns and JavaScript Object Notation

UNIT II 10 Hrs
Full Throttle Ajax with Extensible Markup Language (XML) and Cascading Style Sheets (CSS)
Handling multiple XMLHttpRequest requests, Using two XMLHttpRequest requests, Using an array of XMLHttpRequest requests, Using inner functions and multiple XMLHttpRequest requests, Handling JavaScript sent from server, Overcoming browser caching. Working with XML in JavaScript, Navigating through XML documents, Retrieving XML element data, Retrieving XML element attribute data. Getting text noticed with CSS, Styling fonts with CSS, Styling colors with CSS, Setting absolute positions using CSS.

UNIT III 10 Hrs
Ajax with Hypertext Preprocessor (PHP) and Document Object Model (DOM)
Displaying all the data in a form, Working with PHP server variable, Sending form data in arrays, Creating single-page PHP applications, Validating numbers, Validating text. Introducing the Document Object Model (DOM), Appending elements using the DOM, Replacing elements using the DOM, Handling Ajax timeouts.

Self-Learning Topics: Downloading images with Ajax
### UNIT IV  
12 Hrs  
**Understanding Flex Environment, Layouts, Macromedia Flex Markup Language (MXML) and ActionScript**


### UNIT V  
10 Hrs  
**Working with States, Data Models and Data Binding**


Working with Data: Using Data Models, Data Binding, Enabling Data Binding for Custom Classes, Data Binding Examples, Building data binding proxies. Validating and Formatting Data: Validating user input, Formatting Data.  

**Self-Learning Topics:** Client Data Communication in Flex Application.

### Reference Books:

1. Nicholas C Zakas et al: Processional AJAX, Wiley India Publications.  

### Course Outcomes:

At the end of the course student should be able to:

1. **Explain** history, principles and technologies behind Ajax [L2].  
2. **Assess** the management of *states* in Flex Application [L5].  
3. **Develop** Ajax applications using Hidden Frames and XMLHttpRequest object in conjunction with PHP, XML, CSS and DOM [L6].  
4. **Develop** Rich Internet Applications using Flex Framework and Flex Elements like MXML and ActionScript [L6].  
5. **Design** Flex Application using Data Models and Data Binding [L6].
Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
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1. **Professional Skills**: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.[PSO1]
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**Elective (Specialization: Web Technology)**

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# Curriculum Structure with Content - Course wise

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**Course Learning Objectives (CLO’s):**

- Providing a clear understanding of step by step processes for service oriented analysis and service oriented design.
- Imparting an in depth exploration of service orientation as a distinct design paradigm, including a comparison to object orientation.
- Emphasizing on providing descriptions of over dozen key web services technologies and WS-* specifications.
- Acquainting the students with the guidelines for Service Oriented Business Modelling and the creation of specialized service abstraction layers.

**Prerequisites:**

Students must have the knowledge of the following topics:

1. A course on software engineering (15MCA33).
2. A course on web programming (15MCA12).
3. Practical exposure to web services.

## Unit – I

**Introduction and Evolution of SOA:** 12 Hours

- Fundamentals of SOA, Common characteristics of contemporary SOA, Common tangible benefits of SOA, A SOA timeline (from XML to Web Services to SOA), The continuing evolution of SOA (standards organizations and Contributing vendors), The roots of SOA (comparing SOA to Past Architectures).

## Unit – II

**Web Services, Primitives of SOA, Contemporary SOA:** 12 Hours

- The Web Services framework, Services (as Web Services), Service Description (with WSDL), Messaging (with SOAP). Message Exchange patterns, Service Activity; Coordination, Atomic Transactions, Business Activities, Orchestration, Choreography, Addressing, Reliable Messaging, Correlation, Policies, Meta data Exchange, Security, Notification and eventing.

**Self-Learning Topics:** Implementation of SOA concepts like coordination, orchestration and choreography.

## Unit –III

**Principles of Service – Orientation:** 10 Hours

- Services- Orientation and the enterprise, Anatomy of service-oriented Architecture, Common Principles of Service Orientation; How Service Orientation principles inter relate, Service Orientation and object orientation, Native Web Service support for service orientation principles.

## Unit - IV
Service Layers: 10 Hours
Service Orientation and contemporary SOA, Service Layer Abstraction, Application service layer, Business Service Layer, Orchestration Service Layer, Agnostic Services, Service Layer Configuration scenarios.

Self-Learning Topics: Case Study on Orchestration.

Unit - V
Business Process Design: 8 Hours
WS-BPEL Language basics, WS-Coordination overview, Service oriented business process redesign, WS-Addressing language basics, Ws-Reliable messaging language basics.

Self-Learning Topics: Case Study on Infosys SOA

Reference Books:

Course Outcomes (COs):
On successful completion of the course the student will be able to:
1. Explain Service Oriented Architecture and its fundamental concepts. [L2]
2. Explain the concepts of choreography and orchestration. [L2]
3. Compare critically SOA to traditional architectures [L2].
4. Identify common tangible benefits of SOA. [L3]
5. Distinguish between service-orientation and object-orientation [L4].
6. Assess the basics of WS-BPEL language. [L5]
7. Discuss common characteristics of contemporary SOA [L6].

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
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Program Specific Outcomes (PSO’s)
1. Problem-Solving Skills: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success.[PSO2]
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<tr>
<td>4-0-0</td>
<td>52</td>
<td>3 Hrs.</td>
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</table>

**Course Learning Objectives:**

The course aims at:

1. Providing hands on experience solving relevant problems.
2. Developing the skills needed to become a practitioner or carry out research projects in this domain.
3. Developing working experience cloud storage technologies.
4. Learning I/O virtualization techniques that serve in offering software, computation and
5. Understanding the details of the MapReduce programming model.

**Prerequisites:**

A course on

1. Operating Systems (15MCA23)
2. Networks (15MCA31)
3. Knowledge of Virtualization

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**UNIT I**

**Distributed System Models and Enabling Technologies**


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**UNIT II**

**Computer Clusters for scalable parallel computing**

Clustering for massive parallelism: Cluster Development Trends, Design Objective of Computer Clusters, Fundamental Cluster Design issues. Virtual machines and Virtualization of clusters and Data centers: Implementation levels of virtualization: levels of virtualization Implementation, VMM Design requirements and providers, Virtualization support at the OS level, Middleware Support for Virtualization.

**Cloud Platform Architecture over Virtualized Data Centers**


**Self-Learning Topics:** Study of Hypervisors

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**UNIT III**

**Public Cloud Platforms**

Cloud Programming and Software Environments
Features of Cloud and Grid Platforms: Cloud Capabilities and Platform Features, Traditional Features Common to Grids and Clouds, Data Features and Databases, Programming and Runtime Support. Parallel and Distributed Programming Paradigms: Parallel Computing and Programming Paradigms, MapReduce, Twister and Iterative MapReduce, Hadoop Library from Apache.

UNIT IV
Programming Support of App Engine 10 Hours
Programming the Google App Engine, Google File System (GFS), Bigtable, Google’s NOSQL system, Chubby, Google’s Distributed Lock service. Programming on Amazon AWS and Microsoft Azure: Programming on Amazon EC2, Amazon Simple Storage Service S3, Amazon Elastic Block Store EBS and SimpleDB, Microsoft Azure programming support. Emerging Cloud Software Environments: Open Source Eucalyptus and Nimbus, Open Nebula, Sector/Sphere, and OpenStack, Manjrasoft Aneka Cloud and Appliances.

UNIT V
Ubiquitous Clouds and the Internet of Things 10 Hours
Performance of Distributed Systems and the Cloud Data-intensive Scalable Computing (DISC), Quality of Service in Cloud computing, Benchmarking MPI, Azure, EC2, MapReduce, and Hadoop. Online social and Professional Networking: Online Social Network Characteristics, Graph-Theoretic Analysis of Social networks, Communities and Applications of Social Networks, Facebook: The World’s Largest Content-Sharing Network, Twitter for Micro blogging.

Self-Learning Topics:
News and Alert Services.

Reference Books:

Course Outcomes:
Upon successful completion of this course you should be able to:

1. **Compare** the operation, implementation and performance of cloud computing systems, and the relative merits and suitability of each for complex data-intensive applications [L4]
2. **Explain** and **categorize** different cloud computing models, namely, infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) [L2,L4]
3. **Identify** security implications in cloud computing [L3]
4. **Analyze** the trade-offs inherent in Cloud Computing [L4]
5. **Compare**, **contrast**, and **evaluate** the key trade-offs between multiple approaches to cloud system design [L4,L5]
6. **Identify** appropriate design choices when solving real-world cloud computing problems [L3]
7. **Compose** comprehensive case studies analyzing and contrasting different cloud computing solutions [L6]
8. **Develop** recommendations on cloud computing solutions for an enterprise [L3]

**Program Outcomes (POs) of the course:**
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5] Postgraduates will demonstrate research-based knowledge and research methods for addressing current issues in research trends. [PO12]

**Program Specific Outcomes (PSO’s):**
1. **Successful Career and Entrepreneurship:** The ability to employ modern computer languages, technologies, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies. [PSO3]

**Scheme of Continuous Internal Evaluation (CIE):**

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**Scheme of Semester End Examination (SEE):**

**Question paper contains 08 questions** each carrying 20 marks. Students have to answer FIVE full questions.

SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hrs duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
Elective (Specialization: Web Technology)

<table>
<thead>
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<th>Software Architecture</th>
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<tr>
<td>Hrs/Week :L:T:P</td>
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<tr>
<td>Total Hours:</td>
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</table>

**Course Learning Objectives:**

Course aims at
1. Providing a clear understanding of the challenges of advanced software design and the issues associated with large-scale software architectures, frameworks, patterns and components.
2. Exploring the tools and techniques used for the automatic analysis and evaluation of software.

**Prerequisites:**

A course on Analysis of Algorithms (15MCA41) and Software Engineering (15MCA33)

**UNIT I** 10 Hours

**Introduction to Software Architecture and its context:**
Meaning of software architecture and its scope; Architectural Structures and views; Architectural patterns; Features of a good Architecture. Importance of Software Technical Context; Project life-cycle context; Business context; Professional context; Stake holders; Influence of Software Architecture.

**UNIT II** 10 Hours

**Understanding Quality Attributes Architecture & Requirements:**
Functionality; quality attribute considerations; Specifying and achieving Quality attribute requirements; Guiding quality design decisions; Availability; Interoperability; Modifiability; Performance; Security; Testability; Usability.

**UNIT III** 11 Hours

**Quality Attribute modeling and Analysis:**
Modeling Architecture to enable quality attribute analysis; Quality attribute check lists; Through experiments and Back-of-the envelope analysis; Experiments; Simulations and prototypes; Analysis at different stages of the life cycle.
## UNIT IV

**Architecture and requirements:**
Gathering ASRs from requirements documents; ASRs by interviewing stakeholders; ASRs by understanding the business; capturing ASRs in a utility tree; Typing the methods together

### UNIT V

**Designing an Architecture:**
Design strategy; the attribute driven design methods; the steps of ADD Documenting Software Architecture: Uses and Audiences for architecture documentation; Notations, View and Behavior.

**Self-Learning Topics:** Documentation and quality attributes

### Reference Books

### Course outcomes:

**Students will be able to:**
1. **List** the major approaches to automated software analysis achievable through static and dynamic analysis. [L1]
2. **Classify** some of the challenging design issues that software engineers face and the trade-offs associated with the solutions to these. [L2]
3. **Explain** the principles behind software patterns and be able to apply a number of the fundamental patterns. [L2]
4. **Demonstrate** practical competence in the application and construction of tools to support automated software analysis. [L2]
5. **Compose** the need for software architecture and the principles of the classic architectural styles. [L6]

### Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
3. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]

### Program Specific Outcomes (PSO’s):
Professional Skills: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]
Scheme of Continuous Internal Evaluation (CIE):

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Scheme of Semester End Examination (SEE):

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### Elective [Web Technology]

**Mobile Applications**

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<tr>
<td>52</td>
<td>3 Hrs.</td>
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</table>

### Course Learning Objectives (CLO’s):

The course aims at

1. Providing the basic knowledge of Mobile applications.
2. Understanding mobile application users, information design, mobile platforms and using the tools for interface design.
3. Emphasizing on the basics of Android, guide them in Android application development, designing user interfaces using views, pictures and menus.
4. Introducing data persistence, creating and using databases.
5. Introducing the IOS tools, debugging IOS apps, working with Objective C. Introducing the Windows Phone 7 tools and building a simple application in windows app

### Prerequisites:

1. Basic knowledge of computer and logic building capabilities.
2. Knowledge of IDE.

### Unit I

**Introduction to Mobile Applications**

12 Hours


**Self-Learning Topics:** Developing WCF Application in Visual Studio

### Unit II

**Mobile User interface Design and Mobile Websites**

10 Hours
Choosing a Mobile Web Option, Adaptive Mobile Website, Mobile Web Applications with HTML 5

Unit III
Introduction to Android 10 Hours
Android – Deciding to target android as your mobile platform, Getting the tools you need, Understanding Activities, Linking activities, Calling Build-in-Applications using Intents, Displaying Notifications, Understanding the components of a screen

Unit IV
Designing Android user-interfaces and Data Persistence 10 Hours
Designing the user interface using views – Basic views, Picker views, List views, Using image views to display pictures, using menus with views. Data Persistence – saving and loading user preferences, Persisting Data to Files, Creating and using Databases.

Unit V
Android Messaging, Networking, Location Based Services 10 Hrs
SMS Messaging, Sending E-mail – Networking – Downloading Binary Data, Text Files-Accessing Web Services – Performing Asynchronous Calls – Location Based Services – Displaying Maps – Getting Location Data – Creating your own services – Communicating between a service and an activity – Binding activities to Services

Self-Learning Topics: IOS and Windows Phone 7

Reference Books:
2. Wei – Meng Lee, Beginning Android Application Development, Wiley 2011

Course Outcomes (Cos):
After going through this course the student will be able to:
9. List the importance of Mobile Strategies in Business World. [L1]
10. Identify the tools required for Mobile interface Design. [L3]
11. Apply HTML 5 in Mobile Web Applications development. [L3]
12. Design interfaces using views, displaying pictures and menus. [L3]
14. Develop simple apps in Android, IOS and Windows Phone7 [L6]

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
2. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
3. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
4. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
5. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
6. Postgraduates will demonstrate knowledge of professional and ethical responsibilities. [PO7]
7. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]
8. Postgraduates will show the understanding of impact of engineering solutions on the society as a successful entrepreneur or IT professional. [PO9]

**Scheme of Continuous Internal Evaluation (CIE):**

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**Scheme of Semester End Examination (SEE):**

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions.

SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

**Elective (Specialization: Networks)**

**Advanced Computer Networks**
Course Learning Objectives (CLO’s):
The course aims at:

1. Providing a clear understanding of key features of TCP/IP protocols used to explain many performance issues.
3. Studying simulation techniques and discussing one popular simulation tool ns.
4. Examining the performance concepts and issues for running TCP/IP in the emerging networking environment like wireless networks, mobile networks and satellite networks.
5. Understanding congestion control algorithms.
6. Discussing various TCP flavors and examining the new queue management schemes proposed for the network routers to combat congestion in highly dynamic environment.
7. Summarizing critical performance issues for TCP implementation in end systems.

Prerequisites:
Students must have the knowledge of the following topics:
2. Background in system programming (15MCA25), statistics and probability are helpful.

UNIT-I
11 Hours
Introduction, Fundamentals and Performance Measurement of TCP/IP Networks:

UNIT-II
10 Hours
TCP/IP Network Simulation and TCP Modeling:
Self-Learning Topics: Study of different TCP models.

UNIT-III
10 Hours
TCP/IP Performance over Wireless Networks and TCP/IP Performance over Mobile Networks:
Self-Learning Topics: TCP Performance in Ad Hoc Networks.

**UNIT-IV**  
11 Hours


Passive Queue Management, Active Queue Management. TCP Implementation Overview, High Performance TCP.


**UNIT-V**  
10 Hours

Introduction to Internet of Things

Internet of Things Common Definition, IoT Strategic Research and Innovation Directions, IoT Smart-X Applications, Network and Communication.

**Reference Books:**

2. TCP/IP Illustrated (Volume I, Volume II and Volume III), W. Richard Stevens, Addison-Wesley
3. Ovidiu Vermesan, Peter Friess, IoT from Research and Innovation to Market Development, River Publisher 2014

**Course Outcomes (COs):**

On successful completion of the course the student will be able to:

1. **Explain** the types of tools available for performance measurement of TCP/IP networks. [L2]
2. **Interpret** and **Examine** advanced and emerging networking technologies. [L2, L4]
3. **Apply** skills to do advanced networking research and programming. [L3]
4. **Appraise** the metrics used for performance evaluation of TCP/IP networks [L5]
5. **Elaborate** protocol details of TCP necessary to ensure reliable data transfer over unreliable networks. [L6]

**Program Outcomes (POs):**

1. Post graduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Post graduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
3. Post graduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
4. Post graduates will develop confidence for self education and ability for life-long learning.
learning. [PO10]

Program Specific Outcomes (PSO’s)

3. **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

**Scheme of Continuous Internal Evaluation (CIE):**

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**Scheme of Semester End Examination (SEE):**
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**Elective (Specialization: Networks)**

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**Course Learning Objectives (CLO’s):**
**The course aims at:**

2. Describing the various technologies like Global System for Mobile Communication (GSM), Short Message Service (SMS), General Packet Radio Service (GPRS), Code Division Multiple Access (CDMA), Third Generation for Mobile Telecommunication (3G), and World Wide Interoperability for Microwave Access (WiMAX).
3. Understanding Mobile Handsets with their design and Mobile Operating System with their features.
4. Elaborating Mobile Internet Applications with respect to Thin Client, Wireless Application Protocol (WAP) and various Markup Languages.

**Prerequisites:**
2. In-depth knowledge of Computer Networks (15MCA31) and Internet.

<table>
<thead>
<tr>
<th>UNIT I</th>
<th>10 Hrs</th>
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<tr>
<td><strong>Introduction to Mobile Computing and its Architecture:</strong></td>
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<table>
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<tr>
<th>UNIT II</th>
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<tbody>
<tr>
<td><strong>Global System for Mobile Communication (GSM) and Short Message Service (SMS):</strong></td>
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<tr>
<th>UNIT III</th>
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<td><strong>Wireless Networks – 2: GPRS</strong></td>
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<tr>
<th>UNIT IV</th>
<th>12 Hrs</th>
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<tr>
<td><strong>Code Division Multiple Access (CDMA), Third Generation for Mobile Telecommunication (3G), World Wide Interoperability for Microwave Access (WiMAX), and Mobile Client:</strong></td>
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<tr>
<td>Spread-Spectrum Technology: Direct Sequence Spread Spectrum (DSSS), Interim Standard</td>
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</table>

**Self-Learning Topics:** Introduction to Mobile IP and Mobile IP with IPV6

**UNIT V**

**12 Hrs**

**Mobile Operating System, Mobile Computing Environment, and Mobile Internet Applications:**


**Self-Learning Topics:** Midlet Programming

**Reference Books:**


**Course Outcomes:**

At the end of the course student should be able to:

1. **Explain** Mobile Computing, Mobile Computing Architecture, and describe design considerations for Mobile Computing. [L2]
2. **Explain** Mobile Phones, Mobile OS and their features.[L2]
3. **Illustrate** Global Systems for Mobile Communications (GSM) and Short Service Messages (SMS), GPRS, Packet Data Network, 3G and WiMAX. [L2]
4. **Construct** the complete phases of software development life cycle of any mobile application. [L6]
5. **Design and develop** Mobile Internet Applications using the state of the art technologies and various Markup Languages. [L6]

**Program Outcomes:**

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and
management. [PO1]

2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]

Program Specific Outcomes (PSO’s):

3. Professional Skills: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

Scheme of Continuous Internal Evaluation (CIE):

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Elective (Specialization: Networks)

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<td>Hrs/Week :L:T:P</td>
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</table>

Course Learning Objectives:

The course aims at:

1. Providing a clear understanding of problem domain, Analyzing and designing the solution for a given problem with representation of the solution in the form of Networks.
2. Exploring fundamental concepts and introducing Key Challenges in Managing Information, Information Lifecycle Components of Storage System Environment, Disk Drive Components, Disk Drive Performance.
Prerequisites:
A course on computer network (15MCA31).

UNIT I 12 Hours

UNIT II 12 Hours

UNIT III 08 Hours

UNIT IV 08 Hours

UNIT V 12 Hours
Local Replication, Remote Replication, Securing the Storage Infrastructure, Managing the Storage Infrastructure: Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface, Modes of Remote Replication, Remote Relocation Technologies, Network Infrastructure.

Reference Books:
2. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2003.

Course Outcomes:
At the end of the course student should be able to:
1. Develop Proficiency in Storage fundamentals and Storage Architecture. [L6]
2. Evaluate Network Attached Storage - NAS protocols, Live configuration of NAS. [L5]
3. Apply Backup, Data Replication, Storage Virtualization and Storage systems Monitoring Alerts, Reports. [L3]

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Post graduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]

Program Specific Outcomes (PSO’s):
1. Problem-Solving Skills: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success.

Scheme of Continuous Internal Evaluation (CIE):

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Curriculum Structure with Content- Course wise

Elective (Specialization: Networks)

**Client-Server Computing**

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<td>SEE Marks:</td>
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</table>

**Course Learning Objectives:**

**The course aims at:**

1. Providing a clear understanding of core aspects of Software Architecture and the need for software architecture.
2. Exploring the concepts of middleware architecture design principles, requirements traceability and to insure the system meets crosscutting end-to-end software architectural properties.
3. Implementing an architectural specification and to construct architectures in a teamwork setting with minimal requirements.
4. Applying software-sizing analysis based on architectural components and requirements analysis.

**Prerequisites:**

A course on computer network (15MCA31)

**UNIT I**

**Introduction to Client/Server Computing:**

### Self-Learning Topics: MVC Model

#### UNIT II
10 Hours

**Client services:**
Role of the client, Client services, Remote Procedure call, print services, remote services, Utility Services, Message services, Network Services, Application Services, Database Services, Dynamic Data Exchange(DDE), Object Linking and embedding, Common Object request broker architecture, client tools, Non GUI, GUI Object user interface clients(OOUI).

#### UNIT III
10 Hours

**Server functionality:**

#### UNIT IV
10 Hours

**Connectivity:**
Open systems interconnect, Communications, Interface technology, Inter-process communications, wide area network technology, Network Management. Application development environment definition, productivity measures, performance, support, organization and management, task allocation server and client side.

#### UNIT V
10 Hours

**Distributed objects and components:**
CORBA compound documents, Opendoc component model, OLE/DCOM

### Reference Books:

### Course Outcomes:
At the end of the course student should be able to:
1. **Illustrate** the significance of middleware architecture design principles. [L2]
2. **Identify** and compose design patterns [L3]
3. **Analyze** the requirements traceability and to insure the system meets cross-cutting end-to-end software architectural properties. [L4]
4. **Compare** architectural styles including distributed computing, service-oriented architectures, database-centric architectures, web architectures, email and AI architectures. [L2]
5. **Build** existing systems and then extend them with new capabilities using concepts from architecture description languages. [L6]

**Program Outcomes (PO’s)**

1. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
2. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
3. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
4. Postgraduates will show the understanding of impact of engineering solutions on the society as a successful entrepreneur or IT professional. [PO9]

**Program Specific Outcomes (PSO’s):**

1. **Professional Skills**: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

**Scheme of Continuous Internal Evaluation (CIE):**

<table>
<thead>
<tr>
<th>Components</th>
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**Scheme of Semester End Examination (SEE):**
**Question paper contains 08 questions** each carrying 20 marks. Students have to answer FIVE full questions.

SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hrs duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
Elective (Specialization: Networks)

<table>
<thead>
<tr>
<th>Information and Network Security</th>
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<tbody>
<tr>
<td><strong>Subject Code:</strong></td>
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<tr>
<td><strong>Course Type:</strong></td>
</tr>
<tr>
<td><strong>Hrs/Week: L:T:P</strong></td>
</tr>
<tr>
<td><strong>Total Hours:</strong></td>
</tr>
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</table>

**Course Learning Objectives (CLO’s):**

The course aims at:

1. Providing a clear understanding of fundamentals of Cryptography.
2. Exploring knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
3. Describing the various key distribution and management schemes.
4. Implementing encryption techniques to secure data in transit across data networks.
5. Designing security applications in the field of Information technology and learning Electronic mail security.

**Prerequisites:**

Students must have the knowledge of the following topics:

2. Background in system programming (15MCA25), statistics and probability are helpful.

**Hours**

**UNIT – I**  
10

Planning for Security and Security Technology-1:

Introduction; Information Security Policy, Standards, and Practices; The Information Security Blue Print; Contingency plan and a model for contingency plan.  
Introduction; Physical design; Firewalls; Protecting Remote Connections.

**UNIT – II**  
11 Hours

Security Technology– 2 and Cryptography:

Introduction; Intrusion Detection Systems (IDS); Honey Pots, Honey Nets, and Padded cell systems; Scanning and Analysis Tools.  
Introduction; A short History of Cryptography; Principles of Cryptography; Cryptography Tools; Attacks on Cryptosystems.

#### UNIT – III  
10 Hours

**Introduction to Network Security, Authentication Applications:**  
Attacks, services, and Mechanisms; Security Attacks; Security Services; A model for Internetwork Security; Internet Standards and RFCs. Kerberos, X.509 Directory Authentication Service.

#### UNIT – IV  
11 Hours

**Electronic Mail Security and IP Security:**  
Pretty Good Privacy (PGP); S/MIME. IP Security Overview; IP Security Architecture; Authentication Header; Encapsulating Security Payload; Combining Security Associations; Key Management.

#### UNIT – V  
10 Hours

**Web Security:**  
Web security requirements; Secure Socket layer (SSL) and Transport layer Security (TLS); Secure Electronic Transaction (SET).  
**Self-Learning Topics:** Network management security.

### Reference Books:


### Course Outcomes (COs):

**On successful completion of the course the student will be able to:**

1. **Identify** the security issues in the network and resolve it. [L3]
2. **Analyze** the vulnerabilities in any computing system and hence be able to design a security solution. [L4]
3. **Evaluate** security mechanisms using rigorous approaches, including theoretical. [L5]

### Program Outcomes (POs):

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
3. Postgraduates will show the understanding of impact of engineering solutions on the
Program Specific Outcomes (PSO’s)

1. **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

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**Scheme of Semester End Examination (SEE):**

*Question paper contains 08 questions* each carrying 20 marks. Students have to answer FIVE full questions.

SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hrs duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

**Elective (Specialization: Networks)**

<table>
<thead>
<tr>
<th>Subject Code:</th>
<th>Mobile Ad-hoc Sensor Network</th>
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<tbody>
<tr>
<td>15MCAX18</td>
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<tr>
<td>Credits:</td>
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<td>4-0-0</td>
</tr>
<tr>
<td>Total Hours:</td>
<td>52</td>
</tr>
</tbody>
</table>

**Course Learning Objectives (CLO’s):**

The course aims at:
2. Emphasizing on how the IEEE standards can be used in the development of the networks.
3. Imparting the knowledge on various routing approaches, the principles of wireless and sensor networks.
4. Exploring basic fundamentals of various protocols.

**Prerequisites:**
A course on Computer Networks (15MCA31).

**Unit I**  
**12 Hours**

**Introduction:**

**Unit II**  
**10 Hours**

**Topology, Broadcasting and Routing:**

**Unit III**  
**10 Hours**

**Energy Efficiency, Security and Modelling:**
**Self-Learning Topics:** Algorithmic Challenges in Ad Hoc Networks.

**Unit IV**  
**10 Hours**

**Introduction and Overview of Wireless Sensor Networks:**

**Unit V**  
**10 Hours**

**Wireless Transmission Technology and Systems:**
**Self-Learning Topics:** Case Study on IEEE 802.15.4 LR-WPANs Standard.

**Reference Books:**

Course Outcomes (Cos):
After going through this course the student will be able to:
1. List the advantages and Disadvantages of using Protocols. [L 1]
2. Explain the objectives and functions of Modern Network Systems.[L 2]
3. Explain the Ad-Hoc networks. [L 2]
4. Identify MAC Protocols. [L 3]
5. Apply the Simulation and Modelling of Protocols in creating wireless mobile Networks.[L 3]

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
2. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
3. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
4. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]
5. Postgraduates can participate and succeed in competitive examinations. [PO11]

Program Specific Outcomes(PSO’s)

1. Professional Skills: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. [PSO1]

Scheme of Continuous Internal Evaluation (CIE):

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Scheme of Semester End Examination(SEE):
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### Elective (Specialization: Software Engineering)

#### Software Testing

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<th>Credits:</th>
<th>Course Type:</th>
<th>CIE Marks:</th>
<th>Hrs/Week :L:T:P</th>
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<td>4-0-0</td>
<td>100</td>
<td>52</td>
<td>3 Hrs.</td>
</tr>
</tbody>
</table>

#### Course Learning Objectives:

The course aims at:

1. Providing a clear understanding of problem domain, Analyze and design different test cases for testing various types of system software and application software.
2. Introducing the basics of software testing, finding problems in any computer program, planning and effective test approach, reporting findings etc.
3. Explaining various approaches, techniques, technologies, and methodologies used in software testing and quality assurance.
4. Exhibiting the Software Testing skills for analysis, testing using modern tools and technologies within or outside discipline.
5. Analyzing different approaches to software testing and quality assurance.
6. Selecting optimal solutions for different situations and projects.

#### Prerequisites:

1. A course on Computer programming language (15MCA14).
2. A course on software engineering (15MCA33).

### UNIT I

#### 12 hours

**Basics of Software Testing and Principles, Test case selection, Adequacy**

Humans, Errors and Testing, Software Quality; Requirements, Behavior and Correctness, Correctness Vs Reliability; Testing and Debugging; Test Metrics; Software and Hardware Testing; Testing and Verification; Defect Management; Execution History; Test Generation Strategies; Static Testing; Test Generation from Predicates. Sensitivity, Redundancy, Restriction, Partition, Visibility and Feedback, Test Specification and cases, Adequacy Criteria, Comparing Criteria.
Self-Learning Topics: Case study for a given problem to explore the software quality, input domain and construction of test cases. Carry out the static testing and perform the defect management analysis.

UNIT II
12 hours
A perspective on Testing, Examples and Boundary value testing, Equivalence class testing, Decision table based testing
Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Level of testing, Examples: Generalized pseudocode, The triangle problem, the NextDate function, The commission problem, The SATM (Simple Automation Teller Machine) problem, The currency converter, Saturn windshield wiper. Boundary value analysis, Robustness testing, Worst-case testing, special value testing, Examples, Random testing, Equivalence classes, Equivalence test cases for triangle problem, NextDate function and commission problem, Guidelines and observations, Decision tables, Test cases for triangle problem.
Self-Learning Topics: Practical implementation of the testing methods studied by taking any open source software for the examples studied.

UNIT III
10 Hours
Path Testing, Data flow testing and Levels of Testing, Integration Testing
DD Paths, Test coverage metrics, Basis path testing, guidelines and observations, Definition/Use testing, Slice based testing, Guidelines and observations. Traditional view of testing levels, Alternative life cycle models, the SATM systems, Separating integration and system testing, Guidelines and observations. Decomposition based integration, Call graph-based integration, Path based integration.
Self-Learning Topics:
1. Case study to find out the cyclomatic complexity, DD path, set of basis path, McCabe’s concept of flipping for nodes with outdegree greater than or equal to 3 for the real world examples.
2. Case study of a program to perform the different types of integration methods.

UNIT IV
10 Hours
Fault Based Testing
Assumptions in fault-based testing, Mutation Analysis, Fault-based Adequacy Criteria; Variations on mutation Analysis; From Test case specification to Test Cases, Scaffolding, Generic vs specific Scaffolding, Test Oracles, Self checks as oracles, Capture and Replay.
Self-Learning Topics: Study and analysis of different assumptions in fault based testing, the method of scaffolding.

UNIT V
08 Hours
Planning and Monitoring the Process, Documenting Analysis and Test
Quality and Process, Test and Analysis strategies and plans, Risk Planning, Monitoring the Process, Improving the process, The quality team, Organizing documents, Test strategy
document, Analysis and test plan, Test design specifications documents, Test and analysis reports.

**Self-Learning Topics:** Preparation and organization of different types of documentation, technical writing and project reports.

**Reference Books:**
2. MauroPezze, Michael Young, Software testing and Analysis- Process, Principles and Techniques, Wiley India, 2012

**Course Outcomes (CO’s):**

At the end of the course student should be able to:

1. **Identify** Test cases, Error and fault taxonomies, Levels of testing.  
   [L3]
2. **Classify** Boundary Value Testing, Equivalence Class Testing and Decision Table-Based Testing.  
   [L4]
3. **Determine** Alternative life-cycle models, recognize Basic concepts for requirements specification, assess context of interaction.  
   [L5]
4. **List** and **analyze** approaches for Test Execution: from test case specifications to test cases, Scaffolding, Generic versus specific scaffolding [L1,L4]
5. **Identify** analysis strategies and plans, to Test design specifications documents, to Test and analysis reports.  
   [L3]

**Program Outcomes (PO’s):**

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
3. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
4. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]

**Program Specific Outcomes(PSO’s):**

1. **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality applications for business success.[PSO2]

**Scheme of Continuous Internal Evaluation (CIE):**

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Elective (Specialization: Software Engineering)

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<td>SEE Duration:</td>
<td>3 Hrs.</td>
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</table>

Course Learning Objectives:
The course aims at
1. Providing a clear understanding of usability, design principles, guidelines, heuristics and other fundamentals of Human-Computer Interaction.
2. Analyzing a set of requirements in terms of its user-interface implications.
3. Developing a usage scenario for a given set of user requirements and available technologies. Construct a user-interaction strategy for a given problem.
4. Sketching a series of user-interfaces for a given use scenario.
5. Implementing a designed user-interface to demonstrate its functionality and usability.
6. Employing a set of usability engineering methods to refine a designed user-interface.
7. Evaluating a user-interface using suitable evaluation methodology.

Prerequisites:
A course on software engineering (15MCA33).

UNIT- I
Introduction:
Self-Learning Topics:
Comparative study of the different types of interface designs.

UNIT - II
Evaluating Interface Design: 10 Hours
Introduction, Expert Reviews, Usability Testing and Laboratories, Survey Instruments, Acceptance tests, Evaluation during Active Use, Controlled Psychologically Oriented Experiments Interaction Styles Direct Manipulation and Virtual Environments: Introduction, Examples of Direct Manipulation, Discussion of direct manipulation, 3D Interfaces, Tele-operation, Virtual and Augmented Reality Menu Selection, Form Filling and Dialog Boxes: Introduction, Task-Related Menu Organization, Single Menus, Combination of Multiple Menus, Content Organization, Fast Movement Through Menus, Data Entry With Menus, Form Filling, Dialog Boxes and Alternatives, Audio Menus and Menus for Small Displays

UNIT-III
Command and Natural Languages: 12 Hours
Introduction, Command-organization functionality strategies and structure, Naming and Abbreviations, Natural Language in computing.
Interaction Devices: Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory interfaces, Displays-Small and Large

UNIT IV
Design Issues: 10 Hours
Self-Learning Topics: Comparative study of mobile interfaces and desktop interfaces

UNIT-V
Information Search and Visualization: 10 Hours
Introduction, Search in Textual Documents and Database Querying, Multimedia document search, Advanced filtering and Search Interfaces, Information Visualization: Introduction, Data type by task taxonomy, Challenges for information visualization.
Self-Learning Topics: Exploring the essentials aspect of designing and development of user interface

Reference Books:

**Course Outcomes:**

After going through this course the student will be able to:

1. **Plan and Develop** a methodology for effective design of user-interface to relevant stakeholders using design rationale and a sketching/presentation tool in an informed, reasonable and persuasive way. [L6]
2. **Apply** design principles, guidelines and heuristics to create a user-interaction strategy that solves a real-world problem. [L3].
3. **Interpret** and **determine** the Benefits of Structure, Naming and Abbreviations, Command Menus, Natural Language in Computing. [L2, L5]
4. **Identify** and usage the Interaction Devices, Keyboards and Function Keys, Pointing Devices, Speech Recognition, Digitization, and Generation, Image and Video Displays, Printers. [L3].
5. **Design** a usable and compelling user-interface given a set of requirements and available technologies. [L6]
6. **Evaluation** of user-interface in consultation with stakeholders for employing a series of evaluation methods available in usability engineering. [L5]

**Program Outcomes (POs) of the course:**

1. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
2. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
3. Postgraduates will demonstrate an ability to analyze and build computer applications for multiple domains. [PO5]
4. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
5. Postgraduates will demonstrate knowledge of professional and ethical responsibilities. [PO7]
6. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]

**Program Specific Outcomes (PSO’s):**

1. **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality applications for business success. [PSO2]

**Scheme of Continuous Internal Evaluation (CIE):**

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Elective(Specialization: Software Engineering)

<table>
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<th>Software Project Management</th>
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<tr>
<td><strong>Total Hours:</strong> 52</td>
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</table>

**Course Learning Objectives**
The Course aims at:
1. Providing a clear understanding of basic issues in software project management and highlights the major categories of activities that every project manager undertakes.
2. Providing an overview of project planning and project monitoring & control.
3. Exploring the concepts related to effort and duration estimation techniques.
4. Exploring risk management approaches with special focus on management of risks of schedule slippage using PERT.
5. Providing an insight into the issues of contract management, human resource management, team structure and quality management.

**Prerequisites:**
A course on Software Engineering (15MCA33).

**UNIT 1** 10 Hours

**Introduction to Software Project Management:** Project Definition, contract management, activities covered by software project management, overview of project planning, stepwise project planning

**Project Evaluation:** Strategic assessment, technical assessment, cost benefit
analysis.

UNIT 2  10 Hours
Activity Planning: Objectives, Project Schedule, Sequencing and scheduling activities, network planning models, forward pass, backward pass, activity float, shortening project duration.


UNIT 3  11 Hours
Risk Management: Risk management, nature of risk, types of risk, managing risk, hazard identification, hazard analysis, risk planning and control. Monitoring: creating framework, collecting the data, visualizing progress, cost monitoring, earned value, prioritizing monitoring, getting project back to target.

UNIT 4  10 Hours
Control: change control, managing contracts, types of contract, stages in contract placement, typical terms of a contract, contract management, acceptance.

UNIT 5  11 Hours
Managing people: introduction, understanding behavior, organizational behavior-background, selecting the right person for the job, instructions in the best methods, motivation.

Self-Learning Topics: The oldman, Hackmann job characteristics model.

Reference Books


Course Outcomes
After going through this course the student will be able to:
1. Define the scope of ‘Software Project Management’. Describe the problems and concerns of software project managers. [L1]
2. Analyze the contents of a typical business plan and explain project portfolio management. Appraise the project planning approach in an organized step-by-step manner. [L4, L5]
3. Design a critical path and a precedence network for a project. [L6]
4. Identify the factors putting a project at risk. Categorize and prioritize actions for risk elimination or containment. [L3]
5. Identify the resources required for a project and make the demand for resources more even throughout the life of a project. [L3]
6. Design a work plan and resource schedule to monitor the progress of projects. [L6]
7. Distinguish between the different types of contract. Outline the contents of a contract for goods and services. [L4]
8. Identify some of the factors that influence people’s behavior in a project environment. Improve group working and analyze the coordination needs of a project. [L3]

Program Outcomes (PO’s):
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
3. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
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### Elective (Business Management)

**Professional Communication and Ethics**

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<th>Credits:</th>
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</table>

**Course Type:** GE  
**CIE Marks:** 50

**Hrs/Week :L:T:P** 4-0-0  
**SEE Marks:** 50

**Total Hours:** 52  
**SEE Duration:** 3 Hrs.

**Course Learning Objectives:**

The course aims at:

1. Equipping the students with skill set to face the challenges in communication, primarily in a technical milieu by covering the four dimensions of communications skills, namely listening, speaking, reading and writing.
2. Introducing the basics of communication, barriers in communications, use of technology in communication and active listening.
3. Learning effective presentation strategies and skills to give seminars/presentations,
face interviews and participate in group discussions.

4. Emphasizing on the constituents of effective writing and reading comprehensions, enabling students to improve on their vocabulary, sentence construction, paragraph development and reading strategies.

5. Implementing various writing strategies to write various business letters, job applications, resume, and e-mail messages.

6. Introducing Ethics in Engineering with emphasis on moral problems engineers face in the corporate setting.

7. Stimulating critical and responsible reflection on the moral issues surrounding engineering practice and providing the conceptual tools necessary for pursuing those issues.

**Prerequisites:**

Fundamentals of English Language and English Grammar.

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<th>8 Hrs</th>
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<td><strong>Basics of Technical Communication</strong></td>
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<tr>
<th>UNIT II</th>
<th>12 Hrs</th>
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<tbody>
<tr>
<td><strong>Oral Forms in Communication</strong></td>
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<table>
<thead>
<tr>
<th>UNIT III</th>
<th>12 Hrs</th>
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</thead>
<tbody>
<tr>
<td><strong>Constituents of Effective Writing and Professional Writing</strong></td>
<td></td>
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</tbody>
</table>
Email Messages: Principles and Fundamentals, Formatting E-mail Messages, Standard E-mail Practices, E-mail Writing Strategies.


UNIT IV
7 Hrs

Reading and Language Comprehension

UNIT V
13 Hrs

Ethics in Engineering

Self-Learning Topics: Engineers as Managers, Consultants and Leaders.

Reference Books:

Course Outcomes:
At the end of the course student should be able to:
1. Identify Process, Levels and Flow of Communication [L 3].
2. Evaluate Barriers of Communication and the impact of Technology in communication [L 5].
3. Apply the traits of a good listener and effective presentation strategies in oral communication [L 3].
4. Compose effective writing using appropriate words, phrases and the art of condensation [L 6].
5. Improve the art of reading using reading techniques [L 6].
6. Construct effective Business Letters, Resumes, Job Applications, and E-mail messages [L 6].
7. Analyze the role of Engineers with their social responsibilities to reflect critically on the moral dilemmas they will confront in their profession [L 4].

Program outcomes(PO’s):
1. Postgraduates will demonstrate knowledge of professional and ethical responsibilities. [PO7]
2. Postgraduates will be able to communicate effectively in both verbal and written form [PO8]
3. Postgraduates will show the understanding of impact of engineering solutions on the
society as a successful entrepreneur or IT professional. [PO9]

**Program Specific Outcomes (PSO’s):**
1. **Successful Career and Entrepreneurship:** The ability to employ modern computer languages, technologies, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies [PSO3]

**Scheme of Continuous Internal Evaluation (CIE):**

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**Scheme of Continuous Internal Evaluation (CIE):**
Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA

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**Elective (Specialization: Management)**

<table>
<thead>
<tr>
<th>Supply Chain Management</th>
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<tbody>
<tr>
<td><strong>Subject Code:</strong></td>
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<td><strong>Credits:</strong></td>
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<td><strong>Course Type:</strong></td>
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<tr>
<td><strong>SEE Marks:</strong></td>
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<tr>
<td><strong>SEE Duration:</strong></td>
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</table>

**Course Learning Objectives (CLO’s):**

**The course aims at:**
1. Providing the strategic importance of good supply chain design, planning and operation for every firm and to train the students to identify how good supply chain management can be a competitive advantage, whereas weaknesses in the supply chain can hurt the performance of the firm.
2. Explaining the key drivers of supply chain performance like facilities, inventory, transportation and information.
3. Analyzing how these drivers may be used on a conceptual and practical level during supply chain design, planning and operations to improve performance.
4. Training the students with practical managerial levers and concepts that may be used to improve supply chain performance.
5. Utilizing analytical methodologies for supply chain analysis and understanding the managerial levers.

**Prerequisites:**
A course on:
1. Software engineering (15MCA33).
2. Management information system (15MCA35).

<table>
<thead>
<tr>
<th>Unit – I</th>
<th>Introduction and basic aspects of supply chain management</th>
<th>12 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>What is a Supply Chain, Decision phases in a supply Chain, Process view of a Supply Chain, The importance of Supply Chain Flows, Examples of Supply Chains, Competitive and Supply Chain strategies, Achieving strategic fit, Expanding strategic scope, Drivers of Supply Chain Performance, A framework for structuring drivers, Facilities, Inventory, Transportation, Information, Obstacles to achieve strategic fit, The role of distribution in the Supply Chain, Factors influencing distribution network design, Design options for a distribution network, The value of distributors in the Supply Chain, Distribution Networks in practice.</em></td>
<td></td>
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<tr>
<td></td>
<td><strong>Self-Learning Topics:</strong> Case Study on gateway, DELL and Wallmart.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit – II</th>
<th>Network Design, Demand Forecasting, Aggregate Planning</th>
<th>12 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Self-Learning Topics:</strong> Evaluating Network Design Decisions using Decision Trees.</td>
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</table>

<table>
<thead>
<tr>
<th>Unit –III</th>
<th>Inventory Management</th>
<th>8 Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><em>The role of cycle inventory in a supply Chain; Economies of scale to exploit fixed costs, quantity discounts; Short-term discounting; Managing multi-echelon cycle inventory; Estimating cycle inventory related costs in practice.</em></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit - IV</th>
<th>Transportation, Pricing and Revenue Management, Coordination</th>
<th>12 Hours</th>
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<tbody>
<tr>
<td></td>
<td><em>The role of transportation in the Supply Chain, Factors affecting transportation decisions, Modes of transportation and their performance characteristics, Design options for a transportation network, Trade-offs in transportation design, Tailored transportation, Routing and scheduling in transportation, Making transportation decisions in practice. The role of revenue management in Supply Chain, revenue management for multiple customer segments, perishable assets, seasonal demand, and bulk and spot contracts, Using revenue management in practice, Lack of Supply Chain coordination and Bullwhip effect, Effect of lack of coordination on performance, Obstacles to coordination in the Supply Chain, managerial levers to achieve coordination, Building strategic partnerships and trust within a supply Chain, Achieving coordination in practice.</em></td>
<td></td>
</tr>
</tbody>
</table>

| Unit - V   | 1.1 IT, Internet and Supply Chain |
8 Hours


Reference Books:

Course Outcomes (Cos):

On successful completion of the course the student will be able to :
1. Explain the impact of supply chain decisions on the success of the firm [L2].
2. Identify the drivers of supply chain performance and explain the role each driver plays in creating strategic fit between the supply chain strategies. [L2, L3].
3. Identify the key factors to be considered when designing a distribution network Discuss the strengths and weaknesses of various distribution options. [L3, L6]
4. Define and discuss the role of forecasting for both an enterprise and a supply chain. [L1, L6]
5. Explain the basic trade-offs to consider when creating an aggregate plan. Formulate and solve basic aggregate planning problems. [L2, L6]

Program Outcomes(PO’s):

1. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
2. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications. [PO6]
3. Postgraduates will demonstrate knowledge of professional and ethical responsibilities [PO7]

Program Specific Outcomes(PSO’s):
1. Problem-Solving Skills: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality applications for business success.[PSO2]

Scheme of Continuous Internal Evaluation (CIE):

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Scheme of Semester End Examination (SEE):

Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions.
SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

Elective (Specialization: Software Engineering)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits:</th>
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<tbody>
<tr>
<td>15MCAX24</td>
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**Operation Research**

<table>
<thead>
<tr>
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<tbody>
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<th>Hrs/Week :L:T:P</th>
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<td>52</td>
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</table>

**Course Learning Objectives (CLO’s):**

The course aims at:

1. Providing a clear understanding of the given problem and applies the fundamental techniques of operations research in solving the problem.
2. Learning the necessary available techniques for Managerial decision making situations within business contexts.
3. Introducing programming skills to design and implementing software solutions to solve problems in the domain of operations research.

**Prerequisites:**

1. A course on MIS (15MCA35)
2. Knowledge of Basic mathematics, MIS.

**UNIT I**

12 Hrs

Introduction and Overview of the OR Modelling Approach, Introduction to Linear Programming:

The origin of OR, the nature of OR, the impact of OR, defining the problem and gathering data, Formulating a mathematical model, deriving solutions from the model, testing the model, preparing to apply the model, implementation.

Formulation of linear programming problem (LPP), examples, Graphical solution, the LP Model, Special cases of Graphical method, assumptions of Linear Programming (LP), additional example
UNIT II
Solving LPP - the Simplex Method:
The essence of the simplex method, setting up the simplex method, algebra of the simplex method, the simplex method in tabular form, special cases in the simplex method, tie breaking in the simplex method, adopting to other model forms (Two Phase method, Big-M method)
Self-Learning Topics: Revised Simplex Method, Post optimality analysis.

UNIT III
Duality Theory and Sensitivity Analysis:
The essence of duality theory, economic interpretation of duality, primal dual relationship, adapting to other primal forms, the role of duality in sensitive analysis, the dual simplex method.

UNIT IV
Transportation and Assignment Problems
The transportation problem, a stream line simplex method for the transportation problem, the assignment problem, a special algorithm for the assignment problem

UNIT V
PERT and CPM, Game Theory:
Network representation, Critical path (CPM) computations and PERT networks.
The formulation of two persons, zero sum games, solving simple games- a prototype example, games with mixed strategies, graphical solution procedure, solving by linear programming, extensions.
Self-Learning Topics: Scheduling a Project with PERT/CP

Reference Books :

Course Outcomes:
At the end of the course student should be able to:
1. Design and build mathematical models to achieve higher profits and lower costs in business making decisions. [L 6]
2. Apply the tools and techniques in making critical thinking and objective analysis of decision problems in project management.[L 3]
3. Analyze the decision-making problem and identify the appropriate technique that can be applied to solve the problem. [L 4]
4. Evaluate performance of system or decision taken. [L 5]

Program Outcomes (POs) of the course:
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems. [PO2]
3. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
4. Postgraduates will be able to communicate effectively in both verbal and written form. [PO8]
5. Postgraduates will demonstrate research-based knowledge and research methods for addressing current issues in research trends. [PO12]

**Program Specific Outcomes (PSO’s)**
1. **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver quality applications for business success. [PSO2]

**Scheme of Continuous Internal Evaluation (CIE):**

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**Scheme of Semester End Examination (SEE):**

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Elective (Specialization: Management)

Enterprise Resource Planning

<table>
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<tr>
<th>Course Code</th>
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<th>Credits:</th>
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<th>SEE Marks:</th>
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<td>04</td>
<td>50</td>
<td>100</td>
<td>52</td>
<td>3 Hrs.</td>
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</table>

Course Learning Objectives:

The course aims at:

1. Providing a clear understanding of foundational methodologies, techniques and tools that understanding the successful implementation of enterprise resource planning (ERP) systems.
2. Focusing on integrating business processes in an enterprise resource planning (ERP) system. Students will experience both, the end-user and configuration perspectives of an ERP system implementation.

Prerequisites:

1. Knowledge of Business Process Reengineering, Data Warehousing, Data Mining, On–line Analytical Processing, Supply Chain Management.

Unit I 10 Hours
Introduction To ERP
Overview, Benefits of ERP, ERP and Related Technologies, Business Process Reengineering, Data Warehousing, Data Mining, On–line Analytical Processing, Supply Chain Management.

Unit II 12 Hours
ERP Implementation

Unit III 10 Hours
Business Modules

**Unit IV**  
**10 Hours**

**ERP Market**
ERP Market Place, SAP AG, PeopleSoft, Baan Company, JD Edwards World Solutions Company, Oracle Corporation, QAD

**Self-Learning Topics:** System Software Associates.

**Unit V**  
**10 Hours**

**ERP – Present And Future**
Turbo Charge the ERP System, EIA, ERP and E–Commerce, ERP and Internet,

**Self-Learning Topics:** Future Directions in ERP.

**Reference Books:**

**Course Outcomes:**
At the end of the course student should be able to:
1. **Demonstrate** the basic structure of an Enterprise Resource Planning system. [L2]
2. **Demonstrate** typical integrated business processes in an ERP, such as procurement, production, and fulfillment. [L2].
3. **Design** common business transactions as an end-user in an ERP system. [L6]
4. **Perceive** as a member of an ERP implementation or configuration team. [L5]
5. **Analyze** and **evaluate** the critical stage of implementation in the development of enterprise wide systems. [L4,L5]
6. **Build** an ERP system for specific business processes. [L6].
7. **Evaluate** and **discuss** the need for linking enterprise mission & goals with the implementation of ERP systems [L5,L6].
8. **Develop** and **demonstrate** the use of SAP tools to aid and understand the implementation process [L2,L3].

**Program Outcomes:**
1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management. [PO1]
2. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data. [PO3]
3. Postgraduates will demonstrate an ability to design a system, component or process as per needs and specifications. [PO4]
4. Postgraduates will demonstrate skills to use modern software tools and technology to
Program Specific Outcomes (PSO’s):

1. Successful Career and Entrepreneurship: The ability to employ modern computer languages, technologies, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies [PSO3]

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Scheme of Semester End Examination (SEE):

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**Elective (Specialization: Marketing)**

**Digital Marketing**

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<tr>
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</table>

Course Learning Objectives:

The course aims at:

1. Adapting web marketing strategies and best practices.
2. Understanding the concepts of web marketing.
3. Defining web marketing goals; assigning resources and assessing growth opportunities.

Unit I 10 Hours
Introduction to Digital marketing

Now and before of digital marketing - digital marketing for the 21st century, Importance and scope of digital marketing; How web sites works – dynamic, static, blogs: search engines and types of search engines – meta, crawler, directories; How to create a blog

Unit II 10 Hours

Concepts of Digital marketing


Unit III 10 Hours

Social Media

Introduction to social media, Examples of social media, Uses of social media, How companies use social media, Impact of social media in search Benefits of social media: Case studies of social media, SEO for social media, How to get started in social media. Social media profile creation and optimization

UNIT IV 12 Hours

Advertisements

Online Ads – How online ads work : Interactive ads, Creative ads, Google Ad words, Online ad methods, Types of online advertisements, Face book ads, LinkedIn ads, Video ads, Text ads, Image ads, Local ads, Content network ads, Best practices, Campaign set up, Billing, Budget, Segment, Audience Effective Ads: Calculating ROI, Budget, How to choose your ad partner, Blogging for businesses


Unit V 10 Hours

Digital Marketing Management

Digital Marketing Management : Role of web marketing manager, Web marketing department structure, Roles and responsibilities, Job description, Targets, goals. Digital Marketing Plan:
Goals, objectives, KPI's, Market research, Value creation process. Strategic web marketing plan, Budgeting, Channel. Online Reputation Management: Brand management, Tools to monitor online brand reputation, Communication online best practices, Online press releases, Online newspaper, magazine ads, Google, Yahoo news

Reference Books:
1. Zimmerman Jan, Sahlin Doug; Social media marketing, All-in-one for dummies, Wiley India.

Course Outcomes:
Upon successful completion of this course you should be able to:
1. Assess the impact of digital technology on the practice of marketing.
2. Analyze the use of different forms of digital marketing in the development of an online presence.
3. Use a publishing platform to build a web presence with integrated data collection and links to social media.
4. Develop a plan for marketing a product of business online.
5. Integrate social media tools into a marketing communications strategy.

Elective (Specialization: Image Processing)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Digital Image Processing</th>
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<tbody>
<tr>
<td>15MCAX27</td>
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<tr>
<td>Credits:</td>
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Course Learning Objectives:
The course aims at:
2. Explaining the fundamentals theories and techniques of digital image processing.
3. Developing an understanding of basic image processing operations.
4. Exposing the students to current applications in the field of digital image processing.

Prerequisites:
1. Digital Systems and Computer Organization (15MCA13)  
2. Discrete Mathematical Structures (15MCA15)

**UNIT 1: Introduction**  
10 Hours  

**UNIT 2: Image Enhancement in the Spatial Domain and Frequency Domain**  
12 hours  
**Self Study:** Homomorphic Filtering.

**UNIT 3: Morphological Image Processing and Image Segmentation**  
10 Hours  
Dilation and erosion, opening and closing, Hit-or-Miss transformations, basic morphological algorithms, Detection of discontinues, edge linking and boundary detection, thresholding, region – based segmentation.

**UNIT 4: Representation and Descriptors**  
10 Hours  

**UNIT 5: Use of Image Processing in Pattern Recognition**  
10 Hours  
Introduction to the tools of Matlab and Open CV.  
**Self Study:** Case study on Object Identification, Biometrics and Content Based Image retrieval.

**Reference Books:**  

**Course Outcomes:**  
**At the end of the course student should be able to:**  
1. **Explain** the basic elements and applications of image processing. [L2]
2. Apply histogram equalization for image enhancement [L3]
3. Utilize Matlab to implement different image processing tasks [L3]
4. Analyze image sampling and quantization requirements and implications [L4]
5. Design and implement two-dimensional spatial filters for image enhancement [L6]

**Program Outcomes (PO’s)**

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management [PO1]
2. Postgraduates will demonstrate an ability to design and conduct experiments, analyze and interpret data [PO3]
3. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications [PO4]

**Program Specific Outcomes (PSO’s):**

**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality applications for business success [PSO 2]

**Scheme of Continuous Internal Evaluation (CIE):**

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**Scheme of Semester End Examination (SEE):**

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**Elective (Specialization: Image Processing)**

**PATTERN RECOGNITION**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits:</th>
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<tbody>
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**Course Type:** GE  
**CIE Marks:** 50  
**Hrs/Week :L:T:P** 4-0-0  
**SEE Marks:** 50  
**Total Hours:** 52  
**SEE Duration:** 3 Hrs.

**Course Learning Objectives:**

The course aims at providing a clear understanding with the focus on following learning perspectives:

- Fundamentals of pattern recognition system.
- Feature extraction and pattern classification algorithms.
• Unsupervised classification or clustering techniques.
• Applications of pattern classification algorithm for a pattern recognition problem.

Prerequisites:
1. Computer programming language(C) (15MCA14).
2. Discrete Mathematics (15MCA15).

UNIT I 13 Hrs
Introduction and Bayesian Decision Theory: Machine perception, an example; Pattern Recognition System; The Design Cycle; Learning and Adaptation. Introduction, Bayesian Decision Theory; Continuous Features, Minimum error rate, classification, classifiers, discriminant functions, and decision surfaces; The normal density; Discriminant functions for the norm.

UNIT II 13 Hrs
Maximum-Likelihood And Bayesian Parameter Estimation and Non-Parametric Techniques:
Introduction; maximum-likelihood estimation; Bayesian Estimation; Bayesian parameter estimation: Gaussian Case, general theory; Hidden Markov Models. Density Estimation; Parzen windows; kn Nearest-Neighbor Estimation; The Nearest-Neighbor Rule; Metrics and Nearest-Neighbor Classification.

UNIT III 6 Hrs
Linear Discriminant Functions: Introduction; Linear Discriminant Functions and Decision Surfaces; Generalized Linear Discriminant Functions; The Two-Category Linearly Separable case; Minimizing the Perception Criterion Functions; Relaxation Procedures; Nonseparable Behavior; Minimum Squared-Error procedures.
Self Study: The Ho-Kashyap procedures.

UNIT IV 13 Hrs
Stochastic Methods and Non-Metric Methods: Introduction; Stochastic Search; Boltzmann Learning; Boltzmann Networks and Graphical Models; Evolutionary Method Decision Trees; CART; Other Tree Methods; Recognition with Strings; Grammatical Methods.

UNIT V 7 Hrs
Unsupervised Learning and Clustering: Introduction; Mixture Densities and Identifiably; Maximum-Likelihood Estimates; Application to Normal Mixtures; Unsupervised Bayesian Learning; Data Description and Clustering.
Self Study: Criterion Functions for Clustering.

Reference Books:

Course Outcomes:

At the end of the course student should be able to:

1. List learning algorithms for unsupervised tasks.[L1]
2. Construct, document and present a literature review on a topic related to Machine Learning and Pattern Recognition[L3]
3. Identify areas where Pattern Recognition and Machine Learning can offer a solution[L3]
4. Discuss the strength and limitations of some techniques used in computational Machine Learning for classification, regression and density estimation problems.[L6]
5. Discuss some discriminative, generative and kernel based techniques.[L6]

Program Outcomes:

1. Postgraduates will demonstrate knowledge of mathematics, computer applications, and management.[PO1]
2. Postgraduates will demonstrate an ability to identify, formulate and solve engineering problems.[PO2]
3. Postgraduates will demonstrate skills to use modern software tools and technology to build and test applications.[PO6]
4. Postgraduates will show the understanding of impact of engineering solutions on the society as a successful entrepreneur or IT professional.[PO9]

Program Specific Outcomes:

Professional Skills: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, simulation, software design, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.[PSO1]

Scheme of Continuous Internal Evaluation (CIE):

<table>
<thead>
<tr>
<th>Components</th>
<th>Average of best of two tests out of three</th>
<th>Average of two assignments, Course Seminar, Course Project, Subject Proficiency test</th>
<th>Quiz</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>30</td>
<td>15</td>
<td>5</td>
<td>50</td>
</tr>
</tbody>
</table>
Scheme of Semester End Examination (SEE):
Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions.
SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.