Learning Outcomes based Curriculum Framework

(LOCF)

for

# Bachelor of Science in Computer Science (Shift II)

under

Choice Based Credit System


Madras Christian College (Autonomous)

(UGC – College with Potential for Excellence)

Tambaram East, Chennai – 600059.

Tamil Nadu, India.

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# MADRAS CHRISTIAN COLLEGE (AUTONOMOUS)

**Choice Based Credit System**

## Bachelor of Science in Computer Science

## Preamble

Education is the key to development of any society. Role of higher education is crucial for securing right kind of employment and also to pursue further studies in best available world class institutes elsewhere within and outside India. Quality education in general and higher education in particular deserves high priority to enable the young and future generation of students to acquire skill, training and knowledge in order to enhance their thinking, creativity, comprehension and application abilities and prepare them to compete, succeed and excel globally. Sustained initiatives are required to reform the present higher education system for improving and upgrading the academic resources and learning environments by raising the quality of teaching and standards of achievements in learning outcomes across all undergraduate programs in science, humanities, commerce and professional streams of higher education including computer science. One of the significant reforms in the undergraduate education is to introduce the Learning Outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. LOCF also aims at ensuring uniform education standard and content delivery across the country which will help the students to ensure similar quality of education irrespective of the institute and location. With initiatives of University Grants Commission (UGC) for nation-wide adoption and implementation of the LOCF for bachelor's programmes in colleges, universities and HEIs in general. The B. Sc Computer Science offered by the institution is designed as per LOCF and as per UGC guidelines. The Qualification Descriptors (QD), Program Outcomes (PO) and Course Outcomes (CO) are also finalized keeping the broad requirement of the programme in view.

## 1. Introduction

The Bachelor's degree programme in Computer Science is proposed with the aim of introducing job-oriented value-based quality education with specialization in data analytics and other information sciences. On completion of the course, the students will be well-equipped with excellent knowledge of computing, particularly in core Computer Science subjects, blended with inter-disciplinary skills. The course, in particular, imparts profound knowledge in analysis of problems and effective decision-making. Thus, the Bachelor's Degree course in Computer Science focuses on the theoretical foundations of Computer Science along with the practical approach of data analytics and computation. It also provides an added dimension to help students understand how people process information using real-time applications.

## Program Goals and Objectives

The primary goals of B.Sc. Computer Science are as listed below:

- To inculcate the technical skills of students and bring proficiency in computationally analyzing and creatively solving complex problems.
- To aid students excel in various dimensions, bringing in the best of practices and standards of software development and to apply the learnt notions in developing socially relevant innovative applications.

The objectives are as follows:

- Understanding of programming languages, computing tools, packages and problem design.
- Learning computer science theories, problem-solving methods and programming skills.
- Adapting to rapid technological advancements like, SPSS, Artificial Intelligence, Programming with Python and R.

- Creating the ability to understand complex data with analytical and critical thinking skills. Inculcating analyzing, decision-making, and problem-solving abilities.

## 2. Nature and Extent of the B.Sc Programme

The undergraduate programs in Computer Science builds on science-based education at +2 level. The +2 senior secondary school education aims and achieves a sound grounding in understanding the basic scientific temper with introduction to process of computation by introducing some programming languages.

### 2.1 Eligibility for Admission

Applicants should have passed the +2 examination of the Government of Tamil Nadu or any other equivalent examination recognized by the Government of Tamil Nadu or an Examination accepted as equivalent thereof by the Syndicate of the University of Madras and as per the eligibility criteria of the University of Madras.

### 2.2 Eligibility for the Award of Degree

A Candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than three academic years, passed the examinations in all the Six Semesters prescribed earning 140 credits in Parts I, II, III, IV, and V.

### 2.3 Duration

a) Each academic year shall be divided into two Semesters. The first academic year shall comprise I and II semesters, the second academic year the III and IV Semesters and the third academic year the V and VI Semesters respectively.

b) The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester.

## 2.4 Pattern of Question Paper for UG (ESE) and (ICA)

**End of Semester Examination (ESE)**

a) **Part A:** Ten (10) questions are to be set. Students are to answer all the questions. Each question carries two marks – 10 x 2=20
b) **Part B:** Eight questions are to be set and students are to answer five (5) out of eight (8). Each question carries eight (8) marks- 5 x 8=40
c) **Part C:** Three (3) questions are to be set and students to answer two (2) out of three (3). Each question carries twenty marks – 2 x 20=40 The Maximum score for a paper is 100 marks

**Internal Continuous Assessment (ICA)**

Three Continuous Assessment in Theory and Practical Papers will be conducted for 50 marks. The average of best two out of the three tests would be considered.

**3. Course of Study (As Per TANSCHE Guidelines)**

# Bachelor of Science – Computer Science

| | | |
|---|---|---|
| Part I – Language | 4 papers x 3 Credits | 12 Credits |
| Part II – English | 4 Papers x 3 Credits | 12 Credits |
| Part III | | |
| Core Subjects | Semester I – 8 Credits<br>Semester II- 8 Credits<br>Semester III- 8 Credits<br>Semester IV- 8 Credits<br>Semester V- 12 Credits<br>Semester VI- 16 Credits | 60 Credits |
| Allied Subjects | 4 Papers x 5 Credits | 20 Credits |
| Elective Paper | 3 Papers x 5 Credits | 15 Credits |
| Part IV | | |
| NME/BT/AT | 2 Papers x 2 Credits | 4 Credits |
| Soft Skills | | |
| Inter disciplinary | 3 Credits | 12 Credits |
| Personality Development | 3 Credits | |
| Skill Based Course | 3 Credits | |
| General Elective | 3 Credits | |
| Environmental Studies | | 2 Credits |
| Value Education | | 2 Credits |
| Part V | Extension Activity | 1 Credit |

Total: (12 + 12+ 60 + 20 + 15 + 4 + 12 + 2 + 2 + 1) = 140 Credits

## 4. Teaching Learning Strategies

The classes will be handled using classroom lectures, demonstrations, seminars, discussions, videos, charts and presentations. Virtual instructional platforms such as online lectures, Google classrooms, Google meets, Swayam Platforms (www.swayam.gov.in) are also used. Students may learn various topics using resources like e-books and simulators. Students can also complete certain portions of the curriculum by referring to websites for practical components wherever necessary.

*Activities* - Project Work/ Seminars/ Term Papers/Assignments/ Group work/ Practical sessions.

*Assessment Rubric* - Classroom Test, Online test, Group Work, Assignments, and Presentations.

### 4.1 Internship

Internship is an integral part of the three-year B.Sc. Computer Science Undergraduate degree programme. The course was designed to bridge the gap between theoretical and practical computer knowledge and create a natural interest in the practical aspects. Internships help students to get valuable work experience by learning the ropes from more experienced professionals. The training and exposure would be under the joint supervision and guidance of the respective guides. The details of the training undergone by the students will be clearly documented in the form of a report.

## 4.2 Structure of Internship Programme

| Year | Month | Subject | Period | Condition |
|---|---|---|---|---|
| I<br><br>**(OR)**<br><br>II | May | Front end /Back End Application Developments / Data Analytics/ Product management / Mobile Technology / Web Designing/ Machine Learning/ Data Science/ Big Data Analysis | 4 weeks/ 30 Days | During Summer Vacation |

## 4.3 Method of Evaluation- Practical

| | | |
|---|---|---|
| 1. | Proficiency in programming | 80 Marks |
| 2. | Practical Record | 20 Marks |
| | Total Marks | **100 Marks** |

## 4.4 Method of Evaluation - Mini Project and Internship Report

| | | |
|---|---|---|
| 1. | Development of Application/ Prototype | 10 Marks |
| 2. | Usage of Modern tools/technology | 10 Marks |
| 3. | Presentation & Viva-voce | 20 Marks |
| 4. | Mini Project Dissertation | 40 Marks |
| 5. | Internship Report | 20 Marks |
| | Total Marks | **100 Marks** |

## 4.5 Students Abroad Programme (SAP)

Students are given opportunities to have international exposures and global opportunities in Semester V. Under the Semester Abroad Program the students are allowed to take a few subjects in foreign Universities with due mapping of courses. The credits earned in the foreign university through the SAP will be mapped by an approved procedure.

## 4.6 MOOC Courses

The students can enroll themselves in an online course and earn additional credits.

# 5. Graduate Attributes

The Madras Christian College defines the philosophy underpinning its academic programmes and student life experience on campus through the Graduate Attributes (GA), that describe the knowledge, competencies, values and skills students imbibe for holistic development and contribution to society. These attributes encompass characteristics that are transferable beyond the domain of study into the national and international realm fostered through curricular, co-curricular and extra-curricular engagements

**GA 1: Intellectual Competencies -** Graduates of MCC have a comprehensive and incisive understanding of their domain of study as well as the capability for cross-disciplinary learning. They have the ability to apply the knowledge acquired through the curriculum as well as self-directed learning to a broad spectrum ranging from analytical thinking to synthesise new knowledge through research.

**GA 2: Professional Ethics -** Graduates of MCC develop ethical and professional behaviour, which will be demonstrated in their chosen careers and constructive citizenship roles. They imbibe intellectual integrity and ethics in scholarly engagement and develop a spirit of inclusiveness through interactions with people of special needs and diversity.

**GA3: Leadership Qualities -** Graduates of MCC inculcate leadership qualities & attitudes, and team behaviour along democratic lines through curricular, co-curricular and extra-curricular activities. They develop managerial and entrepreneurial skills to ideate and create new opportunities along with career readiness and capacity to take up various competitive exams.

**GA 4: Holistic Skill Development -** Graduates of MCC develop critical thinking, problem-solving, effective communication, emotional and social skills. They develop digital competency to live, learn and serve in society.

**GA 5: Cross-Cultural Competencies -** Graduates of MCC imbibe cross-cultural competencies through engaging with diverse linguistic, ethnic and religious communities providing scope to understand, accept and appreciate individuals at local, national and international levels. They develop a global perspective through contemporary curriculum, culture, language and international exchange programmes

**GA 6: Service-Oriented Focus -** Graduates of MCC have sensitivity to social concerns and a conviction toward social justice through a commitment to active social engagement. They are endowed with a strong sense of environmental awareness through the curriculum and campus eco-system.

**GA 7: Value-Based Spiritual Development -** Graduates of MCC are rooted in the principles of ethical responsibility and integrity permeated with Christian values leading to the building of character. They develop virtues such as love, courage, unity, brotherhood, industry and uprightness

## 5.1 Program Outcomes (POs)

At the end of the B.Sc Computer Science Programme, the student will:

- **PO1: Analyze Problems -** Identify, formulate, review literature and analyze complex problems in Computer Science.

- **PO2: Design and Development of Solutions -** Design solutions for complex problems and design system components or processes of Computer Science that would meet the needs of the society.
- **PO3: Use Modern tools -** Create, select and apply appropriate techniques, resources, and modern IT tools including prediction and Modeling to Computer Science with an understanding of the limitations.
- **PO4: The engineer and society -** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice in Computer Science.

## 6. Qualification Descriptors for B.Sc CS / Program Specific Outcome (PSOs)

After completion of the Undergraduate Programme in Computer Science, the students will be able to:

| | |
|---|---|
| PSO 1 | apply fundamental principles and methods of Computer Science to a wide range of applications. |
| PSO 2 | apply their programming skills to solve real world problems in society. |
| PSO 3 | inculcate Algorithmic knowledge to solve mathematical problems. |
| PSO 4 | formulate solutions for computational problems. |
| PSO 5 | design and implement software systems to meet the desired needs |
| PSO 6 | apply algorithms and mathematical concepts to design and analysis of software. |
| PSO 7 | develop software skills and training to tackle real world problems using latest Cloud technologies |
| PSO 8 | get employed in the field of software industry and pursue higher education in Computer Science. |
| PSO 9 | model, analyze, design, visualize and realize physical systems or processes of increasing size and complexity. |
| PSO 10 | define, assess and adhere to software quality practices, and software |

| | |
|---|---|
| | processes and methodologies. |
| PSO 11 | analyze data sets in the context of real-world problems and interpret results using data analytics |
| PSO 12 | understand various methods used to collect and analyze data for decision making. |

## 7. Cognitive Levels of Learning

The cognitive domain, is the first and most common hierarchy of learning objectives (Bloom, 1956). It focuses on the acquisition and application of knowledge and is widely used in the educational setting. It aims to develop the mental skills and the acquisition of knowledge of the individual. The cognitive domain encompasses of six categories which include remembering, understanding, applying, analyzing, evaluating and creating.

| | | |
|---|---|---|
| **K1** – Remembering | **K2** – Understanding | **K3** – Applying |
| **K4** – Analyzing | **K5** – Evaluating | **K6** – Creating |

## 8. Syllabus Template

| Sem | Subjects | Subj. Code | Courses | Name of the Subject | Weekly Hrs. | | | C |
|---|---|---|---|---|---|---|---|---|
| | | | | | L | P | T | |
| . | Foundational | | Language | | 4 | - | 4 | 3 |
| | | | English | | 4 | - | 4 | 3 |
| | | | Value Edu. | | 2 | - | 2 | 1 |
| I | Gen. Course | 224BC1G01 | Part IV(a) | Web designing using HTML and CSS | 2 | 2 | 4 | 2 |
| | Core papers | 224BC1M01 | Major I | Programming Principles Using C | 5 | - | 5 | 5 |
| | | 224BC1M02 | Major II | Programming Principles Using C Laboratory | - | 5 | 5 | 3 |
| | | 224BC1A01 | Allied I | Mathematics for Computer Science I – Discrete Mathematics | 6 | - | 6 | 5 |
| II | Foundational | | Language | | 4 | - | 4 | 3 |
| | | | English | | 4 | - | 4 | 3 |
| | | | Value Edu. | | 2 | - | 2 | 1 |
| | Gen. Course | 224BC1G01 | Part IV(a) | Web designing using HTML and CSS | 2 | 2 | 4 | 2 |
| | Core papers | 224BC2M01 | Major III | Data Structures and Algorithms | 5 | - | 5 | 5 |
| | | 224BC2M02 | Major IV | Object oriented Programming using Java Laboratory | - | 5 | 5 | 3 |
| | | 224BC2A01 | Allied II | Mathematics for Computer Science II – Statistical Methods | 6 | - | 6 | 5 |
| III | Foundational | | Language | | 4 | - | 4 | 3 |
| | | | English | | 4 | - | 4 | 3 |
| | | | Pers. Dev. | | 2 | | 2 | - |
| | IDE/EVS | 224BC3I01 | Part IV(b) | Digital Marketing with Analytics | 2 | 2 | 4 | 3 |
| | Core papers | 224BC3M01 | Major V | Data Mining | 5 | - | 5 | 5 |
| | | 224BC3M02 | Major VI | Database Management Systems Laboratory | - | 5 | 5 | 3 |
| | | 224BC3A01 | Allied III | Statistics for Computer Science I – Data transformation with Spreadsheets and Wrangling with SQL | 3 | 3 | 6 | 5 |
| IV | Foundational | | Language | | 4 | - | 4 | 3 |
| | | | English | | 4 | - | 4 | 3 |
| | | | Pers. Dev. | | 2 | - | 2 | 3 |
| | IDE/EVS | 224BC3I01 | Part IV(b) | Digital Marketing with Analytics | 2 | 2 | 4 | 3 |
| | Core Papers | 224BC4M01 | Major VII | Operating Systems | 3 | 2 | 5 | 4 |
| | | 224BC4M02 | Major VIII | Programming using Python Laboratory | - | 5 | 5 | 3 |
| | | 224BC4A01 | Allied IV | Statistics for Computer Science II – Data Visualization | 3 | 3 | 6 | 5 |
| | Gen. Elective | 224BC5L01 | Part IV (b) | Information Security and Digital Forensics | 4 | - | 4 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| V | Skill Based | 224BC5M01 | Part IV(b) | Employability Skills through Language and digital platform | 1 | 1 | 2 | 3 |
| | Core Papers | 224BC5M02 | Major IX | Software Engineering | 4 | - | 4 | 4 |
| | | 224BC5M03 | Major X | Machine Learning with Python Laboratory | - | 5 | 5 | 3 |
| | | 224BC5M04 | Major XI | Front End Development | 3 | 2 | 5 | 4 |
| | Core Electives | 224BC5M05 | Elective 1 | A] Computer Organization and Architecture | 5 | - | 5 | 5 |
| | | 224BC5M06 | | B] Dot Net Framework | 3 | 2 | | |
| | | 224BC5M07 | | C] Android Mobile Application Development | 3 | 2 | | |
| | | 224BC5M08 | Elective 2 | A] Text Analytics | 5 | - | 5 | 5 |
| | | 224BC5M09 | | B] Data analytics with SPSS | 3 | 2 | | |
| | | 224BC5M10 | | C] Big Data Analytics | 3 | 2 | | |
| VI | Core Papers | 224BC6M01 | Major XII | Computer Networks | 5 | - | 5 | 5 |
| | | 224BC6M02 | Major XIII | Cloud Computing – Software development and deployment | 3 | 2 | 5 | 5 |
| | | 224BC6M03 | Major XIV | Data Analytics with R Laboratory | - | 5 | 5 | 3 |
| | | 224BC6M04 | Major XV | Project Work * | - | 10 | 10 | 5 |
| | Core Elective | 224BC6M05 | Elective 3 | A] Software Testing | 5 | - | 5 | 5 |
| | | 224BC6M06 | | B] IoT and Stream Handling | 5 | - | | |
| | | 224BC6M07 | | C] Block chain Technology | 5 | - | | |
| Extension Activities – NCC/NSS/ Sports | | | | | | | | 1 |
| Total Credits | | | | | | | | 140 |

L – Lecture / P – Practical / T – Total Hours / C – Credit * Credits earned through Internship added

**This syllabus aligns with 75% of TANSCHE Syllabus**

## 9. Syllabus Contents and References

The syllabus contents with course objectives, course outcomes, cognitive levels of learning, course contents and references are as follows.

# SEMESTER - I

**Semester – 1 (General Course)** **Subject Code:224BC1G01**

## WEB DESIGNING USING HTML AND CSS

**Credit: 2** **Total Hours: 60** **Hours Per Cycle: 4**

### Course Objectives

- To develop skills in analyzing the usability of a web site.
- To provide a standard way to define, apply, and manage sets of style characteristics.
- To design and create web sites.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Learn and remember the terms and structure of HTML | K1 |
| CO-2 | Understand how to design a web page with tables, lists and stylesheets. | K2 |
| CO-3 | Design a simple web page | K3 |
| CO-4 | Compare with available web sites and improvise the design | K4, K5 |
| CO-5 | Creating webpages with HTML and CSS elements | K6 |

**UNIT I** **(10 Hours)**

**Introduction to the Internet**: Networking, Internet, www, Internet technologies: Modem, internet addressing. Protocol: FTP, HTTP, TCP/IP. Electronic Mail: POP3, SMTP.

**UNIT II** **(10 Hours)**

**Introduction to HTML**: History to HTML, HTML generations, HTML documents, anchor tag, hyperlinks, Heading, Title. Links, colorful web pages, comment lines. Designing the body section: heading printing, aligning the heading, horizontal rule, paragraph, images & pictures.

**UNIT III** **(10 Hours)**

**Order and unordered list**: Lists, Unordered list, headings in a list, ordered list, nested list. Table Handling: Tables, Table creation in HTML, width of the table's cells, Cell spanning multiple rows/columns, coloring cells, column specification.

**UNIT IV** **(15 Hours)**

**Types of style sheets**: Defining styles, elements of styles, linking the style sheet, in-line style, External style sheets, internal style sheets, and inline style sheet.

**UNIT V** **(15 Hours)**

**Frames**: Frameset definition, Frame definition, Nested framesets, Forms: Action attribute, Method attribute, Enctype attribute, drop down list, Textbox, Multiline Textbox, Label, Checkbox, Radio button, Field set

## Text Books


1. Jon Duckett, HTML & CSS: Design and Build Websites, Wrox, 2011.
2. C.Xavier, Www & HTML, McGraw Hill 2014.


## References Books


1. Jennifer Kyrnin and Julie Meloni, Sams Teach Yourself HTML, CSS and JavaScript, Pearson, 2018.
2. Jennifer Niederst Robbins, Learning Web Design, O'Reilly,2012.


## Web References

1. https://www.w3schools.com. html
2. https://www.javatpoint.com/html-tutorial

**Semester – 1 (Major-I)** **Subject Code:224BC1M01**

## PROGRAMMING PRINCIPLES USING C

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

### Course Objectives

- To learn the syntax and functionalities of C Programming and its structure.
- To understand the programming logic and acquire the skills to help the students to develop programs and applications in C Programming.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember the program structure of C with its syntax and semantics | K1 |
| CO-2 | Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files) | K2 |
| CO-3 | Apply the programming principles learnt in real-time problems | K3 |
| CO-4 | Analyze the various methods of solving a problem and choose the best method | K4 |
| CO-5 | Code, debug and test the programs with appropriate test cases | K5, K6 |

**UNIT I** **(15 Hours)**

**Overview of C**: Importance of C, sample C program, C program structure, executing C program. Constants, Variables, and Data Types: Character set, C tokens, keywords and identifiers, constants, variables, data types, declaration of variables, assigning values to variables-Assignment statement, declaring a variable as constant, as volatile. Operators and Expression*:* Arithmetic, Relational, logical, assignment, increment, decrement, conditional, bitwise and special operators, arithmetic expressions, operator precedence, type conversions, mathematical functions. Managing Input and Output Operators*:* Reading and writing a character, formatted input, formatted output.

**UNIT II** **(15 Hours)**

**Decision Making and Branching**: Decision making with If, simple IF, IF ELSE, nested IF ELSE, ELSE IF ladder, switch, and GOTO statement. Decision Making and Looping: While, Do-While, For, Jumps in loops.

**UNIT III** **(15 Hours)**

**Arrays:** Declaration and accessing of one & two-dimensional arrays, initializing two-dimensional arrays, multidimensional arrays. Functions: The form of C functions, return values and types, calling a function, categories of functions, Nested functions, Recursion, functions with arrays, call by value, call by reference, storage classes, String Functions.

**UNIT IV** **(15 Hours)**

**Structures and Unions**: Defining, giving values to members, initialization and comparison of structure variables, arrays of structure, arrays within structures, structures within structures, structures and functions, unions. Preprocessors: Macro substitution, file inclusion.

**UNIT V** **(15 Hours)**

**Pointers:** definition, declaring and initializing pointers, accessing a variable through address and through pointer, pointer expressions, pointer increments and scale factor, pointers and arrays, pointers and functions, pointers and structures.

File Management in C: Opening, closing and I/O operations on files, random access to files, command line arguments.

## Text Book

1. E. Balagurusamy, Programming in ANSI C, 5th Ed, Tata McGraw-Hill, 2011.

## Reference Books


1. Byron Gottfried, Schaum's Outline Programming with C, Third Edition, Tata McGraw-Hill, 2007.
2. Kernighan and Ritchie, The C Programming Language, Second Edition, Prentice Hall, 1998.


## Web References

1. https://www.javatpoint.com/c-programming-language-tutorial
2. https://www.w3schools.in/category/c-tutorial/

**Semester – 1 (Major-II)** **Subject Code: 224BC1M02**

# PROGRAMMING PRINCIPLES USING C LABORATORY

**Credits: 3** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To understand the art of writing programs using C
- To apply all the concepts learnt in C programming in developing programs and applications in C.
- To practice writing codes efficiently.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember and understand how to write programs using the basic principles in C | K1, K2 |
| CO-2 | Apply the concepts of functions, macros, arrays, structures, pointers and files in programs to solve problems | K3 |
| CO-3 | Analyze and understand programs written in C language | K4 |
| CO-4 | Evaluate the program execution flow with test cases and apply debugging | K5 |
| CO-5 | Design algorithm and write programs in C language for the given problems. | K6 |

## List of Practical Exercises

**1. Basic Programming** **(15 Hours)**

1. Programs using variables and datatypes
2. Programs using constants, expressions and operators
3. Programs using Precedence

**2. Decision making and Control structures** **(15 Hours)**

4. Programs using If, For loop, while loop and do-while loops
5. Programs using break and continue
6. Programs using Switch – case statements
7. Programs solving sequences

**3. Arrays, Functions and Strings** **(15 Hours)**

8. Programs using 1-D and 2-D arrays
9. Function with no arguments and no return values
10. Programs using parameter passing (User defined functions)
11. Function using recursion.
12. Program using built-in functions – Math & String

**4. Structures, Unions and Macros** **(15 Hours)**

13. Programs using Structures
14. Programs using arrays in Structures
15. Programs using Pointers in Structures.
16. Program using Macros

**5. Pointers, Files and Command Line arguments** **(15 Hours)**

17. Program using Pointers and arrays
18. Program using Pointers and Functions
19. Programs using Files
20. Programs using Command line argument

**Semester – 1 (Allied-I)** **Subject Code: 224BC1A01**

# MATHEMATICS FOR COMPUTER SCIENCE I – DISCRETE MATHEMATICS

**Credit: 5** **Total Hours: 90** **Hours Per Cycle: 6**

## Course Objectives

- To acquire knowledge and logic about discrete structures, mathematical logic, and graphs.
- To apply the concepts learnt in solving simple mathematical problems.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember and understand the definitions and the concepts of Logic, set theory, relations, functions and graph structures. | K1, K2 |
| CO-2 | Apply the concepts learnt in solving mathematical / computational problems | K3 |
| CO-3 | Analyze counting techniques and acquire the concepts of relations and function or mapping, and apply the knowledge in mathematical problem | K4 |
| CO-4 | Understanding the concepts of matrix theory and applying the solution for computational problem | K5 |
| CO-5 | Develop simple proofs for some standard theorems of concepts of Graph structures | K6 |

**UNIT I** **(20 Hours)**

Logic: Propositions and Truth Values - Logical Connectives and Truth Tables - Tautologies and Contradictions - Logical Equivalence and Logical Implication – Boolean Algebra introduction - Switching Circuits – Logic Networks

**UNIT II** **(15 Hours)**

**Set Theory:** Sets and Membership - Subsets - Operations on Sets - Counting Techniques - The Algebra of Sets - The Cartesian Product

**UNIT III** **(15 Hours)**

**Relations and Functions:** Relations and Their Representations - Properties of Relations - Intersections and Unions of Relations - Equivalence Relations (definition only) - Composite Functions - Injections and Surjections - Bijections and Inverse Functions

**UNIT IV** **(20 Hours)**

**Matrix Algebra**: Introduction - Some Special Matrices - Operations on Matrices - Elementary Matrices - The Inverse of a Matrix - Matrix Inverse Method for systems of linear equations

**UNIT V** **(20 Hours)**

**Graph Theory:** Definitions and Examples - Paths and Cycles - Isomorphism of Graphs – Trees - Planar Graphs - Directed Graphs

## Text Book

1. Rowan Garnier, John Taylor, Discrete Mathematics: Proofs, Structures, and Applications, Third Edition, CRC Press, Year: 2009.
   Unit 1 Sections 1.1- 1.4, 10.1, 10.4, 10.5 , Unit 2 Sections 3.1- 3.5, 3.7, Unit 3 Sections 4.1 – 4.4, 5.1- 5.4, Unit 4 Sections 6.1 – 6.5, 7.2, Unit 5 Sections 11.1 – 11.6

## Reference Books

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 7th Edition
2. Seymour Lipschutz, Marc Lipson, Schaum's Outlines, Discrete Mathematics, III Edition
3. Veerarajan T- Discrete Mathematics, with Graph Theory and Combinatorics - With Graph Theory and Combinatorics, McGraw Hill Publication.

### Web References

1. http://research.engineering.nyu.edu/~greg/discrete/resources.html
2. https://onlinecourses.nptel.ac.in/noc19_cs67/preview
3. https://ocw.mit.edu

# SEMESTER - II

**Semester – 2 (General Course)** **Subject Code: 224BC1G01**

## WEB DESIGNING USING HTML AND CSS

**Credit: 2** **Total Hours: 60** **Hours Per Cycle: 4**

## Course Objectives

- To develop skills in analysing the usability of a web site
- To provide a standard way to define, apply, and manage sets of style characteristics in the websites.
- To create a website with the knowledge gained and apply measures for improvisation.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Learn and remember the terms and structure of HTML | K1 |
| CO-2 | Understand how to design a web page with tables, lists and style sheets. | K2 |
| CO-3 | Design a simple web page | K3 |
| CO-4 | Compare with available web sites and improvise the design | K4, K5 |
| CO-5 | Creating the webpages with HTML and CSS elements | K6 |

**UNIT I** **(10 Hours)**

**Introduction to the Internet**: Networking, Internet, www, Internet technologies: Modem, internet addressing. Protocol: FTP, HTTP, TCP/IP. Electronic Mail: POP3, SMTP.

**UNIT II** **(10 Hours)**

**Introduction to HTML**: History to HTML, HTML generations, HTML documents, anchor tag, hyperlinks, Heading, Title. Links, colorful web pages, comment lines. Designing the body section: heading printing, aligning the heading, horizontal rule, paragraph, images & pictures.

**UNIT III** **(10 Hours)**

**Order and unordered list**: Lists, Unordered list, headings in a list, ordered list, nested list. Table Handling: Tables, Table creation in HTML, width of the table's cells, Cell spanning multiple rows/columns, coloring cells, column specification.

**UNIT IV** **(15 Hours)**

**Types of style sheets**: Defining styles, elements of styles, linking the style sheet, in-line style, External style sheets, internal style sheets, and inline style sheet.

**UNIT V** **(15 Hours)**

**Frames**: Frameset definition, Frame definition, Nested framesets, Forms: Action attribute, Method attribute, Enctype attribute, drop down list, Textbox, Multiline Textbox, Label, Checkbox, Radio button, Field set

## Text Books


1. 1. Jon Duckett, HTML & CSS: Design and Build Websites, Wrox, 2011.
2. C.Xavier, Www and Html, McGraw Hill 2014.


## References Books


1. Jennifer Kyrnin and Julie Meloni, Sams Teach Yourself HTML, CSS and JavaScript, Pearson, 2018.
2. Jennifer Niederst Robbins, Learning Web Design, O'Reilly,2012.


## Web References

1. https://www.w3schools.com › html
2. https://www.javatpoint.com/html-tutorial

**Semester 2 (Major-III)** **Subject Code:224BC2M01**

# DATA STRUCTURES AND ALGORITHMS

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To understand the concepts of data structures to design and analyze algorithms for solving problems
- To impart knowledge about the concepts of data structures and algorithms.
- To train the students to design and analyze linear and non-linear data structures and algorithms.
- To make the students apply suitable data structures and algorithms for solving real-world applications.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | CL |
|---|---|---|
| CO-1 | Remember and understand the basic data structures: lists, stacks, queues, trees and graphs. | K1 |
| CO-2 | Understand the asymptotic analysis of problems, algorithmic techniques and various sorting and searching algorithms. | K2 |
| CO-3 | Apply appropriate data structures and algorithm paradigms in solving real-time problems. | K3 |
| CO-4 | Analyse the efficiency of algorithms in solving the problems. | K4 |
| CO-5 | Code, debug and test the programs using the efficient algorithms and required data structures with appropriate test cases. | K5, K6 |

**UNIT I** **(15 Hours)**

**Problem Solving:** Problem solving phase; program methodologies; algorithms; efficiency of an algorithm; asymptotic notation; algorithmic paradigms – divide and conquer algorithm, greedy algorithm.

**UNIT II** **(15 Hours)**

**Stacks and Queues:** Stacks, representation of stack using arrays; representation of stack using linked lists, Queues - types of queues; representation of linear queues using arrays; representation of linear queues using linked lists.

**UNIT III** **(15 Hours)**

**Linked List:** Introduction; abstract data type; list ADT; basic operations in a singly linked list; basic operations in a doubly linked list

**UNIT IV** **(15 Hours)**

**Sorting and Searching:** Bubble sort; insertion sort; selection sort; quick sort; merge sort; linear search, binary search.

**UNIT V** **(15 Hours)**

**Trees:** Trees - binary trees; representation of binary trees; binary tree traversal; binary search trees. **Graphs** - Graph terminology; Breadth First Traversal; Depth First Traversal.

## Text book

1. J. John Manoj Kumar. P. Sudharsan, Data Structures using C, RBA Publications, Second edition, 2005

## Reference books

1. Horowitz, Ellis, SartajSahni, and S. Rajasekaran. Fundamentals of Computer Algorithm, Galgotia, 1999.
2. Kruse, Robert. L, Bruce B. Leung, and Clovis L. Tondo.Data Structures and Program Design in C.

## Web References

1. https://www.geeksforgeeks.org/data-structures/
2. https://www.javatpoint.com/data-structure-tutorial

**Semester – 2 (Major-IV)** **Subject Code:224BC2M02**

## OBJECT ORIENTED PROGRAMMING USING JAVA LABORATORY

**Credits: 3** **Total Hours: 75** **Hours Per Cycle:5**

### Course Objectives

- To understand the concepts and logics for better programming, based on object-oriented principles.
- To learn OOPS concepts using Java and to apply the suitable data structures algorithms.
- To understand the logic which will help them to create programs, and applications in Java Programming.
- To understand the logic and apply the Java constructs to create programs, and applications in Java.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember and understand the principles of OOPs and execution procedures of Java program in Command prompt and IDE. | K1, K2 |
| CO-2 | Apply the OOPs concept and develop a basic structure of Java program. | K3 |
| CO-3 | Analyze the problem specific requirements and develop java programs. | K4 |
| CO-4 | Evaluate the programs by using extended functionalities. | K5 |
| CO-5 | Create an interactive application using Applets and Event Handling | K6 |

## List of Practical Exercises

**Java Basics** **(20 Hours)**

1. Programs using Control Statements: if, else, nested if, if-else ladders, Switch, while, do-while, for, for-each, break, continue. Wrapper Class.
2. Programs using Single and Multidimensional Array.
3. Programs to use String class, StringBuffer class, Operations on string, Command line argument.

**OOPs Concepts** **(20 Hours)**

4. Programs to use Classes and Objects, constructor, constructor overloading, method overloading, nested class, inner class, anonymous inner class, abstract class.
5. Programs to use Inheritance, constructor in inheritance, method overriding, multilevel inheritance, multilevel constructors.
6. Programs using Polymorphism.
7. Programs to implement interface, interface reference, interface inheritance, interface and abstract class.

**Packages** **(10 Hours)**

8. Programs to use package, classpath, import statement, static import, access control

**Exception Handling** **(10 Hours)**

9. Programs to implement Built in Exception, Custom exception, Throwable Class.

**Multithreaded Programming** **(15 Hours)**

10. Programs to implement Thread class and Runnable interface, thread priority, thread synchronization.

## Reference Books


1. Herbert Schildt, Java: The Complete Reference, McGraw Hill Education, Seventh Edition, 2012.
2. Paul Deitel and Harvey Deitel, Java: How to Program, Prentice Hall, Nineth Edition, 2012
3. Patrick Niemeyer, Daniel Leuck, Learning Java, O'Reilly Media, Fourth Edition, 2013
4. James Gosling et al., The Java Language Specification, Java SE 7 Edition, Oracle America, 2011.
5. Bruce Eckel, Thinking in Java, Prentice Hall, Fourth Edition,
6. Allen B. Downey and Chris Mayfield, Think Java: How to Think Like a Computer Scientist, O'Reilly Media, 2016


**Semester – 2 (Allied-II)** **Subject Code: 224BC2A01**

# MATHEMATICS FOR COMPUTER SCIENCE II – STATISTICAL METHODS

**Credit: 5** **Total Hours: 90** **Hours Per Cycle: 6**

## Course Objectives

- To learn and understand the various statistical methods
- To apply statistical analysis to a sample dataset.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember and understand the definitions and the concepts of measures of central value, correlation, regression and hypothesis test. | K1, k2 |

| | | |
|---|---|---|
| CO-2 | Apply the statistical methods to understand and analyze the data | K3 |
| CO-3 | Perform correlation and regression analysis | K4 |
| CO-4 | Distinguish between the various hypothesis tests and testing of errors | K5 |
| CO-5 | Learn the basics of statistical methods to enable the students to create and develop data science projects | K6 |

**UNIT I** **(18 Hours)**

**Diagrammatic and Graphical Presentation of Data:** Significance of diagrams and graphs – types of bar graphs; types of diagrams – types of bar diagrams – simple bar diagrams, multiple bar diagrams, sub divided bar diagrams; graphs of frequency distributions – histogram, frequency polygon, cumulative frequency curves.

**UNIT II** **(20 Hours)**

**Measures of Central Value:** Objectives of averaging, requisites of good average, types of averages – Arithmetic mean, Median, Mode. Measures of Dispersion: Methods of studying variation – Inter-quartile range or the quartile deviation, mean deviation, standard deviation

**UNIT III** **(20 Hours)**

**Correlation Analysis:** Types of correlation: Karl Pearson's coefficient; properties of coefficient of correlation; rank correlation coefficient. Regression Analysis: Regression lines, regression equations.

**UNIT IV** **(16 Hours)**

Testing of Hypothesis: Statistical Hypothesis – Simple and composite hypothesis, Null and Alternate hypothesis – two kinds of errors, level of significance, size and power of a test.

**UNIT V** **(16 Hours)**

The Analysis of Variance: ANOVA – One way and two way classifications – Analysis of Variance for a one-way layout and a two-way layout.

## Text Book

1. S.P.Gupta, Statistical Methods, Sultan Chand & Sons, Forty third edition, 2014.

## Reference Books

1. S.C.Gupta and V.K.Kapoor, Fundamentals of Mathematical Statistics, Sultan & Chand & Sons, New Delhi, Eleventh Edition, 2002.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Co, Third Edition, 2007.

## Web References

1. https://onlinecourses.swayam2.ac.in/cec21_mg18/preview
2. https://onlinecourses.nptel.ac.in/noc20_ma19/preview
3. https://nptel.ac.in/courses/110107114

# SEMESTER - III

**Semester-3 (Interdisciplinary)** **Subject Code: 224BC3I01**

# DIGITAL MARKETING WITH ANALYTICS

**Credit: 3** **Total Hours: 60** **Hours Per Cycle: 4**

## Course Objectives

- To impart basic knowledge on Digital Marketing like planning, developing and marketing a website, Search Engine Optimization (SEO), Social Media Marketing (SMM) and Customer Relationship Management (CRM).
- To teach students the usage of various metrics to analyse and improve websites.
- To facilitate the students to develop a website, market it with the knowledge gained, apply the contact strategy, analyse and improve it.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Ascertain the concepts of digital marketing and its analytics. | K1 |
| CO-2 | Understand how to develop a website and its marketing strategies. | K2 |
| CO-3 | Produce a well-thought-through contact strategy in the website. | K3 |
| CO-4 | Analyze the website developed with metrics and measures for improvement. | K4 |
| CO-5 | Develop a website, market it using the marketing strategies, determine the contact strategy, and find ways of improving it using performance metrics. | K5, K6 |

**UNIT I** **(10 Hours)**

Digital Marketing strategies – The 4 Ps of marketing - Understanding the digital consumer and defining the target group – Planning process: Vision-based planning, Real-time planning – Phased approach – Goals, objectives and strategies – Action plans – Budgeting and forecasting - Creating Web Sites – Case study: Development of a sample website

**UNIT II** **(10 Hours)**

Search engines and their types – Local and global search engines - Essential tools – Strategies – Usage of SEO for different search engines – Technical SEO - Content writing – Content marketing strategies – Paid Search – Campaign setup measurement and optimization – Programmatic Advertising - Case study: Optimize the searches of the website created

**UNIT III** **(10 Hours)**

Different forms of social media – Challenges and opportunities of digital social media - Collecting and extracting social media data - Adding social media to the website – Designing strategic online messages – Social media campaign planning and management - Google AdWords - Making a Facebook page - Key metrics used for analysing social media - Social media analytics and tools – Case study: Marketing the website created

**UNIT IV** **(15 Hours)**

Spectrum of web analytics – Software platforms supporting web analytics – Web analytics process – Calculating web metrics and improvement – Case study: Analyze the website for improvement

**UNIT V** **(15 Hours)**

CRM and retention – Contact strategy - Cross-selling and up-selling - Predictive analytics - CRM systems - Social CRM (SCRM) - Loyalty – Case study: To produce a well-thought-through contact strategy in the website

## Text Books


1. Kevin Hartman, Digital Marketing Analytics, In Theory and In Practice, 2nd Ed, Ostmen Bennettsbridge Publishing Services, 2020
2. Marshall Sponder, Gohar F, Khan, Digital Analytics for Marketing, Routledge, Taylor & Francis, 2018

## Reference Books


1. Simon Kingsnorth, Digital Marketing Strategy An Integrated Approach to Online Marketing, Kogan Page Ltd., 2016
2. Chuck Hemann, Ken Burbary, Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World, Que Publications, 2013
3. Dave Chaffey, Fiona Ellis-Chadwick, Digital Marketing, 7th Ed, Pearson, 2019


## Web References

1. https://www.javatpoint.com/digital-marketing
2. https://www.tutorialspoint.com/amazon_marketplace/index.htm

**Semester - 3 (Major-V)** **Subject Code:224BC3M0**

# DATA MINING

**Credits: 5** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To understand the data and to extract information (with intelligent methods) from a data set and transform the information into a comprehensible structure for further analysis.
- To train the students to understand data mining principles and techniques.
- To study algorithms for finding the hidden interesting patterns in data.
- To learn various Data Mining techniques such as classification, clustering and Association rule mining.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember and understand the various preprocessing techniques of data and the data mining techniques | K1, K2 |
| CO-2 | Apply the classification, clustering and association techniques for various real-life problems | K3 |
| CO-3 | Distinguish between the various classification and clustering methods | K4 |
| CO-4 | Compare the performance of various mining techniques on complex data objects | K5 |
| CO-5 | Design classification, clustering and association rule mining techniques for complex real-time problems | K6 |

**UNIT I** **(15 Hours)**

**Data Mining, Data** : Kinds of data mined – kinds of patterns mined – technologies used – data mining applications – major issues in data mining Data : Data Objects and Attribute Types - Basic Statistical Descriptions of Data - Data Visualization - Measuring Data Similarity and Dissimilarity.

**UNIT II** **(15 Hours)**

**Data Preprocessing:** Knowledge Discovery in Databases – Major tasks in Data Preprocessing – Data Cleaning – Data Integration – Data Reduction - Data Transformation – Data Discretization

**UNIT III** **(15 Hours)**

**Classification and Prediction**: Classification vs Prediction – Data preparation for Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification - Classification by Back propagation. Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor

**UNIT IV** **(15 Hours)**

**Clustering:** Cluster Analysis - Types of data in cluster analysis – Distance measures - Clustering methods: Partitioning, Hierarchical, Density-based, Grid-based and Model-based clustering methods. Clustering high-dimensional data.

**UNIT V** **(15 Hours)**

**Association Rule Mining:** Types of data in Association Rule Mining - Frequent item sets and association rules – Frequent itemset generation – Apriori algorithm. Association rule generation - Mining various kinds of association rules – multi-level, multi-dimensional, quantitative.

## Text book

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2011.

## Reference Books

1. K.P. Soman, Shyam Diwakar and V. Ajay, “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
2. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Pearson Education, 2007.

## Web References

1. https://www.javatpoint.com/data-mining
2. https://www.tutorialspoint.com/data_mining/index.htm

**Semester – 3 (Major-VI)** **Subject Code: 224BC3M02**

# DATABASE MANAGEMENT SYSTEMS LABORATORY

**Credit: 3** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To gain knowledge in database systems and database management systems software.
- To understand database design, normalization and querying in databases.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to | Cognitive Level |
|---|---|---|
| CO-1 | Be acquainted with the basics of database designing, transaction processing and concurrency control. | K1 |
| CO-2 | Identify and explain the database storage structures, normalization theory and access techniques. | K2 |
| CO-3 | Demonstrate normalization of a database, querying and updating the database using SQL and GUI based applications | K3 |
| CO-4 | Analyse the database design and results from querying the database and improvise the effectiveness | K4 |
| CO-5 | Model and evaluate data in applications using conceptual modelling tools and design database schemas | K5, K6 |

### List of Practical Exercises

1. Create a set of database tables, add constraints (primary key, unique, check, Not null, foreign key constraints) and incorporate referential integrity.
2. Insert rows, update and delete rows using SQL DDL and DML commands.
3. Query the database tables using different ‘where’ clause conditions and also implement aggregate functions.
4. Query the database tables and explore sub queries and simple join operations.
5. Write User defined functions and stored procedures in SQL.
6. Execute complex transactions and realize DCL and TCL commands.

7. Write SQL Triggers for insert, delete, and update operations in database table.
8. Create View and index for database tables with large number of records.
9. Create Document, column and graph-based data using NOSQL database tools.

10. Develop a simple GUI based database application and incorporate all the above-mentioned features.

### Reference Books


1. James Groff, Paul Weinberg, Andy Oppel, "SQL The Complete Reference", 3rd Edition, 2017.
2. "IBM i: Database SQL programming", IBM Corp., 2010.
3. Ryan Stephens, Ron Plew, Arie D. JonesSams, "Teach Yourself SQL in 24 Hours", 5th Edition, 2011.
4. Donald J bales, "Beginning Oracle PL-SQL", 2nd Edition, 2015.


**Semester – 3 (Allied-III)** **Subject Code:224BC3A01**

## STATISTICS FOR COMPUTER SCIENCE I – DATA TRANSFORMATION WITH SPREADSHEETS AND WRANGLING WITH SQL

**Credit: 5** **Total Hours: 90** **Hours Per Cycle:6**

### Course Objectives

- To understand data transformation using excel and wrangling with SQL
- To understand how to apply functions and statistical measures in Excel sheets.
- To create visualized elements for sample data using excel.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Define and describe the various statistical measures. | K1 |
| CO-2 | Understand the basic structure, functions and visualizations in MS Excel, SQL database and queries | K2 |
| CO-3 | Apply functions and statistical measures in Excel and generate charts and graphs | K3 |
| CO-4 | Analyse and infer from the Excel results. | K4 |
| CO-5 | Perform syntactic and semantic analysis in the functions and statistical measures. | K5 |
| CO-6 | Design and develop a problem with sample data (using SQL database) to perform the statistical analysis using Excel and generate visualized reports. | K6 |

**UNIT I** **(15 Hours)**

**Introduction to MS Excel:** Structure of an excel function- Using Excel Shortcuts - Copy, Cut, Paste, Hide, Unhide, and Link the Data in Rows, Columns and Sheet - Using Paste Special Options - Formatting Cells, Rows, Columns and Sheets - Protecting & Unprotecting Cells, Rows, Columns and Sheets with or without Password - Page Layout and Printer Properties

**UNIT II** **(20 Hours)**

**Functions**: Logical Functions - Date and Time Functions - Information Functions -Math and Trigonometry Functions - Statistical Functions - Text Functions -Using Excel's VLOOKUP, HLOOKUP, INDEX and MATCH Functions. Excel's Text Based Functions: Using Excel's functions such as LEFT(), RIGHT() and MID(), LEN(), SEARCH(), CONCATENATE().- Data Sorting and Filtering - Pivot Tables - Chart Templates – Adding Add-Ins in Excel - Solver – Goal Seek.

**UNIT III** **(15 Hours)**

**Charts:** Simple Bar Chart – Multiple Bar Chart – Subdivided Bar Chart – Pie Chart – Donut Chart - Line Chart – Histogram – Scatter Plot – Plotting Density Function and Distribution Function

**UNIT IV** **(20 Hours)**

**Statistical measures**: Mean, Variance, Percentiles, Quantiles - Pearson correlation – Spearman's Rank correlation – Parametric tests – test for single population mean, equality of mean for two independent sample, paired t test, testing correlation coefficient, Non parametric tests – Mann Whitney U test, Wilcoxon signed rank test – Kruskall Wallis test – One way ANOVA – Simple and Multiple Linear regression.

**UNIT V** **(20 Hours)**

**SQL:** SQL data definition and data types, commands, specifying constraints in SQL, schema change statements, Basic queries, Complex queries: Comparison involving NULL and Three-valued logic, Nested queries, renaming of attributes and joining of tables, Aggregate functions, Grouping- Managing views.

## Text Books


1. Alexander, Kusleika, & Walkerbach ; Excel 2019 Bible;Wiley,2018 - Unit I: Chapter 1,2,3,4,5,6,7 and Unit II: Chapter 9,10,12,13,14,29,30 and Unit III: Chapter 20 and 21
2. Microsoft Excel Functions & Formulas by Bernd Held - Unit IV
3. Ramez Elmasri and Shamkant B. Navathe - Database Systems, Seventh Edition, Pearson Education - Unit V: Chapter 6 and 7


## Reference Books


1. Winston, W. (2011). Microsoft Excel 2010 Data Analysis and Business Modeling: Data Analysis and Business Modeling. Pearson Education.

2. Melton, J., & Simon, A. R. (1993). Understanding the new SQL: a complete guide. Morgan Kaufmann.

## Web References

1. https://support.microsoft.com/
2. https://mode.com/sql-tutorial/

# SEMESTER - IV

**Semester-4 (Interdisciplinary)** **Subject Code: 224BC3I01**

# DIGITAL MARKETING WITH ANALYTICS

**Credit: 3** **Total Hours: 60** **Hours Per Cycle: 4**

## Course Objectives

- To impart basic knowledge on Digital Marketing like planning, developing and marketing a website, Search Engine Optimization (SEO), Social Media Marketing (SMM) and Customer Relationship Management (CRM).
- To teach students the usage of various metrics to analyse and improve websites.
- To facilitate the students to develop a website, market it with the knowledge gained, apply the contact strategy, analyse and improve it.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Ascertain the concepts of digital marketing and its analytics. | K1 |
| CO-2 | Understand how to develop a website and its marketing strategies. | K2 |
| CO-3 | Produce a well-thought-through contact strategy in the website. | K3 |
| CO-4 | Analyze the website developed with metrics and measures for improvement. | K4 |
| CO-5 | Develop a website, market it using the marketing strategies, determine the contact strategy, and find ways of improving it using performance metrics. | K5, K6 |

**UNIT I** **(10 Hours)**

Digital Marketing strategies – The 4 Ps of marketing - Understanding the digital consumer and defining the target group – Planning process: Vision-based planning, Real-time

planning – Phased approach – Goals, objectives and strategies – Action plans – Budgeting and forecasting - Creating Web Sites – Case study: Development of a sample website

**UNIT II** **(10 Hours)**

Search engines and their types – Local and global search engines - Essential tools – Strategies – Usage of SEO for different search engines – Technical SEO - Content writing – Content marketing strategies – Paid Search – Campaign setup measurement and optimization – Programmatic Advertising - Case study: Optimize the searches of the website created

**UNIT III** **(10 Hours)**

Different forms of social media – Challenges and opportunities of digital social media - Collecting and extracting social media data - Adding social media to the website – Designing strategic online messages – Social media campaign planning and management - Google AdWords - Making a Facebook page - Key metrics used for analyzing social media - Social media analytics and tools – Case study: Marketing the website created

**UNIT IV** **(15 Hours)**

Spectrum of web analytics – Software platforms supporting web analytics – Web analytics process – Calculating web metrics and improvement – Case study: Analyze the website for improvement

**UNIT V** **(15 Hours)**

CRM and retention – Contact strategy - Cross-selling and up-selling - Predictive analytics - CRM systems - Social CRM (SCRM) - Loyalty – Case study: To produce a well-thought-through contact strategy in the website

## Text Books

1. Kevin Hartman, Digital Marketing Analytics, In Theory and In Practice, 2nd Ed, Ostmen Bennettsbridge Publishing Services, 2020

2. Marshall Sponder, Gohar F, Khan, Digital Analytics for Marketing, Routledge, Taylor & Francis, 2018

### Reference Books

1. Simon Kingsnorth, Digital Marketing Strategy An Integrated Approach to Online Marketing, Kogan Page Ltd., 2016
2. Chuck Hemann, Ken Burbary, Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World, Que Publications, 2013
3. Dave Chaffey, Fiona Ellis-Chadwick, Digital Marketing, 7th Ed, Pearson, 2019

### Web References

1. https://www.javatpoint.com/digital-marketing
2. https://www.tutorialspoint.com/amazon_marketplace/index.htm

**Semester – 4 (Major-VII)** **Subject Code: 224BC4M01**

## OPERATING SYSTEMS

**Credit: 4** **Total Hours: 75** **Hours Per Cycle:5**

### Course Objectives

- To understand the basic concepts and functions of operating system
- To teach the structure, storage and processes using which an Operating System of a computer works
- To train the students to apply the concepts through system programming tutorials

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Define the fundamentals of OS and identify the concepts relevant to process, process life cycle, Scheduling Algorithms, Deadlock and Memory management | K1 |
| CO-2 | Explain the critical analysis of process, interpret the types of Process Scheduling, identify the threads and semaphores | K2 |
| CO-3 | Demonstrate the impact of Deadlock over OS and categorize measures to retrieve from deadlock. Prioritize the scheduling algorithms and discriminate between the real and virtual memory. | K3, K4 |
| CO-4 | Evaluate various Algorithms and appraise the performance of OS. | K5 |
| CO-5 | Anticipate the importance of process synchronization and formulate Memory organization and management | K6 |

**UNIT I** **(15 Hours)**

**Introduction**: operating system, history (1990s to 2000 and beyond), Process concepts: definition of process, process states-Life cycle of a process, process management- process state transitions, process control block(PCB), process operations , suspend and resume, context switching, Interrupts -Interrupt processing, interrupt classes, Inter process communication-signals, message passing. Programs: Process Control Running UNIX Commands from C using system().

**UNIT II** **(15 Hours)**

**Asynchronous concurrent processes:** mutual exclusion- critical section, mutual exclusion primitives, implementing mutual exclusion primitives, software solutions to the mutual Exclusion Problem-, Dekkers algorithm, n-thread mutual exclusion- Lamports Bakery Algorithm. Semaphores – Mutual exclusion with Semaphores, thread synchronization with semaphores, counting semaphores, implementing semaphores. Programs: Semaphores

**UNIT III** **(15 Hours)**

**Deadlock and indefinite postponement:** Resource concepts, four necessary conditions for deadlock, deadlock prevention, deadlock avoidance and Dijkstra's Banker's algorithm, deadlock detection, deadlock recovery. Programs: Interrupts and Signal Handling

**UNIT IV** **(15 Hours)**

Processor scheduling: scheduling levels, preemptive vs non-preemptive scheduling, scheduling objectives, scheduling criteria, scheduling algorithms -FIFO scheduling, RR scheduling, SJF scheduling, HRRN scheduling, SRT scheduling, multilevel feedback queues, Fair share scheduling.

**Programs:** Processor Scheduling -Round Robin

**UNIT V** **(15 Hours)**

R**eal memory organization and management**: Memory organization, Memory management, Memory hierarchy, Memory management strategies, contiguous vs non-contiguous memory allocation, single user contiguous memory allocation, fixed partition multiprogramming, variable partition multiprogramming. Virtual memory organization: virtual memory basic concepts, block mapping, paging address translation by direct mapping, associative mapping and with direct/associative mapping.

## Text Book

1. H.M. Deitel, Paul J. Dietel, David R Choffnes Operating Systems, Third Edition, Pearson Education Asia, 2012.

## Reference Books

1. William Stallings, Operating System: Internals and Design Principles, Fifth Edition, Prentice-Hall of India, 2005.
2. Silberschatz, and P.B. Galvin., Operating Systems Concepts, Fifth Edition, John Wiley &Sons (ASIA) Pvt Ltd, 2012.

## Web References

1. https://www.tutorialspoint.com/operating_system
2. https://www.geeksforgeeks.org/operating-systems/

**Semester – 4 (Major-VIII)** **Subject Code: 224BC4M02**

# PROGRAMMING USING PYTHON LABORATORY

**Credit: 3** **Total Hours: 75** **Hours Per Cycle:5**

## Course Objectives

- To acquire programming skills in core Python
- To have hands-on experience with problem solving using Python, to perform simple Statistical analysis and to solve analytical problems in real-world scenarios.
- Acquire programming skills in core Python.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember and understand the program structure of Python syntax and semantics, Statistical analysis and Data Visualization. | K1, K2 |
| CO-2 | Learn Python Environment set up and apply programming concepts to solve problem using Python | K3 |
| CO-3 | Analyze the data using Python | K4 |
| CO-4 | Evaluate the program with test cases and apply debugging | K5 |
| CO-5 | Design an application to solve analytical problems in real-world scenarios | K6 |

## List of Practical Exercises

Establishing a Python environment for Data Analysis using ANACONDA NAVIGATOR

**Basic Python** **(15 Hours)**

1. Programs using If, Loops, For loop ,while loop
2. Programs using Strings , Lists ,Tuples
3. Programs using Dictionary, Function , File Handling
4. Programs using Command Line Arguments and Exception Handling

**OOP Concept** **(10 Hours)**

5. Programs using Class and object Attributes,
6. Programs using Inheritance, Overloading and Overriding,
7. Programs using Data hiding and Polymorphism.

**Database** **(15 Hours)**

8. Programs to use Connections and executing queries
9. Programs to use Transactions, and Handling error.

**Data Analytics Using Python** **(15 Hours)**

10. Programs to demonstrate essential Python Packages for Data Analysis: NumPy Matplotlib and Pandas
11. Programs to demonstrate importing and exporting datasets in Python

**Data Processing** **(20 Hours)**

12. Data Operations, Data Cleansing-Identify and Handle Missing Values and Data Formatting
13. Data Frame Manipulation using Pandas**:** Descriptive Statistics, Correlation and Regression
14. Data Visualization: Basic plotting with Matplotlib, Line plots, Histograms, Bar charts, Box plots and Pie charts

15. Analyze data using Python

## Reference Books


1. Bill Lubanovic, Introducing Python, Sixth Indian Reprint, O'Reilly, 2019.
2. Katie Cunningham, Sams Teach Yourself in 24 Hours Introducing Python, Second Edition, Pearson, 2014
3. Fabio Nelli, *Python Data Analytics with Pandas, Numpy, and Matplotlib*, Second Edition, Apress, 2018.
4. Sedgewick and Wayne,Dondero, *Introduction to Programming in Python*, Third Edition, Pearson Education, 2016
5. Mark Lutz, *Learning Python: Powerful Object Oriented Programming*, Fourth Edition, O,Reilly Media, 2013
6. Kenneth A. Lambert, *Fundamentals of Python: First Programs*, CENGAGE Learning, 2012.


**Semester – 4 (Allied - IV)** **Subject Code: 224BC4A01**

# STATISTICS FOR COMPUTER SCIENCE II – DATA VISUALIZATION

**Credit: 5** **Total Hours: 90** **Hours Per Cycle:6**

## Course Objectives

- To learn data visualization and visualization analytics.
- to develop computational and visualization skills using Tableau

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|

| | | |
|---|---|---|
| CO-1 | Learn the basic concepts of data visualization and visualization analytics. | K1 |
| CO-2 | Understand the basic formation of Tableau and building charts with it. | K2 |
| CO-3 | illustrate the blending of different data sources in a single worksheet and visualize the data using heatmaps and charts with Tableau, | K3 |
| CO-4 | analyse the inference from the visualization | K4 |
| CO-5 | Create the calculations and parameters and customize the data based on the parameters. | K5, K6 |

**UNIT I** **(20 Hours)**

**Introduction to Tableau**: Starting Tableau- Connecting to Data- Generated values- Joining database tables- Blending Different Data sources in a Single Worksheet- Filtering data.

**UNIT II** **(20 Hours)**

**Visualizing data**: Using Shelves and Cards- The Columns shell- The Rows shell- The Filters shell- Pages shell- Marks card- Modifying the view- Fitting the space- Adding annotations- Adding mark labels.

**UNIT III** **(15 Hours)**

**Chart types**- text tables- Maps- Heat maps- Highlight tables- Tree maps- Bar chart- Stacked bar- side-by- side bar- Line charts- Area charts- Pie charts- Scatter plot- Histogram – Gantt charts.

**UNIT IV** **(15 Hours)**

**Advanced Visual Analytics**: Calculations- Parameters- Totals- Reference lines, bands, distribution and boxes- Trend lines- Forecasting.

**UNIT V** **(20 Hours)**

**Calculated fields**- Table calculations- Creating Calculations and Parameters- Creating calculated fields- Creating table calculations and percentages- Creating parameters- Customizing data with Parameters- Data Types- Functions- Operators.

## Text Books

1. Daniel. G. Murray, Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software, Unit I: Chapter 2,
2. Molly Monsey and PavolSocháň, Tableau for Dummies, Unit II: Chapter 6, Unit III: Chapter 8, Unit IV: Chapter 14, Unit V: Chapter 15 and 16

## Reference Book

1. Milligan, J. N. (2016). Learning Tableau 10. Packt Publishing Ltd.

## Web References

1. https://www.analyticsvidhya.com/
2. https://www.datacamp.com/

# SEMESTER - V

**Semester – 5 (General Elective)** **Subject Code: 224BC5L01**

# INFORMATION SECURITY AND DIGITAL FORENSICS

**Credit: 3** **Total Hours: 60** **Hours Per Cycle: 4**

## Course Objectives

- To understand the threats in networks, fundamentals of cyber-crime and the need information security..
- To identify, collect, preserve, and analyze data in a way that preserves the integrity of the evidence collected.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Understand the fundamentals of cyber-crime, the need for information security and the legal perspectives | K1, K2 |
| CO-2 | Analyze and validate offenses and crime issues in wireless and mobile medium | K3 |
| CO-3 | Apply the tools and methods associated in security mechanisms in present-day situation | K4 |
| CO-4 | Compute the forensic evidences and assess the concepts to manage Forensic Data | K5 |
| CO-5 | Build a security- focused domain ensuring end-point protection | K6 |

**UNIT I** **(10 Hours)**

**Introduction**: Definitions and origin of the word - cybercrime and information security - who are Cyber criminals? - Classifications of Cybercrime. Cybercrime - the legal and Indian perspectives

**UNIT II** **(10 Hours)**

**Cyber Offenses:** Introduction - How criminals plan the attacks? - Cyberstalking - Botnuts, the fuel for Cybercrime. Proliferation of Mobile and Wireless devices - trends in mobility-credit card frauds in mobile and wireless computing era - attacks on mobile/cell phones - Mobile devices, security implications for Organizations.

**UNIT III** **(10 Hours)**

**Tools and Methods**: Introduction - Proxy servers and anonymizers - Phishing - Password cracking- keyloggers and spywares - virus and worms - Trojan Horses and Backdoors - Dos and DDOs attacks - Attacks on wireless Networks.

**UNIT IV** **(15 Hours)**

**Understanding Computer Forensics:** Introduction - historical background of digital forensics, digital forensics science, the need for Computer forensics –forensics and digital evidence - digital forensic life cycle.

**UNIT V** **(15 Hours)**

**Illustrations, Examples and Mini-cases:** Introduction - Real life examples - illustrations of financial frauds in cyber domain - digital signature related crime scenarios - Online scams. **Careers in Security:** Career paths - certifications.

## Text Book

1. Sunit Belapure and Nina Godbole, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley India Pvt, Chapters 1 - 4 , 7 - 8 and 11.

## Reference Books

1. Robert M Slade,” Software Forensics”, Tata McGraw – Hill, New Delhi
2. Nelson Phillips and Enfinger Steuart, “Computer Forensics and Investigations”, Cengage Learning, New Delhi

## Web References

1. https://www.javatpoint.com/cyber-security-tutorial
2. https://www.w3schools.com/cybersecurity/index.php

**Semester – 5 (Skill Based Training)** **Subject Code: 224BC5M01**

# EMPLOYABILITY SKILLS THROUGH LANGUAGE AND DIGITAL PLATFORM

**Credit: 3** **Total Hours: 30** **Hours Per Cycle: 2**

## Course Objectives

- To enhance effective and ethical human communication with creativity, critical thinking and problem-solving skills.
- To learn about installing, creating and publishing websites

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Learn strong practical orientation in building and improving their skills in communication | K1, K2 |
| CO-2 | Design their resume to capture the attention of an employer by highlighting their most related experience and skills | K3 |
| CO-3 | Have proper Body language and Etiquette, Group discussion skills, Interview skills, Presentation skills | K4 |
| CO-4 | Learn how to install, setup and publish websites using the core functionality of the WordPress platform by comparing websites | K5 |
| CO-5 | Create beautiful, functional WordPress-powered sites with minimal hassle. | K6 |

**UNIT I** **(6 Hours)**

**Effective Communication:** Developing fluency in English - families of words - improvement of vocabulary

**UNIT II** **(6 Hours)**

CVs, Resumes and Profiles: CV and Resumes - Effective Resume preparation - details in CV and resume preparation - personal profiles

**UNIT III** **(6 Hours)**

**Effectively facing Interviews and Group Discussions:** kinds of interview - preparation for interviews - effective participation in Group discussions.

**UNIT IV** **(6 Hours)**

**Content Management System**: Getting Familiar with WordPress - Installation of WordPress.org - a Quick Tour of WordPress.org Dashboard building -building A Website (open source version) - posts, pages, widgets, menus and plugins.

**UNIT V** **(6 Hours)**

**Advanced Theme Development:** Anatomy of a WordPress theme - building a theme from scratch - working with template files and tags - custom content types - One installation, multiple blogs.

## Text Books


1. English conversation for Indian Students, Yardi. V.V, New Delhi Orient Black Swan 2002.
2. Communicative English, Suresh Kumar. E and Sree Hari. P, NewDelhi Orient Black Swan 2007.
3. WordPress: Visual Quickstart Guide (2nd Edition) by Matt Beck, Jessica Neuman Beck

## Reference Books


1. Business Communication: Basic concepts and skills, Parikh J. P, et. al., NewDelhi Orient Black Swan 2002
2. Wordpress Complete, Sixth Edition: A comprehensive guide to WordPress development from scratch, Karol krol, Pact.com, 2017


## Web References

1. https://wordpress.org/download/
2. https://www.mindtools.com/

**Semester – 5 (Major- IX)** **Subject Code: 224BC5M02**

# SOFTWARE ENGINEERING

**Credit: 4** **Total Hours: 60** **Hours Per Cycle: 4**

## Course Objectives

- To understand the software engineering concepts and to create a system model in real life applications
- To understand and perform testing at various levels.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Acquire basic knowledge of analysis and design of systems | K1 |
| CO-2 | Recollect all software engineering principles and techniques | K2 |
| CO-3 | Design and model a reliable and cost-effective software system | K3 |
| CO-4 | Compare with all available prototype models and propose an effective model of the system | K4, K5 |
| CO-5 | Perform Testing at various levels and produce an efficient system. | K6 |

**UNIT I** **(12 Hours)**

**Software Development Approaches**: Introduction; The Evolving Role of Software– Software Characteristics– Software Applications– Software: A Crisis on the Horizon?- Software Myths- **Software Engineering**: A Layered Technology– The Software Process– Software Process Models– The Linear Sequential Model– The Prototyping Model- The RAD Model- Evolutionary Software Process Models- Component-Based Development.

**UNIT II** **(12 Hours)**

**Software Quality Assurance** : Quality Concepts– Software Quality Assurance– Software Reviews– Formal Technical Reviews– Formal Approaches to SQA – Statistical Software Quality Assurance– Software Reliability– Software Configuration Management- The SCM Process- Identification of Objects in the Software Configuration- SCM Standards.

**UNIT III** **(12 Hours)**

**System Engineering and Modeling:** Computer-Based Systems– The System Engineering Hierarchy – Business Process Engineering: An Overview– Product Engineering: An Overview– Requirements Engineering– System Modeling– Requirement Analysis- Requirements Elicitation for Software- Software Prototyping- Specification- Specification Review.

**UNIT IV** **(12 Hours)**

**System Analysis and Design**: Data Modeling – Data Flow Diagrams – Behavioral Modeling – The Mechanics of Structured Analysis – The Data Dictionary – Software Design and Software Engineering – The Design Process – Design Principles – Design Concepts – Effective Modular Design – Design Heuristics for effective Modularity – The Design Model – Design Documentation.

**UNIT V** **(12 Hours)**

**Software Testing**: Fundamentals– Test Case Design- White-Box Testing– Basis Path Testing– Control Structure Testing – Black-Box Testing– A Strategic Approach to Software Testing– Unit Testing – Integration Testing– Validation Testing– System Testing.

### Text Book

1. Roger S. Pressman, (2001), "Software Engineering ",Fifth edition, McGraw-Hill Higher Education-A Division of The McGraw-Hill Companies. (UNIT I – V)

### Reference Books

1. Sommerville, Ian,(2008)," Software Engineering", Seventh edition Pearson Education
2. Pankaj Jalote," An Integrated Approach to Software Engineering", Third Edition, Narosa Publications.

### Web References

1. https://www.ece.rutgers.edu/~marsic/books/SE
2. https://www.educba.com/software-development

**Semester – 5 (Major- X)** **Subject Code: 224BC5M03**

## MACHINE LEARNING WITH PYTHON LABORATORY

**Credit: 3** **Total Hours: 75** **Hours Per Cycle: 5**

### Course Objectives

- To provide the basic knowledge on machine learning like supervised learning, unsupervised learning and evaluation metrics and their applications.
- To learn Python and Scikit-learn libraries to handle machine learning algorithms.

- To facilitate the students to apprehend and implement various machine learning algorithms for classification, prediction and clustering using Python and evaluate the developed models.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | ascertain and understand Python and Scikit-learn libraries, concepts of supervised and unsupervised learning | K1, K2 |
| CO-2 | apprehend and implement various machine learning algorithms for classification, prediction and clustering using Python | K3 |
| CO-3 | Analyse the machine learning algorithms to choose efficient models for classification, regression and clustering. | K4 |
| CO-4 | evaluate the developed models of classification, regression and clustering | K5 |
| CO-5 | create effective models using appropriate metrics to test with the real-time data | K6 |

**Case-studies**

**Supervised learning**

1. To depict classification of entities with a sample data using the following libraries, features and classifiers:
   - Use scikit-learn libraries and tools like Jupyter Notebook, NumPy, SciPy, Pandas matplotlib, mglearn, and Tensorflow.
   - Feature extraction
   - Use classifiers like Decision tree, KNN, Naïve Bayes and Random Forest and analyse to find the best classifier.
   - Cross validation
2. To exercise prediction using regression (supervised learning) with a sample data. The case-study should use the following features and regression models:
   - Feature extraction

- KNN regression
- Linear model
- Polynomial regression
- Multiple regression

**Unsupervised learning**

3. To exercise clustering (supervised learning) in a sample data with the following features:
   - Pre-processing and scaling
   - Feature selection using PCA
   - Perform K-means clustering
   - Use evaluation metrics, scoring and improvement

## References


2. Andreas C. Muller, Sarah Guider, Introduction to Machine Learning with Python: A Guide for Data Scientists. O'Reilly, 2016.
2. Manaranjan Pradhan, U Dinesh Kumar, Machine Learning using Python, Wiley Pubn, 2020.
3. Dipanjan Sarkar, Raghav Bali, Tushar Sharma, Practical Machine Learning with Python A Problem-Solver's Guide to Building Real-World Intelligent Systems, Apress, 2018.
4. Mark E Fenner, Machine Learning with Python for Everyone, 2020, Addison Wesley.
5. Raúl Garreta Guillermo Moncecchi, *Learning Scikit-learn: Machine Learning in Python*, 2013, Packt Publication
6. https://www.tutorialspoint.com/machine_learning_with_python/index.htm.
7. https://www.w3schools.com/python/python_ml_getting_started.asp

**Semester – 5 (Major- XI)** **Subject Code: 224BC5M04**

## FRONT END DEVELOPMENT

**Credit: 4** **Total Hours: 75** **Hours Per Cycle: 5**

### Course Objective

- To develop skills in analyzing the usability of a web site and to provide a standard way to define, apply, and manage sets of style characteristics.
- To understand the concepts and architecture of the World Wide Web.
- To understand and practice markup languages, and embedded dynamic scripting on client side Internet Programming
- To understand and exercise web development techniques on client-side

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Learn, understand and recall the concepts and architecture of the World Wide Web | K1, K2 |
| CO-2 | Apply dynamic scripting on client-side Internet Programming and web development techniques on client-side and use markup languages | K3 |
| CO-3 | Analyse the web development techniques, compare with other standard techniques. | K4 |
| CO-4 | Choose the best web development technique by giving room for improvisation | K5 |
| CO-5 | Design using Angular JS and the front-end web page with Web technologies using HTML, CSS, JS and rich client presentation using Angular JS | K6 |

**UNIT I** **(15 Hours)**

**HTML5:** HTML rules – Structure of HTML Document – Basic HTML elements – Attributes – Divisions – Linking: Anchor tag and attributes – HTML table tags - Form Controls - **CSS:** Basic – CSS Style rules – Linking, Embedding and Importing Style Sheets – Inline Styles.

**UNIT II** **(15 Hours)**

**CSS:** CSS Selectors – CSS Constructs – CSS Properties – Positioning - Combinators – CSS Forms: Navigation bar, Dropdown, Check box, Radio buttons – **JAVA SCRIPT:** Embedding JavaScript in HTML – Data Types - Operators and Expressions - Functions - Dialog boxes - alert, confirm and prompt methods.

**UNIT III** **(15 Hours)**

**Advanced JAVA SCRIPT:** Introduction to Regular Expressions: Matching Patterns - Event handling: Form, Windows, Mouse and Keyboard Events - Form processing: Form Validation – **React JS:** Rendering function – React Components, Props and Events – React Forms – Styling React using CSS.

**UNIT IV** **(15 Hours)**

**HTML5:** Basic HTML file, HTML elements, Attributes, Divisions - Linking: Anchor tag and attributes

HTML table tags - Form Controls **CSS:** Basic CSS file - Style rules, Linking, Embedding and Importing Style Sheets Inline Styles, CSS Selectors and Constructs CSS Properties, Positioning and Combinators CSS Forms: Navigation bar, Dropdown, Check box, Radio buttons.

**UNIT V** **(15 Hours)**

**JAVA SCRIPT** using HTML controls: Embedding JavaScript in HTML. Variables, operators, statements, functions. Dialog box - alert, confirm and prompt methods. Form processing: form validation. Event handling: link, document, image, form, mouse and keyboard events. ReactJS Forms and Styling.

### Text Books

1. Thomas A. Powell, HTML: The Complete Reference, Third Edition, Tata McGraw Hill, 2001.
2. Thomas A. Powell, HTML & CSS: The Complete Reference, Fifth Edition, Tata McGraw Hill, 2017.
3. Thomas A.Powell and Fritz Schneider, JavaScript: The Complete Reference, Tata McGraw Hill, 2002.

### Reference Books

1. James Jaworski, Mastering JavaScript, First Edition, BPB Publications, 1999
2. Andrew Grant, Beginning Angular JS, First Edition, Apress, 2014.

### Web References

1. https://www.w3schools.com/html/
2. https://www.javatpoint.com/html-with-css

**Semester – 5 (Core Elective - 1-A)** **Subject Code: 224BC5M05**

## COMPUTER ORGANIZATION AND ARCHITECTURE

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To provide knowledge on overview of computer organization and architecture
- To impart Hardware and software implementation of arithmetic unit to solve addition, subtraction, multiplication and division.
- To instill knowledge of memory technologies, registers, and stack organization

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Understand the theory and architecture of computers and control unit operations such as stack, address instructions, addressing modes and processor | K1, K2 |
| CO-2 | Apply the learnt arithmetic operations and memory management techniques | K3 |
| C0-3 | Analyze the performance of Arithmetic logic unit, memory and CPU | K4 |
| CO-4 | Compare and contrast the features of I/O devices and parallel processors | K5 |
| CO-5 | Build the various algorithms using the principles learnt | K6 |

**UNIT I** **(15 Hours)**

Basic of Computer, Von Neumann Architecture, Generation of Computer, Classification of Computers, Instruction Execution. Register Transfer and Micro operations: Register Transfer, Bus and Memory Transfers, Three-State Bus Buffers, Memory Transfer, Micro-Operations, Register Transfer Micro-Operations, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro- Operations.

**UNIT II** **(15 Hours)**

Stack Organization, Register Stack, Memory Stack, Reverse Polish Notation. Instruction Formats, Three- Address Instructions, Two – Address Instructions, One - Address Instructions, Zero - Address Instructions, RISC Instructions, Addressing Modes. RISC & CISC and their characteristics.

**UNIT III** **(15 Hours)**

Addition And Subtraction With Signed-Magnitude, Multiplication Algorithm, Booth Multiplication Algorithm, Array Multiplier, Division Algorithm, Hardware Algorithm, Divide Overflow, Floating-Point Arithmetic Operations, Decimal Arithmetic Operations, BCD Adder, BCD Subtraction.

**UNIT IV** **(15 Hours)**

Modes Of Transfer, Priority Interrupt, DMA, Input-Output Processor (IOP), CPU-IOP Communication. Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Cache Memory, Virtual Memory, Associative Memory.

**UNIT V** **(15 Hours)**

Control memory – Address sequencing – Design of Control unit. Pipelining: Parallel Processing, Pipelining - Arithmetic Pipeline, Instruction Pipeline. Multiprocessors: Characteristics of Multiprocessors, Interconnection Structure: Time-Shared Common Bus, Multi-Port Memory, Crossbar Switch, Multistage Switching Network, Hypercube Interconnection.

### Text Book

1. "Computer System Architecture", M.Morris Mano , Revised third edition, 2017

### Reference Books

1. "Computer Organization, C. Hamacher, Z. Vranesic, S.Zaky, 5th edition, 2011
2. "Computer Architecture and parallel Processing ", Hwang K. Briggs, 2017

### Web References

1. https://www.javatpoint.com/computer-organization-and-architecture-tutorial
2. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/

**Semester – 5 (Core Elective - 1-B)** **Subject Code: 224BC5M06**

# DOT NET FRAMEWORK

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To develop and understand .NET core with hands on experience and exploration of .NET framework
- To learn a cross-platform framework which accepts multiple coding languages and features large code libraries that make it easy to build applications.

.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember the .Net IDE Component Framework, web concepts and features. | K1 |
| CO-2 | To understand the .NET Framework and its core functionalities that helps in making the application development process easier | K2 |
| CO-3 | Apply the functionalities of framework to develop the windows form with classes and controls | K3 |
| CO-4 | Analyze and evaluate the appropriate classes and events to develop applications using Windows Forms, ADO.NET and ASP.NET | K4, K5 |
| CO-5 | Create applications with strong object-oriented principles using C# | K6 |

**UNIT I** **(15 Hours)**

**Introducing Microsoft .NET:** Microsoft .NET platform, .NET framework and .NET Namespaces, Memory management, Garbage collection. Project and Console application. NET Languages and database.

**UNIT II** **(15 Hours)**

**Common Language Runtime (CLR):** CLR: PE files, Meta data, Assemblies and manifests, Intermediate Language, Common Type System (CTS), Common Language Specification (CLS) and CLR Execution (Class loader, verifier, JIT compilers)

**UNIT III** **(15 Hours)**

**.NET Enterprise Servers, .NET Building block Services. Windows Forms:** Windows Forms .NET classes, Windows controls, Data binding, Developing a windows application using C#. Errors, Testing and Debugging – Optimizing performance – Packaging and Deployment.

**UNIT IV** **(15 Hours)**

**ASP.NET: Web Forms**: ASP.NET over ASP, Main classes in ASP.NET, Web Controls, Web Forms Syntax, Components and life cycle, Developing a simple ASP.NET page.**ADO.NET**: Handling data: Benefits of ADO.NET, ADO.NET Architecture, Main classes in ADO.NET, Developing a Windows/Web application using database

**UNIT V** **(15 Hours)**

**C# basics:** Type System, Boxing and Unboxing, expression, Constants, operators and statements, Classes, Methods. C# Classes, Objects and Object Oriented Features: Method overloading, parameter types, constructors. Access control specifiers, Arrays, Iterators, Structs, Static -static data, static members and static classes, Inheritance, Polymorphism and Interfaces, Namespaces. (Demo Programs)

## Text Books


1. Thuan Thai, .NET Framework, O'Reily publications, 3rd edition, 2009
2. Herbert Schildt, C# 4.0 The Complete Reference, Tata McGraw Hill, 2010


## Reference Books


1. David S Platt, Introducing Microsoft .NET , Microsoft press, 3rd Edition, 2003
2. Deitel & Deitel, C# 2012 for Programmers, Pearson, 2010
3. NIIT, Special Edition Using C#, Pearson Education Asia, 1st Indian Reprint, 2002
4. Tom Archer, Inside C#, Microsoft corporation, Edition 2001, WP Publishers and Distributors, 1st Indian Reprint, 2001
5. Ian Gariffiths, Mathew Adams, Jesse Liberty, ―Programming C# 4.0‖, OReilly, Fourth Edition, 2010.

6. Andrew Troelsen, Pro C# 5.0 and the .NET 4.5 Framework, Apress publication, 2012.

### Web References

1. https://www.javatpoint.com/net-framework
2. https://dotnettutorials.net/lesson/dotnet-framework/

## Semester – 5 (Core Elective - 1-C) Subject Code: 224BC5M07

## ANDROID MOBILE APPLICATION DEVELOPMENT

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

### Course Objectives

- To learn fundamental concepts in Android programming, activities and intents, content providers, and development of android services.
- To learn a cross-platform framework that accepts multiple coding languages and features large code libraries that make it easy to build mobile applications.

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| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Understand the configuration of Android Studio and remember the fundamentals of Android operating systems | K1, K2 |
| CO-2 | Apply the skills of using Android User Interface and Event Handling | K3 |
| CO-3 | Analyze the ability to develop a database application. | K4 |
| CO-4 | Implement Services and Multimedia. | K5 |
| CO-5 | Build and deploy Android application | K6 |

## UNIT I (15 Hours)

**Introduction:** Mobile Application – Characteristics and Benefits – Application Model, **Android Introduction**: Android Features, Architecture, Application Components-Android Development Environment: IDE for Mobile Development, Android Development Tools: Android Virtual Device Manager, Android Sdk, Emulator, DDMS, Building a simple Android application.

## UNIT II (15 Hours)

**User Interface:** Resources, Activities- Activity Life Cycle, Android UI Widgets, Menu - Styles and Theme -**Intents:** Linking Activities with Intent, Intent Filters- **Layouts:** Linear Layout, Table Layout, Relative Layout-**Views:** List View, Spinner View, Image View, Grid View- **Event Handling**- Fragments -Applications using GUI components.

## UNIT III (15 Hours)

**Dealing with Data:** SQLite Database, Content Values, and Cursors, working with SQLite Databases, **Content Providers**-Data Persistence: Saving and loading user preferences, Sharing Data using Content providers.

## Unit IV (15 Hours)

**Services**: Overview of services in Android, Service lifecycle, communicating with services, -**Multimedia:** Working with Audio and Video.

## UNIT V (15 Hours)

**Application Development:** Graphics and Animation, Telephony, SMS, Notification and Alarms, Location-Based Services - Publishing Android Application.

### Text Book

1. Reto Meier, Professional Android 4 Application Development, Second Edition, Wiley India Edition, 2014.

## References


1. J.F.DiMarzio, Beginning Android Programming with Android Studio, Fourth Edition, Wiley, 2016.
2. John Horton, Android Programming for Beginners, Third Edition, Packt, 2021.
3. Wei-Meng Lee, Beginning Android 4 Application Development, Wiley, 2012.
4. Onur Cinar, Android Apps with Eclipse,Apress, Springer, 2012.


## Web References

1. developer.android.com/training/basics/firstapp/index.html
2. www.tutorialspoint.com/android/index.htm
3. www.javatpoint.com/android-tutorial
4. www.vogella.com/articles/Android/article.html

**Semester – 5 (Core Elective - 2-A)** **Subject Code: 224BC5M08**

# TEXT ANALYTICS

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

**Course Objective**

- To understand the concepts and approaches to Text analytics
- To have awareness on the applications of Text Analytics, its challenges and limitations
- To learn the Text analytics Process, and Python Libraries for Text analytics
- To have applicative knowledge on Conventional to Deep Learning

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Acquire knowledge on basics of Text Analytics and the Tools needed for Text Analytics | K1 |
| CO-2 | Understand the approaches for Text Analytics and the necessary Python Libraries | K2 |
| CO-3 | Apply the knowledge on Text Analytics using Python Libraries – Conventional to Deep Learning | K3 |
| CO-4 | Analyze a Text Analytics problem and apply the concepts to design a solution | K4 |
| CO-5 | Compare the problem with design standards and develop a Python application to a Text Analytics problem | K5, K6 |

**UNIT I** **(15 Hours)**

Definition of Text analytics - Disciplines involved in Text Analytics: Machine Learning, Statistics, Data Mining, and Computational Linguistics – Approaches to Text Analytics: Linguistic, Statistical and Machine Learning - Applications of Text Analytics - Challenges and Limitations in Text Analytics – Tools for Text Analytics

**UNIT II** **(15 Hours)**

Text Mining Vs Text Analytics - Information Retrieval: Document matching, Link Analysis, Search Optimization - Linguistic approach: Linguistic Terms / 'Nyms' - Data Preparation - Data Cleaning – NLP tasks for Text Analytics: Tokenization, Stemming, POS Tagging, , Lemmatization, Word Disambiguation, Chunking, Syntax Parsing, Sentence chaining - Text Categorization – Information extraction: Feature selection, Feature extraction, Named-Entity Recognition

**UNIT III** **(15 Hours)**

Data Mining: Text Clustering - Text Classification - Web Mining – Web content, Web structure and Web usage mining - Data Visualization: Frequency chart, Distribution chart, Word Cloud using Keywords, Word Tree, Word Counts, Document Term Matrix, Frequency of Word Within Topic

**UNIT IV** **(15 Hours)**

Machine Learning approach: Supervised ML algorithms: Support Vector Machines, Bayesian Networks, Maximum Entropy, Conditional Random Field, Neural Networks/Deep Learning – Unsupervised ML algorithms: Clustering, latent Semantic Indexing (LSI), Matrix Factorization

**UNIT V** **(15 Hours)**

Python NLTK programs and Case study in Text Analytics using Python NLTK and ML Libraries: NumPy / SciPy / Scikit-learn / Theano / TensorFlow / Keras / PyTorch / Pandas / Matplotlib

## Text Books


1. Ramesh Sharda, Dursun Delen, Efraim Turban, Analytics, Data Science & Artificial Intelligence – Systems for Decision Support, 2020
2. Srinivasa-Desikan, Bhargav, Natural Language Processing and Computational Linguistics, Packt Publishing, 1st edition, 2018
3. Jens Albrecht, Sidharth Ramachandran, Christian Winkler, Blueprints for Text Analytics Using Python, O'Reilly Media, Inc., 2020


## Reference Books


1. Nitin Hardeniya, Jacob Perkins, Deepti Chopra, Nisheeth Joshi, Iti Mathur, Natural Language Processing: Python and NLTK, Packt Publishing, 2016
2. Miner G, Delen, D, Elder J., Fast A, Hill T, Nisbet B, Practical Text Mining and Statistical Analysis for Non-structured Text Data Applications, Elsevier Inc., 2012
3. Benjamin Bengfort , Rebecca Bilbro , Tony Ojeda, Applied Text Analysis with Python: Enabling Language-Aware Data Products with Machine Learning, O'Reilly Media; 1st edition, 2018
4. Bird, S., Klein, E., & Loper, E, Natural Language Processing with Python, O'Reilly Media, Inc, 2009

5. Steven Bird, Ewan Klein, and Edward Loper Manning, C. D., Raghavan, P., and Schutze, H, Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit, 2008.

**Web References**

1. https://www.javatpoint.com/sentiment-analysis-in-python
2. https://www.javatpoint.com/nlp

**Semester – 5 (Core Elective - 2-B)** **Subject Code: 224BC5M09**

## DATA ANALYTICS WITH SPSS

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

### Course Objectives

- To understand statistical tools and to develop computational skills using SPSS.
- To apply statistical analysis using SPSS in a sample data.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Learn how to handle data using SPSS | K1 |
| CO-2 | Understand the basic structure of SPSS and how it handles descriptive statistics. | K2 |
| CO-3 | Illustrate the working of files with SPSS, handling of data, usage of descriptive statistics and their diagrammatic representation | K3 |
| CO-4 | Interpret the results from the descriptive statistical analysis, analyse the relationship between the variables and test the hypothesis. | K4 |
| CO-5 | Compare the results and summarize the interpretations. | K5 |
| CO-6 | Develop decision making concepts using statistical tool in SPSS | K6 |

**UNIT I** **(15 Hours)**

Getting to Know SPSS: Starting SPSS- SPSS windows – Menus - Dialogue boxes. Working with data file: open SPSS data file – save – import from other data source – data entry – Managing data: labeling for dummy numbers - recode into same variable – recode into different variable – transpose of data – insert variables and cases – merge variables and cases.

**UNIT II** **(15 Hours)**

Data handling: Split – select cases – compute total scores – table looks – Changing column - font style and sizes.

**UNIT III** **(15 Hours)**

Diagrammatic representation: Simple Bar diagram – Multiple bar diagram – Sub-divided Bar diagram - Percentage diagram - Pie Diagram – Frequency Table – Histogram – Scatter diagram – Box plot.

**UNIT IV** **(15 Hours)**

Descriptive Statistics - Mean, Median, Mode, Standard Deviation - Skewness- Kurtosis. Statistical techniques: Explore relationship among variables- Correlation – Karl Pearson's and Spearman's Rank Correlation, Regression analysis: Simple and Multiple Regression Analysis [Enter and stepwise methods].

**UNIT V** **(15 Hours)**

Testing of Hypothesis: Parametric – One sample – Two sample- Independent t – test – Paired t – test. Non – parametric: One sample KS test- Mann-Whitney U test – Wilcoxon Signed Rank test - Kruskal Wallis test – Friedman test- Chi- square test. Analysis of variance: One way and Two way ANOVA.

### Text Book

1. Cunningham, B.J (2012):Using SPSS: An Interactive Hands-on approach Unit I: Chapter 1, 2 and 3, Unit II: Chapter 6 and 7, Unit III: Chapter 8 and 9, Unit IV: Chapter 11, 19, 20 and 21, Unit V: Chapter 12, 13, 14, 15, 16, 17, 24 and 25

### Reference Books

1. Jeremy J. Foster (2001). Data analysis using SPSS for windows. New edition. Versions 8-10. Sage publications. London.
2. Michael S. Louis – Beck (1995). Data analysis an introduction, Series: quantitative applications in the social sciences. Sage. Publications. London

### Web References

1. https://www.youtube.com/watch?v=Bku1p481z80
2. https://www.spss-tutorials.com/basics/
3. https://www.javatpoint.com/spss

**Semester – 5 (Core Elective - 2-C)** **Subject Code: 224BC5M10**

## BIG DATA ANALYTICS

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

### Course Objectives

- To understand the Big Data Platform and its Use cases and to provide an overview of Apache Hadoop
- To provide HDFS concepts and understand Map Reduce Jobs and learn hands-on Hadoop Eco System

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Understand the Big Data platform and remember its use cases. | K1, K2 |
| CO-2 | Access the Components of Hadoop and process data on Distributed File System | K3 |
| CO-3 | Apply analytics on Structured, Unstructured Data | K4 |
| CO-4 | Analyze Infosphere Big Insights Big Data Recommendations | K5 |
| CO-5 | Develop Big Data Solutions using Hadoop Eco System | K6 |

**UNIT I** **(15 Hours)**

**Introduction to Big Data and Hadoop** - Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analyzing Data with Unix tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere Big Insights and Big Sheets.

**UNIT II** **(15 Hours)**

**HDFS (Hadoop Distributed File System)** - The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

**UNIT III** **(15 Hours)**

**Map Reduce** - Anatomy of a Map-Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

**UNIT IV** **(15 Hours)**

**Hadoop Eco System Pig** - Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases,

HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction

## UNIT V (15 Hours)

**Data Analytics -** Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with Big R.

### Text Books


1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.


### Reference Books


1. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
2. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
3. Anand Rajaraman and Jefrey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
4. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.


### Web References

1. https://www.tutorialspoint.com/big_data_analytics/index.htm
2. https://www.javatpoint.com/what-is-big-data

# SEMESTER - VI

**Semester – 6 (Major-XII)** **Subject Code: 224BC6M01**

# COMPUTER NETWORKS

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To understand the layered architecture and protocols of computer networks.
- To determine and manage data transmissions and multiplexing methods.
- To acquire knowledge in detecting and correcting errors in data transmission.
- To familiarize with encoding and modulation techniques

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Understand the layered architecture and protocols of computer networks and fundamental principles of networking | K1, K2 |
| CO-2 | Describe network principles in data transmission standards and transmission media. | K3 |
| CO-3 | Determine and manage data transmissions and multiplexing methods | K4 |
| CO-4 | Acquire knowledge in detecting and correcting errors in data transmission such as error control, error detection and correction, | K5 |
| CO-5 | Construct an optimal network connection for effective data transmissions. | K6 |

**UNIT I** **(15 Hours)**

**Basic Concepts**: Line configuration – point to point, multipoint; Topology – mesh, star, tree, bus, ring, hybrid technologies; transmission mode – simplex, half-duplex and full-duplex; categories of networks– LAN, MAN, WAN. **The OSI Model**: Model – Layered architecture; functions of the layers – physical layer, data link layer, network layer, transport layer, session layer, presentation layer, application layer; TCP/IP protocol suite

**UNIT II** **(20 Hours)**

**Signals**: Analog and digital – Analog and digital data, analog and digital signals; periodic and aperiodic signals; analog signals – simple analog signals, time and frequency domains; composite signals – frequency spectrum and bandwidth; digital signals - decomposition of a digital signal. **Transmission Media:** Guided media – twisted pair cable, coaxial cable, optical fiber; unguided media-radio frequency allocation, propagation of radio waves, satellite communication, cellular telephony. **Multiplexing**: Many to one/ One to many; Frequency Division Multiplexing (FDM); Wave Division Multiplexing (WDM); Time Division Multiplexing (TDM).

**UNIT III** **(15 Hours)**

**Data Link Control:** line discipline - ENQ/ACK, Poll/Select; Flow Control-Stop-and-wait, sliding window; Error Control – Automatic Repeat Request (ARQ), Stop- and-Wait ARQ. **Switching**: circuit switching; packet switching.

**UNIT IV** **(15 Hours)**

**Networking and Internetworking devices**: repeaters; bridges; routers; gateways; routing algorithms – Distance vector routing; link state routing; **Transport Layer**: Duties of the transport layer; connection; OSI transport protocol.

**UNIT V** **(10 Hours)**

**Application Layer**: Domain Name System (DNS); Telnet; File Transfer Protocol (FTP); Simple Network Management Protocol (SNMP); Hyper-Text Transfer Protocol (HTTP); World Wide Web (WWW).

## Text Books


1. Behrouz, A. Forouzan, Data Communications and Networking, Second Edition, Tata McGraw-Hill publishing company Ltd 2003.
2. Andrew. S. Tannenbaum, Computer Networks, Prentice Hall of India Private Ltd, Third edition, 2005.

## Reference Books


1. Data and Computer Communications by William Stallings
2. Larry L. Peterson & Bruce S. Dave, Computer Networks-A Systems Approach, 5/e, Morgan Kaufmann, 2011.
3. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e.
4. Keshav, An Engineering Approach to Computer Networks, Addison Wesley, 1998.
5. Data Communication and Networks, Godbole Achyut, Tata McGraw Hill, New Delhi, 2006.


## Web References

1. http://nptel.ac.in/courses/106105082/
2. http://www.networkworld.com/blogs
3. http://nptel.ac.in/courses/117102059/

**Semester – 6 (Major-XIII)** **Subject Code: 224BC6M02**

# CLOUD COMPUTING – SOFTWARE DEVELOPMENT AND DEPLOYMENT

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To understand the various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends.
- Develop a programming model using the concepts learnt.

| CO – No | Course Outcome<br>Upon successful completion of the project work, students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Study and recall the cloud architecture, types, virtualization, cloud security and lead players in cloud | K1 |
| CO-2 | Understand the concept of cloud computing and their issues. | K2 |
| CO-3 | Construct a programming model using MapReduce, Hadoop Library and GAE. | K3 |
| CO-4 | Point-out the Resource Provisioning and Platform Deployment, Dynamic Resource Deployment and the challenges in cloud security. | K4 |
| CO-5 | Test the programming model, compare with other standard models and choose the best model | K5, K6 |

**UNIT I** **(15 Hours)**

**Introduction and Architecture:** Technologies for Network-Based System: CPU and GPU – Software Environment for Cloud Computing: Service-Oriented Architecture (SOA) - Cloud Types : IaaS – PaaS - SaaS – Public - Private and Hybrid clouds – Cloud Development Trends – Characteristics of Cloud Computing - NIST Cloud Computing Reference Architecture.

**UNIT II** **(15 Hours)**

**Virtualization :** Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU – Memory - I/O Devices.

**UNIT III** **(15 Hours)**

**Cloud Infrastructure :** Architectural Design of Compute and Storage Clouds - Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management –Containers and Resource Management.

**UNIT IV** **(15 Hours)**

**Programming Model :** Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Programming Support of GAE – Google File System – Big Table.

**UNIT V** **(15 Hours)**

**Cloud Deployment and Security :** Resource Provisioning and Platform Deployment – Dynamic Resource Deployment - Global Exchange of Cloud Resources - Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Security Monitoring – Security Architecture Design – Data Security – Application Security.

## Text Books


1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers, 2012.
2. John W.Rittinghouse and James F.Ransome, Cloud Computing: Implementation, Management, and Security, CRC Press, 2010.


## Reference Books


1. Barrie Sosinsky, Cloud Computing Bible, Wiley India Pvt. Ltd, 2013.
2. Roger Jennings, Cloud Computing with Windows Azure Platform, Wiley India Pvt. Ltd, 2009.


## Web References

1. https://www.javatpoint.com/cloud-computing-tutorial
2. https://www.javatpoint.com/salesforce-overview-of-cloud-computing

**Semester – 6 (Major-XIV)** **Subject Code: 224BC6M03**

## DATA ANALYTICS WITH R LABORATORY

**Credit: 3** **Total Hours: 75** **Hours Per Cycle: 5**

### Course Objectives

- To understand the logics which will help them to create programs and develop computational skills in R Programming.
- To solve statistical problems using the concepts of R programming.

| CO – No | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember and understand the basic concepts of R programming language and how to construct different plots using R, exploratory data analysis, linear regression and random number generation. | K1, K2 |
| CO-2 | Solve computational and statistical problems (with descriptive statistics, sample tests, linear regression and random number generation) using R and provide visualization. | K3 |
| CO-3 | Interpret the results from statistical analysis, relationship between the variables and test the hypothesis. | K4 |
| CO-4 | Assess the various interpretations and visualizations. | K5 |
| CO-5 | Formulate decisions based on the assessment. | K6 |

**UNIT I** **(15 Hours)**

Introduction to statistical software R: Data objects in R, Arithmetic operators and special values, manipulating vectors, matrices, lists, importing of files, data frame. Controlling Loops- For, repeat, while, if, if else, Functions in R.

**UNIT II** **(15 Hours)**

Data in Statistics and in R: Data Organization-Data import, export and connections, Computations of descriptive statistics measures. R- Graphics-Tables, Histogram, Box-Plot, Stem and leaf plot, Scatter plot, Dot charts, lattice plots-Plot options- multiple plots in a single graphic window.

**UNIT III** **(15 Hours)**

Exploratory data analysis: Plotting of probability distributions and sampling distributions-P-P plot- Q-Q plot-Fitting of discrete and continuous distributions. One- and two-sample tests, paired sample t-tests and independent sample t-tests- Chi square tests for goodness of fit.

**UNIT IV** **(15 Hours)**

Simple Linear Regression: Simple linear models-Estimating regression coefficients-The model goodness of fit- Hypothesis testing and confidence interval. Simple logistic regression- Correlation- ANOVA and Kruskal Wallis.

**UNIT V** **(15 Hours)**

Random number generation: Simulation of random numbers-Uniform random generation-Generation of non-uniform random variables-Simple discrete random variables like Bernoulli, Binomial, Uniform- Inversion methods.

## Text Books


1. Yosef, C. and Jeremiah, Y.C. 2008. Statistics and Data with R: An applied approach through examples: John Wiley and Sons Ltd, United Kingdom. Unit I: Chapter 1 and 2, Unit II: Chapter 2 and 3, Unit III: Chapter 5, 6, 8, 9 and 10, Unit IV: Chapter 14, -16
2. P. W. Glynn and S. Asmussen. Stochastic Simulation: Algorithms and Analysis. Springer, 2007. Unit V: Chapter 2


## Reference Books


1. An Introduction to R by W. N. Venables, D. M. Smith and the R Core Team
2. Dalgard, Peter, Introductory statistics with R, Springer,
3. Schumacker, Randall E., Using R with multivariate statistics, sage 2016
4. The R Book by Michael J. Crawley, John Wiley and Sons, Ltd., 2007.


## Web References

1. https://www.geeksforgeeks.org/decision-tree-in-r-programming/
2. http://www.r-tutor.com/

**Semester – 6 (Major -XV)** **Subject Code: 224BC6M04**

## PROJECT WORK

**Credit: 5** **Total Hours: 150** **Hours Per Cycle: 10**

## Course Objectives

- To enable students to implement Project in their final semester, which culminates towards the Bachelor of Computer Science degree.
- To document the entire project work to be evaluated.

| CO – No | Course Outcome<br>Upon successful completion of the project work, students would be able to | Cognitive Level |
|---|---|---|
| CO-1 | Recall the knowledge acquired in programming, data analytics and acquire domain specific knowledge in the field of the project work chosen. | K1 |
| CO-2 | Understand the flow of the work, independently carry out literature survey in the identified domain, and consolidate it to formulate a problem statement. | K2 |
| CO-3 | Apply the logical thinking to propose the work flow and sketch an application. | K3 |
| CO-4 | Break down the problem into various modules and analyse them to choose effective methods of solving. | K4 |
| CO-5 | Design the application using a design model, code, debug and test the application with appropriate test cases | K5, K6 |

Students are required to carry out a mini project and submit a technical report. This mini project is a substantial piece of work that will require creative activity and original thinking. Students are supervised while working on a project accounting for six hours per cycle, extending over the sixth semester.

Within one month of the commencement of the sixth semester, each student will identify and confirm the selection of subjects under which project works will be carried out and accordingly, continuous project work evaluation will be carried out by the respective project guides. The Undergraduate Internship Report is also evaluated along with the project

**Semester – 6 (Core Elective – 3A)** **Subject Code: 224BC6M05**

# SOFTWARE TESTING

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To explore the effective testing techniques for ensuring high quality software
- To learn the criteria and design for test cases.
- To understand test management and test automation techniques.
- To apply test metrics and measurements

| CO - No. | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember and recall testing principles, test-case design, testing levels and metrics. | K1 |
| CO-2 | Understand the testing strategies. | K2 |
| CO-3 | Prepare test cases for various levels of testing. | K3 |
| CO-4 | Connect the theoretical understanding to a real-time problem, and design a test suite. | K4 |
| CO-5 | Compare and measure the efficiency of open-source testing tools. | K5 |
| CO-6 | Develop an application, test the same and prepare the test reports. | K6 |

**UNIT I** **(15 Hours)**

Introduction: Purpose – Productivity and Quality in Software – Testing Vs Debugging – Model for Testing – Bugs – Types of Bugs – Testing and Design Style.

**UNIT II** **(15 Hours)**

Flow / Graphs and Path Testing – Achievable paths – Path instrumentation – Application – Transaction Flow Testing Techniques.

**UNIT III** **(15 Hours)**

Data Flow Testing Strategies - Domain Testing: Domains and Paths – Domains and Interface Testing.

**UNIT IV** **(15 Hours)**

Linguistic –Metrics – Structural Metric – Path Products and Path Expressions. Syntax Testing – Formats – Test Cases.

**UNIT V** **(15 Hours)**

Logic Based Testing – Decision Tables – Transition Testing – States, State Graph, State Testing.

### Text Books


1. B. Beizer, "Software Testing Techniques", II Edn., DreamTech India, New Delhi, 2003.
2. K.V.K. Prasad , "Software Testing Tools", DreamTech. India, New Delhi, 2005.


### Reference Books


1. I. Burnstein, 2003, "Practical Software Testing", Springer International Edn.
2. E. Kit, 1995, "Software Testing in the Real World: Improving the Process", Pearson Education, Delhi.
3. R.Rajani, and P.P.Oak, 2004, "Software Testing", Tata Mcgraw Hill, New Delhi.


### Web References

1. https://www.javatpoint.com/software-testing-tutorial
2. https://www.w3schools.in/category/software-testing/

**Semester – 6 (Core Elective – 3B)** **Subject Code: 224BC6M06**

## IOT AND STREAM HANDLING

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To learn the basics of IoT technologies and protocols
- To understand the need of IOT in future with its upcoming technologies

.

| CO - No. | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | To remember the IoT requirements and basics of networking. | K1 |
| CO-2 | To understand the need of various IoT technology and protocols. | K2 |
| CO-3 | Apply and understand the need of IOT to meet Business standards and challenges. | K3 |
| CO-4 | Analyze the role of cloud technology in IoT applications. | K4 |
| CO-5 | To create and evaluate the Pros and Cons of IoT applications with case studies and real time applications. | K5, K6 |

**UNIT I** **(15 Hours)**

**Introduction:** Definitions and Functional Requirements –Motivation – Architecture – Four Pillars of IoT – DNA of IoT - IoT Ecosystem -Sensors, Actuators, and Smart Objects and networking

**UNIT II** **(15 Hours)**

**IOT Protocols:** Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Protocols – BACNet Protocol – Modbus – KNX – Zigbee Architecture

**UNIT III** **(15 Hours)**

**Web of Things:** Web of Things versus Internet of Things – Two Pillars of the Web — Platform Middleware for WoT – WoT Portals and Business Intelligence – IoT vs WOT Challenges

**UNIT IV** **(15 Hours)**

**Cloud & IOT Stream:** Cloud of Things and architecture - Cloud Computing – Cloud Standards – Cloud Providers and Systems – IOT Data Streams– Event Stream Processing – Distributed Computing Platforms

**UNIT V** **(15 Hours)**

**Applications**: Smart and connected cities - Smart Transportation - Smart Grid – Case studies using Arduino and Raspberry Pi with data analytics.

## Text Books


1. Arsheep Bahga, Vijay MAdisetti "Internet of Things : A hands on approach", 2014
2. Scott Klein " IOT solutions in Microsoft azure IoT Suite: Data Acquisition and analysis in the real world", 2017


## Reference Books


1. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, Fourth Edition, CRC Press, 2012
2. Mark Harrison and Florian Michahelles, Architecting the Internet of Things, Second Edition Springer, 2011
3. Olivier Hersent, Omar Elloumi and David Boswarthick, The Internet of Things: Applications to the Smart Grid and Building Automation , First Edition, Wiley, 2012
4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things – Key applications and Protocols, First Edition, Wiley, 2012
5. Adrian McEwen and Hakim Cassimally Designing the Internet of Things, First Edition, Wiley, 2013.

## Web References

1. https://www.javatpoint.com/iot-internet-of-things
2. https://www.guru99.com/iot-tutorial.html

**Semester – 6 (Core Elective – 3C)** **Subject Code: 224BC6M07**

# BLOCK CHAIN TECHNOLOGY

**Credit: 5** **Total Hours: 75** **Hours Per Cycle: 5**

## Course Objectives

- To understand the emerging trends in blockchain technologies
- To understand the usage of Bitcoins as decentralized cryptocurrency.
- To know about the emerging trends of Cryptocurrency as a Digital Asset

| CO - No. | Course Outcome<br>Upon completion of the course the students would be able to: | Cognitive Level |
|---|---|---|
| CO-1 | Remember the need of Block chain technology with distributed databases. | K1 |
| CO-2 | Understand the usage of Bitcoins as decentralized cryptocurrency. | K2 |
| CO-3 | Enumerate the emerging trends of Cryptocurrency as a Digital Asset. | K3 |
| CO-4 | Experiment and analyse about the role of Etherium in blockchain | K4 |
| CO-5 | Evaluate and obtain domain knowledge for different applications | K5, K6 |

**UNIT I** **(15 Hours)**

**Blockchain**: Introduction, Distributed Database, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

**UNIT II** **(15 Hours)**

**Distributed Consensus**: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

**UNIT III** **(15 Hours)**

**Cryptocurrency**: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

**UNIT IV** **(15 Hours)**

**Cryptocurrency Regulation**: Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy, Alternative blockchain and emerging trends

**UNIT V** **(15 Hours)**

**Blockchain Applications**: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.

## Text Book

1. Kumar Saurabh, Ashtosh Saxena , Blockchain Technology: Concepts and Applications, Wiley Publications, 2020.

## Reference Books


1. Joseph Bonneau and Arvind Narayanan, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, First Edition, Princeton University Press, 2016.
2. Roger Wattenhofer, The Science of the Blockchain, First Edition, CreateSpace 2017
3. Andreas S. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies., First Edition, O'Reilly, 2014
4. Arvind Narayanan and Joseph Bonneau, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, First Edition, Princeton University Press, 2016


## Web References


1. https://www.javatpoint.com/blockchain-tutorial
2. https://www.tutorialspoint.com/blockchain/index.htm

## 10. **Keywords**

Learning Outcomes, Graduate Attributes, Program Outcomes, Qualification Descriptors, Core Compulsory courses, Discipline Specific Electives, General Elective, Allied Subjects, Skill Enhancement Courses, End of Semester Evaluation and Internal continuous Assessment