SYLLABUS

*for*

# Bachelor of Science (IT)

(2026 Onwards)

Programme

*As Per*

## New Education Policy (NEP-2020)


DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF ENGINEERING AND TECHNOLOGY

HEMVATI NANDAN BAHUGUNA GARHWAL UNIVERSITY

A CENTRAL UNIVERSITY

SRINGAR GARHWAL – (246174)

# PROGRAM STRUCTURE

## FIRST SEMESTER

| S.No. | Category | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | Core Courses | SET/BIT/CC101 | Fundamentals of Computer Science | 3 | - | 2 | 4 |
| 2 | | SET/BIT/CC102 | Programming in C | 3 | - | 4 | 5 |
| 3 | Skill Enhancement Course | SET/BIT/SEC103 | Internet Technologies | 3 | - | 4 | 5 |
| 4 | Ability Enhancement Course | SET/BIT/AEC104 | Indian Modern Language (English) | 1 | 1 | - | 2 |
| 5 | | SET/BIT/AEC105 | Indian Modern Regional Language (Sans/Garh) | 2 | - | - | 0 |
| 6 | Multi-Disciplinary Elective Course | SET/BIT/MDE106 | Disaster Management | 2 | - | - | 2 |
| 7 | Value Added Course | SET/BIT/VAC107 | Life Skills and Personality Development | 2 | - | - | 2 |
| | | | | | | | 20 |

## SECOND SEMESTER

| S.No. | Category | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | Core Courses | SET/BIT/CC201 | Mathematical Foundation | 3 | - | - | 3 |
| 2 | | SET/BIT/CC202 | Digital Electronics | 3 | - | 2 | 4 |
| 3 | | SET/BIT/CC203 | Computer Based Numerical Techniques | 3 | - | 2 | 4 |
| 4 | Skill Enhancement Course | SET/BIT/SEC204 | Data Structures and File Organization | 3 | - | 4 | 5 |
| 5 | | SET/BIT/SEC205 | Office Automation | 1 | - | 2 | 2 |
| 6 | Ability Enhancement Course | SET/BIT/AEC206 | Understanding & Connecting with Environment | 2 | - | - | 0 |
| 7 | Value Added Course | SET/BIT/VAC207 | Heritage of Indian Languages | 2 | - | - | 2 |
| | | | | | | | 20 |

# PROGRAM STRUCTURE

## THIRD SEMESTER

| S.No. | Category | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | Core Courses | SET/BIT/CC301 | Cyber Security | 3 | - | - | 3 |
| 2 | | SET/BIT/CC302 | OOPs Using C++ | 3 | - | 4 | 5 |
| 3 | | SET/BIT/CC303 | Computer Networks | 3 | - | - | 3 |
| 4 | Skill Enhancement Course | SET/BIT/SEC304 | Python Programming | 2 | - | 4 | 4 |
| 5 | Discipline Specific Elective | | Professional Elective - I | 1 | - | 4 | 3 |
| 6 | Value Added Course | SET/BIT/VAC306 | Indian Knowledge System | - | - | 4 | 2 |
| | | | | | | | 20 |

## FOURTH SEMESTER

| S.No. | Category | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | Core Courses | SET/BIT/CC401 | Informatics Cyber laws | 1 | 1 | - | 2 |
| 2 | | SET/BIT/CC402 | Database Management System | 3 | - | 4 | 5 |
| 3 | | SET/BIT/CC403 | Software Engineering | 3 | - | - | 3 |
| 4 | | SET/BIT/CC404 | Design and Analysis of Algorithm | 3 | - | 4 | 5 |
| 5 | Discipline Specific Elective | | Professional Elective - II | 1 | - | 4 | 3 |
| 6 | Skill Enhancement Course | SET/BIT/SEC406 | R Programming | - | - | 4 | 2 |
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# PROGRAM STRUCTURE

## FIFTH SEMESTER

| S.No. | Category | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| **1** | **Discipline Specific Elective** | | Professional Elective III | 3 | - | 4 | 5 |
| **2** | | | Professional Elective IV | 3 | - | 2 | 4 |
| **3** | | | Professional Elective V | 3 | - | 4 | 5 |
| **4** | **Skill Enhancement Course** | SET/BIT/SEC504 | Multimedia Application | - | 2 | - | 2 |
| **5** | | SET/BIT/SEC505 | Internship/Capstone Project | - | - | 8 | 4 |
| **6** | | | Major Project (Evaluation in Sixth Semester) | - | - | - | 0 |
| | | | | | | | 20 |

## SIXTH SEMESTER

| S.No. | Category | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | **Core Course** | SET/BIT/CC601 | Operating System | 3 | - | 4 | 5 |
| 2 | **Discipline Specific Elective** | | Professional Elective VI | 3 | - | 4 | 5 |
| 3 | | | Professional Elective VII | 3 | - | 4 | 5 |
| 4 | **Ability Enhancement Course** | SET/BIT/AEC604 | Communication Skill | - | 1 | - | 1 |
| 5 | **Skill Enhancement Course** | SET/BIT/SEC605 | Major Project (Initiated in 5th Semester) | - | - | 8 | 4 |
| | | | | | | | 20 |

# PROGRAM STRUCTURE

### SEVENTH SEMESTER (UG With Honours)

| S.No. | Category | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | **Multi-Disciplinary Elective Course** | SET/BIT/MDE701 | Mental Health & Wellbeing | 3 | - | - | 3 |
| 2 | **Core Course** | SET/BIT/CC702 | Computer Organization & Architecture | 4 | - | - | 4 |
| 3 | **Discipline Specific Elective** | | Professional Elective VIII | 3 | - | 4 | 5 |
| 4 | | | Professional Elective IX | 4 | - | - | 4 |
| 5 | **Skill Enhancement Course** | SET/BIT/SEC705 | Dissertation Work (Evaluation Eighth Semester) | - | - | - | - |
| 6 | | SET/BIT/SEC706 | Summer Internship | - | - | 8 | 4 |
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### EIGHTH SEMESTER (UG With Honours)

| S.No. | Category | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| **1** | **Discipline Specific Elective** | | Professional Elective X | 3 | - | 2 | 4 |
| **2** | | | Professional Elective XI | 4 | - | - | 4 |
| **3** | | | Professional Elective XII | 3 | - | 2 | 4 |
| **4** | **Skill Enhancement Course** | SET/BIT/SEC804 | Dissertation Work (Started in Seventh Semester) | - | - | 16 | 8 |
| | | | | | | | 20 |

# PROGRAM STRUCTURE

## SEVENTH SEMESTER (UG Honors with Research)

| S.No. | Category | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | Core Course | SET/BIT/CC702 | Computer Organization & Architecture | 4 | - | - | 4 |
| 2 | | SET/BIT/CC701 | Research Methodology | 2 | 2 | - | 4 |
| 3 | | SET/BIT/CC703 | Research Internship Report & Viva-voce | - | - | 8 | 4 |
| 4 | Discipline Specific Elective | | Professional Elective VIII | 3 | - | 2 | 4 |
| 5 | | | Professional Elective IX | 4 | - | - | 4 |
| | | | | | | | 20 |

## EIGHTH SEMESTER

| S.No. | Category | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | Skill Enhancement Course | SET/BIT/SEC801 | Dissertation (For Research Track) * | -- | -- | -- | 20 |

## Elective Course Bucket

| Professional Elective I | Professional Elective II | Professional Elective III | Professional Elective IV |
|---|---|---|---|
| SQL (SET/BIT/DSE/E1.1) | .NET framework & C# (SET/BIT/DSE/E2.1) | Programming with JavaScript (SET/BIT/DSE/E3.1) | Computer Graphics (SET/BIT/DSE/E4.1) |
| PL/SQL (SET/BIT/DSE/E1.2) | Introduction to Django (SET/BIT/DSE/E2.2) | PHP (SET/BIT/DSE/E3.2) | Distributed System (SET/BIT/DSE/E4.2) |
| MOOC (SWAYAM/NPTEL) | MOOC (SWAYAM/NPTEL) | | MOOC (SWAYAM/NPTEL) |
| **Professional Elective V** | **Professional Elective VI** | **Professional Elective VII** | **Professional Elective VIII** |
| Pattern Recognition (SET/BIT/DSE/E5.1) | Artificial Intelligence (SET/BIT/DSE/E6.1) | Machine Learning (SET/BIT/DSE/E7.1) | Basic Java Programming (SET/BIT/DSE/E8.1) |
| Network Simulation & Modelling (SET/BIT/DSE/E5.2) | Social Network Analysis (SET/BIT/DSE/E6.2) | Big Data Analytics (SET/BIT/DSE/E7.2) | Introduction to DevOps (SET/BIT/DSE/E8.2) |
| **Professional Elective IX** | **Professional Elective X** | **Professional Elective XI** | **Professional Elective XII** |
| Graph Theory (SET/BIT/DSE/E9.1) | Deep Learning (SET/BIT/DSE/E10.1) | Blockchain & It's Application (SET/BIT/DSE/E11.1) | Basics of Data Analytics Using Spreadsheet (SET/BIT/DSE/E12.1) |
| Theory of Computation (SET/BIT/DSE/E9.2) | Data Visualization Using R (SET/BIT/DSE/E10.2) | Wireless & Mobile Communication (SET/BIT/DSE/E11.2) | Robotic Process Automation (SET/BIT/DSE/E12.3) |
| MOOC (SWAYAM/NPTEL) | | MOOC (SWAYAM/NPTEL) | |

# SEMESTER 1

**Course: Fundamentals of Computer Science (SET/BIT/CC101)**

**Course Objective:** This course aims to provide a comprehensive understanding of computer hardware components and functions, covering disk storage, memory, input/output devices, and peripherals. It introduces basic operating system concepts, including MS-DOS and Windows, as well as networking fundamentals such as the Internet, TCP/IP, and client-server architecture. Students will grasp number systems, logic operations, and programming fundamentals, while also

gaining insights into language generation, assembly languages, and high-level languages.

**Course Outcome:** On successful completion of the course, students will be able to:

1. Understand the concept of hardware and software.
2. Acquainting with input and output devices.
3. Understand networking concepts and models.
4. Learn and be aware of Internet activities.

**Course Content:**

**Unit 1 Computer Hardware Components and Functions**

Introduction to Computers: Computer hardware Components, Disk Storage, memory, keyboard, mouse, printers, monitors, CD, etc., and their functions, Comparison-based analysis of various hardware components.

**Unit 2 Basic Operating System Concepts and Networking**

Basic Operating System Concepts: MS-DOS, WINDOWS, Functional knowledge of these operating systems. Introduction to Basic Commands of DOS, Managing Files and Directories in various operating Systems, Introduction to the Internet, Basic terms related to the Internet, TCP/IP. Network Topologies, Client-server Architecture, IoT, Cloud Computing

**Unit 3 Number Systems, Logic Operations, and Programming Fundamentals**

Binary, Hexadecimal Number System; Basic Binary Logic Operations; Binary Addition and Subtraction; Generation of Languages, Assembly Language, High-level language; Translators, Interpreters, Compilers, Algorithm, Flow Charts, Dataflow Diagram,

**Unit 4 Elements of a Computer Processing System and Software**

Elements of a computer processing system: Hardware, CPU, storage devices and media, VDU, input- output devices, data communication equipment, software system, application software.

**Unit 5 NICNET, ERNET, E-commerce, and Multimedia Introduction**

Basic Awareness of NICNET and ERNET; E-Commerce, E-Governance; Brief Introduction to Different Formats of Image, Audio, Video. Data Concepts and Data Processing, Data Science, Data Representation, Application of IT to E-commerce, Electronic Governance, Multimedia, Entertainment, Introduction to Information Systems

**Recommended Books:**


1. Sinha, Sinha, “Computer Fundamentals.”
2. Yadav R. P., “Information Technology.”

# SEMESTER 1

**Course: Programming in C (SET/BIT/CC102)**

**Course Objective:** The Programming in C course aims to provide students with a solid foundation in programming using the C language. Participants will start by learning the basics of C syntax, data types, and control structures, and then progress to more advanced topics such as functions, pointers, and memory management. The course focuses on developing problem-solving skills through hands-on coding exercises and projects, enhancing participants' ability to translate real-world problems into C programs.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the basic programming concepts and syntax of the C language.
2. Design and implement algorithms to solve simple programming problems.
3. Write, compile, and execute C programs using integrated development environments (IDEs).

**Course Content:**

**Unit 1: Introduction to C Programming**

Basics of C programming language, Structure of C program, Data types, Variables, Constants, Input and Output functions, Operators, Expressions, Control structures: if, if-else, switch.

**Unit 2 Loops and Functions**

Looping constructs: while, do-while, for, Nested loops, Arrays, Strings, Pointers, Functions: declaration, definition, call, return, and recursion.

**Unit 3 Storage Classes and Preprocessor**

Storage Classes: auto, extern, static, register, Scope and lifetime of variables, Introduction to the Preprocessor, Macros, Conditional compilation.

**Unit 4 User-defined Data Types**

Structures and Unions, Introduction to user-defined data types, Structures: declaration, initialization, accessing members, Arrays of structures, Pointers to structures, Unions: declaration, accessing members.

**Unit 5 File Handling and Command-line Arguments**

File operations: Opening, Reading, Writing, and Closing files, Random Access to files, Command- line arguments, File handling functions, Error handling.

**Recommended Books:**

1. "C Programming Absolute Beginner's Guide" by Greg Perry and Dean Miller.
2. "The C Programming Language" by Brian W. Kernighan

# SEMESTER 1

**Course: Internet Technologies (SET/BIT/SEC103)**

**Course Objective:** The Internet Technologies course aims to provide participants with a comprehensive understanding of the foundational concepts and technologies that underpin the modern internet. Participants will explore the layers of the internet stack, from networking protocols and web technologies to security and emerging trends. The course covers web development essentials, including HTML, CSS, and JavaScript, enabling participants to create interactive, responsive web pages. Participants will gain insights into server-side scripting languages, database integration, and server deployment.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the working principles of the Internet and its protocols.
2. Develop static web pages using HTML and CSS.
3. Implement interactive features on web pages using JavaScript.

**Course Content:**

**Unit 1: Introduction to Internet Technologies**

Overview of the Internet and its evolution, Internet protocols: TCP/IP, HTTP, DNS, SMTP, etc., IP addressing and subnetting, Domain Name System (DNS), Hypertext Markup Language (HTML), and Cascading Style Sheets (CSS).

**Unit 2 Client-Side Web Technologies**

JavaScript programming fundamentals, Document Object Model (DOM) manipulation, Client-side form validation, Introduction to Web development frameworks (e.g., React, Angular).

**Unit 3 Server-Side Web Technologies**

Server-side scripting languages (e.g., PHP, Python, Node.js), handling HTTP requests and responses, Database connectivity and management, Session and cookies management.

**Unit 4 Web Security and Emerging Technologies**

Web security fundamentals: Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), etc.; Secure Sockets Layer (SSL) and Transport Layer Security (TLS); Introduction to Web services and APIs; Emerging technologies and trends in Internet Technologies.

**Recommended Books:**

1. "HTML and CSS: Design and Build Websites" by Jon Duckett.
2. "JavaScript and JQuery: Interactive Front-End Web Development" by Jon Duckett.

# SEMESTER 1

**Course: Disaster Management (SET/BIT/MDE106)**

**Course Content:**

**Unit 1: Introduction to Disasters**

• Definition and Classification: Natural and Man-made disasters
• Concepts: Hazard, vulnerability, risk, resilience, capacity building
• Disaster Cycle: Preparedness, response, recovery, mitigation
• Brief about Global and Indian perspectives: Case studies from Himalaya

**Unit 2: Natural Disasters**

• Earthquakes, Landslides, Tsunamis, Floods, Glacial Lake outburst floods (GLOFs): Causes and warning System
• Volcanic Eruptions Types, monitoring, volcanic hazards
• Cloud burst, Cyclones & Storm Surges, Classification, impacts, prediction
• Forest Fires: Causes, spread, control measures • Desertification and Droughts: Types, causes, and management

**Unit 3: Anthropogenic Disasters**

• Industrial & Chemical Accidents: Bhopal disaster, oil spills
• Nuclear Hazards: Chornobyl, Fukushima, safety measures
• Urban Disasters: Building collapses, fires
• Environmental Pollution: Air, water, soil contamination incidents

**Unit 4: Disaster Preparedness and Management &Policies, Institutions, and Governance**

• Early Warning Systems: Seismic monitoring, meteorological forecasting
• Disaster Risk Reduction (DRR): Sendai Framework, NDMA guidelines
• Emergency Planning: Evacuation, communication strategies
• Role of Remote Sensing & GIS in hazard mapping and disaster response
• Incident Command Systems and coordination mechanisms
• Relief Operations: Logistics, humanitarian aid, temporary shelters
• Post-Disaster Reconstruction: Rehabilitation, livelihood restoration
• Psychosocial Support and community resilience building
• International Frameworks: UNDRR, Hyogo Framework, Sendai Framework
• Indian Disaster Management Act (2005) and institutional framework
• Role of Armed Forces, NGOs, and Community-Based Organizations
• Insurance and Risk Transfer Mechanisms

**References**


1. Alexander, D. (2002). Principles of Emergency Planning and Management. Oxford University Press.
2. NDMA (2005 & updates). Disaster Management Guidelines. Government of India.
3. Coppola, D.P. (2015). Introduction to International Disaster Management. Elsevier.
4. Shaw, R., & Krishnamurthy, R. (2009). Disaster Management: Global Challenges and Local Solutions. Universities Press.

# SEMESTER 1

**Course: Life Skills and Personality Development (SET/BIT/VAC107)**

**Course Objective:** The Life Skills and Personality Development Course aim to equip participants with essential skills and knowledge to enhance their personal growth, interpersonal relationships, and overall well-being. The course is designed to empower individuals to navigate various life situations effectively, develop a positive self-image, and foster the traits necessary for a successful and fulfilling life.

**Course Outcome:** By the end of this course, students should be able to:

1. Develop effective communication skills, including active listening and empathetic expression.
2. Enhance emotional intelligence to manage emotions, empathize with others, and navigate social situations.
3. Cultivate resilience and stress management techniques to cope with challenges and setbacks.
4. Master time management and goal-setting, enabling efficient task prioritization and achievement.

**Course Content:**

**UNIT 1 Career and Professional Skills**

Career and Professional Skills: Listening Skills, Reading Skills, Writing Skills, Effective Resume preparation, Interview Skills, Group Discussion Skills, Exploring Career Opportunities, Psychometric Analysis, and Mock Interview Sessions. Team Skills: Cognitive and Non-Cognitive Skills, Presentation Skills, Trust and Collaboration, Listening as a Team Skill, Brainstorming, Social and Cultural Etiquettes. Digital Skills: Computer skills, Digital Literacy and social media, Digital Ethics and Cyber Security

**UNIT 2 Attitude and Motivation**

Attitude: Concept, Significance, Factors Affecting Attitudes, Positive Attitude - Advantages, Negative Attitude - Disadvantages, Ways to Develop a Positive Attitude, Difference between personalities with positive and negative attitudes. Motivation: Concept, Significance, Internal and external motives - Importance of self- motivation- Factors leading to de-motivation, Maslow's Need Hierarchy Theory of Motivation

**UNIT 3 Stress Management and Development of Capabilities**

Development of willpower and imagination through a yogic lifestyle; development of thinking, emotional control, and discipline of mind through Pranayama; improvement of memory through meditation; stress: meaning, causes, and effects in life management; stress: psycho-physical mechanisms; management of stress through Yoga.

**UNIT 4 Other Aspects of Personality Development**

Body language - Problem-solving - Conflict and Stress Management - Decision-making skills - Leadership and qualities of a successful leader - Character-building - Teamwork - Time management - Work ethics– Good manners and etiquette.

**UNIT 5 Health and Hygiene**

Health and Hygiene- Meaning and significance for Healthy Life, Exercise, Nutrition, and Immunity. Obesity- Meaning, Types, and its Hazards. - Physical Fitness and Health Related Physical Fitness- Concept, Components and Tests, Adventure Sports.

**Recommended Books:**


1. Barun K. Mitra, "Personality Development & Soft Skills", Oxford Publishers, Third impression, 2017.
2. Ghosh, Shantikumar. 2004. Universal Values. Kolkata: The Ramakrishna Mission Larry James, "The First Book of Life Skills"; First Edition, Embassy Books, 2016.

# SEMESTER 1

# Lab Manual

| Fundamentals of Computer Lab (SET/BIT/CP101) |
|---|
| **Course Content:**<br>1. Implementation of basic computer hardware identification and system configuration, including CPU, memory devices, input/output devices, and storage components.<br>2. Implementation of file and directory management operations using Windows/Linux operating system commands, including file creation, copying, moving, renaming, and deletion.<br>3. Implementation of number system conversion techniques, including Decimal, Binary, Octal, and Hexadecimal conversions.<br>4. Implementation of binary arithmetic operations, including binary addition, subtraction, multiplication, and division.<br>5. Implementation of algorithms for problem-solving, including finding the largest number, checking even/odd numbers, factorial calculation, and prime number identification.<br>6. Implementation of flowcharts for computational problems, including factorial calculation, Fibonacci series generation, and decision-making processes.<br>7. Implementation of internet applications, including web browsing, information searching, email creation, sending attachments, and cloud storage utilization.<br>8. Implementation of document creation and formatting techniques using word processing software, including text formatting, tables, headers, footers, and page setup.<br>9. Implementation of spreadsheet-based data processing, including formula application, function usage, data sorting, filtering, and chart generation. |

| Programming in C Lab (SET/BIT/CP102) |
|---|
| **Course Content:**<br>1. Basic input, output, and arithmetic operations using the C programming language.<br>2. Decision-making statements using if, if-else, nested if-else, and switch-case constructs.<br>3. Iterative control structures using for, while, and do-while loops for solving repetitive computational problems.<br>4. Mathematical programs including factorial calculation, prime number checking, palindrome testing, and Fibonacci series generation.<br>5. One-dimensional and two-dimensional arrays for data storage, manipulation, and matrix operations.<br>6. String handling operations, including string length calculation, concatenation, comparison, and reversal.<br>7. User-defined and recursive functions for modular and efficient program development.<br>8. Pointer operations, including pointer arithmetic and passing pointers to functions.<br>9. Structures and file handling techniques for managing records and performing file input/output operations.<br>10. Sorting and searching algorithms, including Bubble Sort, Selection Sort, Linear Search, and Binary Search. |

# SEMESTER 1

| Internet Technologies Lab (SET/BIT/SEP103) |
| --- |
| **Course Content:**<br>1. Working with Microsoft Office (Word, Excel, PowerPoint, Access)<br>2. Use of Search Engine and World Wide Web, Creation of email ID, and<br>3. Working with email, Use of FTP service.<br>4. Basics of Cloud computing, Internet of Things (IoT), Data Science,<br>5. Artificial Intelligence, Blockchain Technology, Client-Server<br>6. Architecture, P2P Networks.<br>7. Besides these, additional experiments can be included to give hands-on<br>8. Experience for students. |

# SEMESTER 2

**Course: Mathematical Foundation (SET/BIT/CC201)**

**Course Objective:** The objective of the "Mathematical Foundations of Computer Science" course is to introduce students to the mathematical concepts and techniques that underpin various areas of computer science. The course aims to help students develop a strong foundation in mathematical reasoning and problem-solving, essential for understanding algorithms, data structures, and the theoretical foundations of computer science.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand fundamental mathematical concepts and their applications in computer science.
2. Analyze algorithms and data structures using mathematical techniques.
3. Formulate and solve problems in computer science using mathematical modeling.
4. Apply mathematical reasoning to analyze the efficiency and correctness of algorithms.
5. Gain a deeper appreciation of the theoretical underpinnings of computer science.

**Course Content:**

**Unit 1 Mathematical Logic**

Propositional Calculus: Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Predicates, Predicative Logic, Statement Functions, Variables and Quantifiers

**Unit 2 Set Theory**

Sets: Operations on Sets, Principle of Inclusion-Exclusion, Relations: Properties, Operations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering, Hasse Diagrams

**Unit 3 Functions**

Bijective, Composition, Inverse, Permutation, and Recursive Functions, Lattice and its Properties, Algebraic Structures: Algebraic Systems, Properties, Semi-Groups and Monoids, Group, Subgroup and Abelian Group, Homomorphism, Isomorphism.

**Unit 4 Combinatorics**

Basis of Counting, Permutations, Permutations with Repetitions, Circular and Restricted Permutations, Combinations, Restricted Combinations, Binomial and Multinomial Coefficients, and Theorems

**Unit 5 Number Theory**

Properties of Integers, Division Theorem, Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic, Fermat's and Euler's Theorems

**Recommended Books:**


1. Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay and P. Manohar, Tata McGraw-Hill.
2. Elements of Discrete Mathematics: A Computer-Oriented Approach, C. L. Liu and D. P. Mohapatra, 3rd Edition, Tata McGraw-Hill.

# SEMESTER 2

**Course: Digital Electronics (SET/BIT/CC202)**

**Course Objective:** To revise and extend the basic knowledge of the number system and logic gates—simplification of the complex Boolean expression using K-map. To understand the combinational and sequential logic circuits. To get the basic knowledge of logic families and semiconductor memories.

**Course Outcome:** By the end of this course, students should be able to:

1. Describe and demonstrate the use of digital test equipment and its operating characteristics.
2. Identify and describe the combinational and sequential logic circuits.
3. Understand the different memory devices.

**Course Content:**

**Unit 1 Introduction**

Positional number system; Binary, octal, and hexadecimal number systems; Methods of base conversions; Binary, octal, and hexadecimal arithmetic; Representation of signed numbers; Fixed- and floating-point numbers. Definition and specification of combination logic; Truth table; Basic logic operation and logic gates; Binary coded decimal codes; Gray codes

**Unit 2 Boolean Algebra and Switching Functions**

Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions - SOP and POS forms; Simplification of switching functions - K-map.

**Unit 3 Logic Families**

Diode, BJT, and MOSFET as switches. Introduction to different logic families; Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption, and power-delay product; circuit description and operation; RTL; DTL, HTL, TTL, and sub-families; Brief idea of ECL, CMOS, BI-CMOS.

**Unit 4 Combinational Logic**

Arithmetic modules: adders, subtractors, and ALU; Design examples—decoders, encoders, multiplexers, and de-multiplexers; Parity circuits and comparators.

**Unit 5 Sequential Logic**

Basic sequential circuits- latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop, and their inter-conversions; Timing hazards and races; Meta-stability; Analysis of state machines using D flip-flops and JK flip-flops; Definition of state machines, synchronous sequential logic, shift register, counters-ripple and mod counters.

**Unit 5 Semiconductor Memories**

RAM, ROM, Content-Addressable Memory, Charge-Coupled Device Memory. PLAs, PALs, and their applications; Sequential PLDs and their applications.

**Recommended Books:**

1. M. Morris Mano, “Digital Design”.

# SEMESTER 2

**Course: Computer-Based Numerical Techniques (SET/BIT/CC203)**

**Course Objective:**

The objective of this course is to provide students with an understanding of numerical techniques and algorithms for solving mathematical problems encountered in computer- based applications. The course aims to develop students' skills in applying numerical methods to practical problems.

**Course Outcome:**

By the end of this course, students should be able to:

1. Understand the principles and importance of numerical techniques.
2. Apply numerical methods for solving mathematical problems.
3. Implement algorithms for numerical differentiation and integration.
4. Use interpolation techniques for data analysis and approximation.
5. Solve ordinary differential equations numerically.

**Course Content:**

**Unit 1 Introduction to Numerical Techniques**

Overview of numerical methods and their applications, Errors in numerical computations, and methods to reduce them.

**Unit 2 Solving Equations**

Bisection method, Newton-Raphson method, Secant method, Root-finding techniques, and convergence criteria.

**Unit 3 Interpolation and Approximation**

Interpolation methods: Lagrange interpolation, Newton's divided difference, Curve fitting techniques: Least squares approximation.

**Unit 4 Numerical Integration and Differentiation**

Numerical integration methods: Trapezoidal rule, Simpson's rule, and numerical differentiation techniques.

**Unit 5 Linear Algebraic Equations and Eigenvalue Problems**

Solving systems of linear equations: Gaussian Elimination, LU Decomposition, Eigenvalues and Eigenvectors using numerical methods.

**Recommended Books:**


1. "Numerical Methods: Principles, Analysis, and Algorithms" by Roland W. Freund and Gene H. Golub.
2. "Numerical Recipes: The Art of Scientific Computing" by William H. Press, Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery.

# SEMESTER 2

**Course: Data Structure & File Organization (SET/BIT/SEC204)**

**Course Objective:** The objective of this course is to familiarize students with fundamental data structures and their applications in solving computational problems. The course aims to develop students' skills in designing, implementing, and analyzing various data structures.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the concepts of data structures and their importance in computing.
2. Implement and use common data structures such as arrays, linked lists, stacks, queues, trees, and graphs.
3. Analyze the time and space complexity of algorithms related to data structures.
4. Apply data structures to solve real-world problems efficiently.

**Course Content:**

**Unit 1: Introduction to Data Structures**

Overview of data organization and data types, Arrays, Linked Lists, Stacks, Queues, and their implementations.

**Unit 2 Trees and Graphs**

Binary Trees and Binary Search Trees, AVL Trees and Red-Black Trees, Graph representation and traversal.

**Unit 3 Hashing**

Introduction to hashing and its applications. Hash functions and collision resolution techniques. Hash tables and their implementation. Understanding the efficiency of hash-based data structures.

**Unit 4 Sorting and Searching Algorithms**

Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Linear and Binary Search.

**Unit 5 File Organization and Indexing**

Fundamentals of file organization: sequential, direct, and indexed. Primary and secondary indexing techniques. B+-tree index structure and its role in efficient data retrieval. Case studies of file organization in database systems.

**Recommended Books:**

1. "Data Structures and Algorithms in Java" by Robert Lafore.
2. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.

# SEMESTER 2

**Course: Office Automation (SET/BIT/SEC205)**

**Course Objective:** The objective of an Office Automation course is to provide students with the necessary skills and knowledge to effectively use various computer software applications and technologies for streamlining and enhancing office tasks and processes. The course aims to equip students with practical abilities to automate routine office functions, improve efficiency, and facilitate communication and collaboration within an office environment.

**Course Outcome:** By the end of this course, students should be able to:

1. Effectively use office automation tools for document creation, presentation, and data analysis.
2. Apply advanced features of office software to optimize office tasks and workflows.
3. Demonstrate effective communication and collaboration skills using office automation tools.

**Course Content:**

**Unit 1 Introduction to Office Automation**

Overview of office automation and its benefits, Office Suite applications and their features. Ethical and Legal Considerations in Office Automation

**Unit 2 Word Processing and Spreadsheets**

Word processing: Formatting, Styles, Mail Merge, Spreadsheets: Formulas, Functions, Charts. Styles, Templates, and Document Automation, Collaboration Tools: Track Changes and Comments

**Unit 3 Presentation Tools and Email Management**

Creating and delivering presentations, Email and Calendaring: Managing emails and appointments.

**Unit 4 Database Management and Workflow Automation**

Database management: Creating and querying databases, Document collaboration and version control, Workflow automation using macros and scripts.

**Unit 5 Streamlining Workflows and Future Trends**

Making Tasks Easier: Workflow Automation, Looking Ahead: Modern Trends in Office Automation, Adapting to New Technologies, Enhancing Efficiency in the Digital Age

**Recommended Books:**


1. "Microsoft Office 365 & Office 2019: Introductory" by Misty E. Vermaat.
2. "Office 2019 All-in-One for Dummies" by Peter Weverka.

# SEMESTER 2

**Course: Understanding and Connecting with Environment (SET/BIT/AEC206)**

**Course Objective:**

The "Understanding and Connecting with Environment" course aims to provide participants with a comprehensive understanding of the natural world and the intricate relationships between humans and their environment. The course seeks to raise environmental awareness, foster a sense of responsibility towards the planet, and empower individuals to make informed decisions for sustainable living.

**Course Outcome:**

By the end of this course, students should be able to:

1. Develop a deep understanding of environmental concepts, ecosystems, and biodiversity.
2. Implement sustainable practices for responsible resource management and waste reduction.
3. Analyze the interconnectedness of species and ecosystems within the natural world.
4. Evaluate and address environmental issues such as climate change and habitat destruction.
5. Cultivate a sense of environmental responsibility and engage in ethical decision-making for sustainable living.

**Course Content:**

**Unit 1 Understanding of Environment**

Definition, scope, and importance of Environment, Multidisciplinary nature of Environmental Sciences, Understanding of Ecology and Ecosystems, Ecological Succession and Ecosystem Services, Energy flow in an Ecosystem; Food Chain, Food Web and Ecological Pyramids, Human interaction with its Environment

**Unit 2 Natural Resources and Biodiversity Conservation**

Basic concept, types and values of Natural Resources, Resource Consumption, Restoration and Conservation Practices, and Sustainable Development, Concept, values and distribution of Biodiversity and its linkages with culture, health and people, Threats to Biodiversity and Biodiversity conservation

**Unit 3 Global Environmental Issues**

Environmental Pollution and Waste Management, Climate Change, Greenhouse Effect and Global Warming, Radiation, Nuclear and Technological Hazards, Population Growth, Disaster, Pandemic, and Human Health Risks

**Unit 4 Environment and Society**

Origin and Evolution of Human; Social, Cultural, and Religious Structure and values of Environment, Traditional Wisdom, Indigenous/traditional Communities and Livelihood Security Industrial Society, Modernization and Adaptations to Natural and Anthropogenic variations, Environmental Movements, Environmental Ethics and Legislations, Connecting human society with conservation and management of water, energy, biodiversity, culture and heritage, and waste management

**Recommended Books:**


1. Erach Bharucha, Environmental Studies. 2004.UGC and BVIEER Pune
2. Singh, J.S., Singh, S.P., and Gupta, S.R., 2014. Ecology, Environmental Science, and Resource Conservation. Anamaya Publishers

# SEMESTER 2

## Lab Manual

| Digital Electronics Lab (SET/BIT/CP202) |
|---|
| **Course Content:**<br>1. Introduction to Lab Equipment: Study of Digital IC Trainer Kits, breadboards, power supplies, and multi-meters.<br>2. Basic Logic Gates: Verification of the truth tables of AND, OR, and NOT gates.<br>3. Universal Logic Gates: Verification of the truth tables of NAND and NOR gates, and implementing basic gates using them.<br>4. Exclusive Gates: Verification of XOR and XNOR gates and their applications.<br>5. Boolean Algebra: Verification of De Morgan's Theorems and simplification of logic expressions.<br>6. Combinational Circuits (Adders/Subtractors): Design and implementation of Half Adder, Full Adder, Half Subtractor, and Full Subtractor.<br>7. Data Processing Circuits: Study and verification of Multiplexers (MUX) and Demultiplexers (DEMUX).<br>8. Encoders & Decoders: Implementation of a 2-to-4 decoder and 4-to-2 encoder.<br>9. Sequential Circuits (Flip-Flops): Study of basic Flip-Flops (RS, JK, D, and T).<br>10. Shift Registers & Counters: Basic introduction to asynchronous/synchronous counters and shift registers (optional/advanced). |

| Computer-Based Numerical Techniques Lab (SET/BIT/CP203) |
|---|
| **Course Content:**<br>1. Write a Program to deduce errors involved in polynomial interpolation.<br>2. Write a Program for algebraic and transcendental equations using bisection, iterative, and the method of false position, also give the rate of convergence of roots in tabular form for each of these methods.<br>3. Write a Program to implement Bessel's functions, Newton's, Stirling's, and Lagrange's interpolation<br>4. Write a Program to implement the method of least squares curve fitting.<br>5. Write a Program to implement numerical differentiation using trapezoidal,<br>6. Simpson 3/8 rules.<br>7. Write a Program to show a frequency chart, regression analysis, linear square fit, and polynomial fit. |

# SEMESTER 2

| Data Structures and File Organization Lab (SET/BIT/SEP204) |
|---|
| **Course Content:**<br><br>1. Array and linked list operations, including insertion, deletion, traversal, searching, and updating of elements.<br>2. Stack and queue implementation using arrays and linked lists, including push, pop, enqueue, dequeue, and display operations.<br>3. Tree implementation, including binary tree and binary search tree creation, insertion, deletion, searching, and tree traversals.<br>4. Graph representation and traversal using adjacency matrix and adjacency list, Breadth First Search (BFS), and Depth First Search (DFS).<br>5. Hash table implementation using suitable hash functions and collision resolution techniques such as linear probing and chaining.<br>6. Implementation and comparative analysis of sorting and searching algorithms, including Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Linear Search, and Binary Search.<br>7. File organization techniques, including sequential, direct, and indexed file operations, basic indexing methods, and simple applications for efficient data storage and retrieval. |

| Office Automation Lab (SET/BIT/SEP205) |
|---|
| **Course Content:**<br>1. Document creation and formatting using word processing software, including text formatting, page layout, headers, footers, and tables.<br>2. Advanced document processing techniques, including styles, templates, mail merge, and macro creation.<br>3. Spreadsheet creation and data management using formulas, functions, sorting, filtering, and data validation.<br>4. Data analysis and visualization using spreadsheet software, including charts and graphs.<br>5. Financial and statistical computations using built-in spreadsheet functions and formulas.<br>6. Presentation creation and multimedia integration using slide designs, animations, transitions, and hyperlinks.<br>7. Database creation and management, including tables, queries, forms, reports, and relationships.<br>8. Integrated Office Automation project combining word processing, spreadsheets, presentations, and a database application |

# SEMESTER 3

**Course: Cyber Security (SET/BIT/CC301)**

**Course Objective:**

After successful completion of course the student will be able to

1. Remember the broad set of technical, social & political aspects of Cyber Security.
2. Understand the importance of ethical hacking, its tool and ethical hacking process.
3. Analyze security principles to system design.
4. Understand the methods for authentication, access control, intrusion detection and prevention in Cyber Security.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the fundamentals of cyber security and cyber threats.
2. Identify common cyber-attacks, vulnerabilities, and malware.
3. Apply ethical hacking and vulnerability assessment concepts.
4. Analyse social engineering attacks and prevention strategies.
5. Demonstrate knowledge of cyber laws, security practices, and cyber security initiatives in India.

**Course Content:**

**Unit-1 Introduction to Cyber Security**

Importance and challenges in Cyber Security, Cyberspace, and Cyber threats, Cyber warfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure

**Unit-2 Hackers and Cyber Crimes**

Types of Hackers - Hackers and Crackers, Cyber-Attacks and Vulnerabilities, Malware threats, Sniffing, Gaining Access - Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks. Worms, Trojans, Viruses, Backdoors

**Unit-3 Ethical Hacking**

Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modeling, Enterprise Information Security Architecture, Vulnerability Assessment and Penetration Testing

**Unit-4 Social Engineering**

Types of Social Engineering - Insider Attack - Preventing Insider Threats - Social engineering Targets and Defence Strategies

**Unit -5 IT Security Act & Cyber Security Initiatives in India**

IT Act, Hackers-Attacker-Countermeasures, Web Application Security, Counter Cyber Security Initiatives in India, Cyber Security Incident Handling, Cyber Security Assurance

**Recommended Books:**


1. “Cyber Security and Cyber Laws” by Nilakshi Jain
2. “Cyber Security” by Nina Godbole
3. “Beginners Guide to Ethical Hacking and Cyber Security” by Abhinav Ojha

# SEMESTER 3

**Course: Object Oriented Programming using C++ (SET/BIT/CC302)**

**Course Objective:** The objective of this course is to introduce students to the principles and concepts of object-oriented programming using the C++ programming language. The course aims to develop students' skills in designing and implementing object-oriented solutions to real-world problems.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the fundamental concepts of object-oriented programming.
2. Design and implement C++ programs using classes, objects, and inheritance.
3. Apply polymorphism and templates to develop reusable code.
4. Utilize advanced features of C++ to develop efficient and modular programs.

**Course Content:**

**Unit 1 Introduction to Object-Oriented Programming (OOP)**

OOP concepts: Abstraction, Encapsulation, Inheritance, Polymorphism, Procedural Vs. Object-Oriented Programming, Principles of OOP, and their benefits.

**Unit 2 C++ Programming Basics**

Program structure and basic syntax in C++, Namespaces, Identifiers, Variables, Constants, Enums, Operators, and typecasting in C++.

**Unit 3 Classes and Objects**

Classes and Objects in C++, Access specifiers: Public, Private, Protected, Constructors and Destructors in classes.

**Unit 4 Inheritance and Polymorphism**

Concept of Inheritance and its types, Polymorphism and function overloading, Virtual functions and abstract classes.

**Unit 5 Exception Handling and File I/O**

Introduction to exception handling, try-catch blocks, Exception propagation, File input and output operations in C++.

**Recommended Books:**


1. "C++ Primer" by Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo.
2. "Effective C++: 55 Specific Ways to Improve Your Programs and Designs" by Scott Meyers.

# SEMESTER 3

**Course: Computer Network (SET/BIT/CC303)**

**Course Objective:** The objective of this course is to provide students with an understanding of data communication and computer networks. The course aims to develop students' knowledge of network protocols, architectures, and technologies.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the fundamentals of data communication and networking concepts.
2. Analyze and design network architectures and topologies.
3. Configure and troubleshoot network devices and protocols.
4. Apply network security measures to protect data transmission.
5. Understand emerging trends and technologies in data communication and networks.

**Course Content:**

**Unit 1: Introduction to Data Communication & Networks**

Components of a data communication system, Types of networks, Network topologies, and communication protocols.

**Unit 2 Network Architecture and OSI Model**

Network architecture: client-server, peer-to-peer, OSI model layers and their functions, TCP/IP protocol suite.

**Unit 3 Data Link Layer and Network Devices**

Data link layer: framing, error detection, and flow control; network devices (switches, routers, bridges, etc.); MAC addressing; and Ethernet standards.

**Unit 4 Network Security and Wireless Networks**

Network security concepts: encryption, firewalls, VPN, Wireless networks, and technologies.

**Unit 5 Network Management and Emerging Technologies**

Network management and monitoring tools, Cloud computing and virtualization, Internet of Things (IoT).

**Recommended Books:**


1. "Computer Networking: A Top-Down Approach" by James F. Kurose and Keith W. Ross.
2. "Data Communications and Networking" by Behrouz A.Forouzan and Sophia Chung Fegan.

# SEMESTER 3

**Course: Python Programming (SET/BIT/SEC304)**

**Course Objective:** This course is designed as the first in a series introducing programming concepts using Python to Computer Science students. The course focuses on developing Python programming skills to solve problems across different domains. It also introduces the concept of object- oriented programming.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the basics of programming language
2. Develop, document, and debug modular Python programs.
3. Apply suitable programming constructs and built-in data structures to solve a problem.
4. Use and apply various data objects in Python.
5. Use classes and objects in application programs and handle files.

**Unit 1 Introduction to Programming**

Problem-solving strategies; Structure of a Python program; Syntax and semantics; Executing simple programs in Python.

**Unit 2 Creating Python Programs**

Identifiers and keywords; Literals, numbers, and strings; Operators; Expressions; Input/output statements; Defining functions; Control structures (conditional statements, loop control statements, break, continue, and pass, exit function), default arguments.

**Unit 3 Built-in data structures**

Mutable and immutable objects; Strings, built-in functions for string, string traversal, string operators and operations; Lists creation, traversal, slicing and splitting operations, passing list to a function; Tuples, sets, dictionaries and their operations.

**Unit 4 Object-Oriented Programming**

Introduction to classes, objects, and methods; Standard libraries

**Unit 5: File and exception handling**

File handling through libraries; Errors and exception handling.

**Recommended Books:**

1. "Effective Python: 90 Specific Ways to Write Better Python" by Brett Slatkin
2. "Python Crash Course" by Eric Matthes.

# SEMESTER 3

**Course: SQL** **(SET/BIT/DSE/E1.1)**

**Course Objective:**

The objective of this course is to introduce students to Structured Query Language (SQL) and relational database concepts. The course enables students to create, retrieve, modify, and manage data using SQL while understanding the fundamentals of relational database design

**Course Outcome:**

Upon successful completion of this course, students will be able to:

1. Understand the fundamentals of relational databases and SQL.
2. Write SQL queries for data retrieval and manipulation.
3. Create and modify database objects using DDL commands.
4. Apply joins, subqueries, and aggregate functions for data analysis.
5. Design normalized databases and enforce data integrity using constraints

**Course Content:**

**Unit 1: Introduction to SQL and Relational Databases**

Introduction to DBMS and RDBMS, features and applications of SQL, database objects, SQL syntax and conventions, SQL data types, SQL operators.

**Unit 2: Data Retrieval and Manipulation**

SELECT statement, filtering data using WHERE clause, sorting data using ORDER BY, DISTINCT clause, pattern matching using LIKE, INSERT statement, UPDATE statement, DELETE statement.

**Unit 3: Advanced SQL Queries**

Single-row and multi-row functions, aggregate functions, GROUP BY clause, HAVING clause, joins, subqueries, set operators.

**Unit 4: Data Definition Language and Integrity Constraints**

CREATE, ALTER, DROP and TRUNCATE commands, primary key, foreign key, unique, check and default constraints, maintaining data integrity.

**Unit 5: Database Design Fundamentals**

Database design principles, entity relationship concepts, normalization (1NF, 2NF and 3NF), views, indexes, transaction control using COMMIT, ROLLBACK and SAVEPOINT.

**Recommended Books:**


1. Ben Forta – *SQL in 10 Minutes a Day*
2. Alan Beaulieu, *Learning SQL: Generate, Manipulate, and Retrieve Data,* O'Reilly Media.
3. Rick F. van der Lans, *The SQL Guide to SQL: Standard SQL Explained,* Addison-Wesley.

# SEMESTER 3

**Course: PL/SQL (SET/BIT/DSE/E1.2)**

**Course Objective:**

The objective of this course is to introduce students to Oracle PL/SQL programming for developing procedural database applications. The course enables students to implement business logic using PL/SQL blocks, procedures, functions, cursors, exception handling, and triggers.

**Course Outcome:**

Upon successful completion of this course, students will be able to:

1. Understand the architecture and programming environment of PL/SQL.
2. Develop PL/SQL programs using variables, operators, and control structures.
3. Create procedures and functions for modular programming.
4. Use cursors and exception handling to build reliable database applications.
5. Implement triggers and packages for basic database automation.

**Course Content:**

**Unit 1: Introduction to PL/SQL**

Overview of PL/SQL, architecture of PL/SQL, structure of a PL/SQL block, variables, constants, data types, operators, input and output statements.

**Unit 2: Control Structures in PL/SQL**

Conditional statements, IF statement, CASE statement, LOOP, WHILE loop, FOR loop, nested blocks, variable scope.

**Unit 3: Procedures and Functions**

Stored procedures, functions, parameter passing (IN, OUT and IN OUT), calling procedures and functions, modular programming concepts.

**Unit 4: Cursors and Exception Handling**

Implicit cursors, explicit cursors, cursor attributes, parameterized cursors, predefined exceptions, user-defined exceptions, raising and handling exceptions.

**Unit 5: Triggers and Database Programming**

Introduction to triggers, BEFORE and AFTER triggers, row-level and statement-level triggers, packages, transaction control in PL/SQL, basic database application development using PL/SQL.

**Recommended Books:**


1. Steven Feuerstein, *Oracle PL/SQL Programming*.
2. Benjamin Rosenzweig and Elena Silvestrova, *Oracle PL/SQL by Example*.
3. Ivan Bayross, *SQL, PL/SQL: The Programming Language of Oracle*.

# SEMESTER 3

**Course: Indian Knowledge System (SET/BIT/VAC306)**

**Course Objective:** This course aims to provide participants with a comprehensive understanding of India's rich and diverse knowledge traditions, encompassing philosophy, literature, sciences, arts, and sustainable practices. Through the exploration of traditional wisdom and its contemporary relevance, this course seeks to foster appreciation, preservation, and responsible utilization of the Indian Knowledge System.

**Course Outcome:** By the end of this course, students should be able to:

1. Define and explain the concept and scope of the Indian Knowledge System (IKS).
2. Evaluate the contributions of renowned Indian scholars to philosophy, literature, mathematics, astronomy, medicine, yoga, and other disciplines.
3. Analyze ancient Indian literature, including Vedas, Upavedas, Puranas, and Upanishads, for insights into cultural and philosophical heritage.
4. Investigate the socio-cultural linkages between traditional, tribal, and ethnic communities and their knowledge systems.

**Course Content:**

**Unit 1 Introduction to Indian Knowledge System (IKS),**

Definition, Concept, Concept and Scope of IKS, IKS-based approaches on Knowledge Paradigms, IKS in ancient India, and in modern India

**Unit 2 IKS and Indian Scholars, Indian Literature**

Philosophy and Literature (Maharishi Vyas, Manu, Kanad, Pingala, Parasar, Banabhatta, Nagarjuna and Panini), Mathematics and Astronomy (Aryabhatta, Mahaviracharya, Bodhayan, Bhashkaracharya, Varahamihira and Brahmgupta), Medicine and Yoga (Charak, Susruta, Maharishi Patanjali and Dhanwantri), Sahitya (Vedas, Upvedas, Upavedas (Ayurveda, Dhanurveda, Gandharvaveda), Puran and Upnishad) and shad darshan (Vedanta, Nyaya. Vaisheshik, Sankhya, Mimamsa, Yoga, Adhyatma and Meditation), Shastra (Nyaya, vyakarana, Krishi, Shilp, Vastu, Natya and Sangeet)

**Unit 3 Indian Traditional/tribal/ethnic communities, their livelihood, and local wisdom**

Geophysical aspects, Resources and Vulnerability, Resource availability, utilization pattern and limitations, Socio-Cultural linkages with Traditional Knowledge System, Tangible and intangible cultural heritage.

**Unit 4 Unique Traditional Practices and Applied Traditional Knowledge**

Myths, Rituals, Spirituals, Taboos and Belief System, Folk Stories, Songs, Proverbs, Dance, Play, Acts and Traditional Narratives, Agriculture, animal husbandry, Forest, Sacred Groves, Water Mills, Sacred Water Bodies, Land, water and Soil Conservation and management Practices, Indigenous Bio-resource Conservation, Utilization Practices and Food Preservation Methods, Handicrafts, Wood Processing and Carving, -Fiber Extraction and Costumes, Vaidya (traditional health care system), Tantra-Mantra, Amchi Medicine System, Knowledge of dyeing, chemistry of dyes, pigments and chemicals

**Unit 5 Protection, preservation, conservation, and Management of the Indian Knowledge System**

Documentation and Preservation of IKS, Approaches for conservation and Management of nature and bio- resources, Approaches and strategies to protection and conservation of IKS

**Recommended Books:**


1. "Introduction To Indian Knowledge System: Concepts and Applications" by B. Mahadevan, Nagendra Pavana, Vinayak Rajat Bhat
2. "Traditional Knowledge System in India" by Amit Jha

# SEMESTER 3

## Lab Manual

| OOP USING C++ Lab (SET/BIT/CC302) |
|---|
| **Course Content:**<br>1. Implementation of input and output statements.<br>2. Implementation of control statements.<br>3. Implementation of functions.<br>4. Implementation of an array<br>5. Implementation of Classes, Constructor, and Destructor.<br>6. Implementation of files.<br>7. Implementation of OOP's Concepts (Inheritance, Polymorphism, Encapsulation, Friend, and Static Functions) |

| Python Programming Lab (SET/BIT/SEP304) |
|---|
| **Course Content:**<br>1. Basic Python programming concepts, including variables, data types, operators, input, and output operations.<br>2. Decision-making and looping statements using if-else, for, and while constructs.<br>3. String operations and pattern generation using built-in string functions and nested loops.<br>4. Functions and recursion, including user-defined functions, lambda functions, and recursive programs.<br>5. List, tuple, dictionary, and set operations for data storage and manipulation.<br>6. File handling operations, including file creation, reading, writing, and appending data.<br>7. Object-Oriented Programming concepts, including classes, objects, inheritance, and polymorphism.<br>8. Exception handling and module usage, including try-except blocks and importing built-in/user-defined modules. |

# SEMESTER 3

| SQL Lab (SET/BIT/DSE/EP1.1) |
|---|
| **Course Content:**<br>1. Create database and tables using SQL DDL commands such as CREATE, ALTER, and DROP.<br>2. Perform data insertion, modification, and deletion using INSERT, UPDATE, and DELETE commands.<br>3. Retrieve records using SELECT statements with filtering and sorting clauses.<br>4. Apply SQL operators and conditional expressions for data querying.<br>5. Use aggregate functions such as COUNT, SUM, AVG, MIN, and MAX for data analysis.<br>6. Implement integrity constraints, including PRIMARY KEY, FOREIGN KEY, UNIQUE, and NOT NULL.<br>7. Perform different types of joins to retrieve data from multiple related tables.<br>8. Write and execute subqueries and nested queries for complex data retrieval |

| PL/ SQL Lab (SET/BIT/DSE/EP1.2) |
|---|
| **Course Content:**<br>1. Write and execute PL/SQL programs using variables, constants, and data types.<br>2. Implement decision-making statements using IF-THEN, IF-THEN-ELSE, and CASE structures.<br>3. Develop PL/SQL programs using LOOP, WHILE LOOP, and FOR LOOP constructs.<br>4. Create and use procedures for performing database operations.<br>5. Create and invoke user-defined functions with input and output parameters.<br>6. Implement exception handling using predefined and user-defined exceptions.<br>7. Use cursors for processing multiple rows returned by SQL queries.<br>8. Create and manage packages containing related procedures and functions.<br>9. Develop database triggers for INSERT, UPDATE, and DELETE operations.<br>10. Design PL/SQL applications integrating procedures, functions, cursors, exceptions, and triggers for database management tasks. |

# SEMESTER 4

**Course: Informatics Cyber Laws (SET/BIT/CC401)**

**Course Objective:** The objective of this course is to provide students with an understanding of cyber laws and their implications in the field of informatics. The course aims to develop students' knowledge of legal frameworks, ethical considerations, and security measures related to information technology.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the legal frameworks and regulations governing cyberspace.
2. Identify and analyze legal issues related to information technology.
3. Evaluate the ethical implications of information technology practices.
4. Apply security measures to protect information systems and data.
5. Develop an understanding of the legal rights and responsibilities of individuals and organizations in cyberspace.

**Course Content:**

**Unit 1: Introduction to Informatics: Cyber Laws**

Overview of Cyber laws and their significance, Types of Cybercrimes and legal implications, Jurisdiction and challenges in Cyber law enforcement.

**Unit 2 Cyber Security and Data Privacy**

Cyber security threats and countermeasures, Data protection laws and regulations, Cybersecurity policies and practices.

**Unit 3 Legal Framework for E-commerce and Intellectual Property**

Laws related to e-commerce and electronic transactions, Intellectual Property laws, and their application in the digital environment.

**Unit 4 Privacy and Data Protection Laws**

Privacy laws and regulations, Data breach notification and handling, GDPR, and other global data protection laws.

**Unit 5 Cyber Crime Investigation and Digital Forensics**

Digital evidence and forensic techniques, Cybercrime investigation process, Role of digital forensics in legal proceedings.

**Recommended Books:**


1. "Cyber Law: Legal and Practical Considerations for Computer, E-commerce, and Intellectual Property" by Brett J. Trout.
2. "Cyberlaw: Management and Entrepreneurship" by Patricia L. Bellia, Paul Schiff Berman, and David G. Post.

# SEMESTER 4

**Course: Database Management System (SET/BIT/CC402)**

**Course Objective:** The objective of this course is to provide students with a comprehensive understanding of database management systems (DBMS) and their role in modern information management. The course aims to develop students' skills in designing, querying, and managing relational databases.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the concepts and principles of database management systems.
2. Design and create relational databases using SQL.
3. Query and manipulate data using SQL commands.
4. Apply normalization techniques to ensure data integrity.
5. Understand the principles of database administration and security.

**Course Content:**

**Unit 1: Introduction to Database Management System**

Overview of database systems and their components, Data models: hierarchical, network, relational, and object-oriented, Relational database concepts: tables, tuples, attributes, keys, etc.

**Unit 2 Entity-Relationship Diagrams and Normalization**

Entity-Relationship (ER) modeling, Functional dependencies and normalization, Normal forms: 1NF, 2NF, 3NF, BCNF.

**Unit 3 Query Languages and Transactions**

SQL fundamentals: SELECT, INSERT, UPDATE, DELETE, Joins and subqueries, ACID properties, and transaction management.

**Unit 4 Indexing and Concurrency Control**

Indexing techniques: B-trees, hash indexes, etc., Concurrency control methods: locking, timestamping, etc., Database recovery and backup strategies.

**Recommended Books:**


1. "Database System Concepts" by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan.
2. "SQL Performance Explained" by Markus Winand.

# SEMESTER 4

**Course: Software Engineering (SET/BIT/CC403)**

**Course Objective:** The objective of this course is to provide students with an understanding of software engineering principles, processes, and methodologies. The course aims to develop students' skills in software requirements analysis, design, implementation, and testing.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the principles and practices of software engineering.
2. Apply software engineering processes and methodologies to develop software systems.
3. Perform requirements analysis and software design.
4. Implement software using appropriate programming languages and development tools.
5. Apply software testing and quality assurance techniques.

**Course Content:**

**Unit 1 Introduction to Software Engineering**

Software development life cycle (SDLC) models, Requirements engineering and analysis, and software project management.

**Unit 2 Software Design and Architecture**

Software design principles and patterns, Architectural styles: layered, client-server, etc., UML, and design documentation.

**Unit 3 Software Development Methodologies**

Agile software development: Scrum, Kanban, etc., Waterfall and iterative development approaches, Quality assurance and software testing.

**Unit 4 Software Maintenance and Configuration Management**

Software maintenance and its challenges, Version control and configuration management, Software re-engineering and refactoring.

**Unit 5 Software Metrics and Emerging Practices**

Software metrics and measurement, Software documentation and knowledge management, Emerging practices in software engineering (DevOps), etc.

**Recommended Books:**

1. "Software Engineering: A Practitioner's Approach" by Roger S. Pressman.
2. "Software Engineering: Principles and Practice" by Hans van Vliet.

# SEMESTER 4

**Course: Design and Analysis of Algorithm (SET/BIT/CC404)**

**Course Objective:** The objective of this course is to provide students with a solid foundation in algorithm analysis and design techniques. The course aims to develop students' skills in solving computational problems, analyzing algorithm complexity, and designing efficient algorithms.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the fundamentals of algorithm analysis and design.
2. Analyze the time and space complexity of algorithms.
3. Apply algorithmic techniques to solve computational problems.
4. Design and implement efficient algorithms for real-world scenarios.
5. Evaluate and compare different algorithmic approaches for problem solving.

**Course Content:**

**Unit 1: Introduction to Algorithms**

Basics of algorithms and problem-solving techniques, Asymptotic analysis: Big-O notation, time and space complexity, Algorithm design paradigms.

**Unit 2 Sorting and Searching Algorithms**

Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Linear and Binary Search.

**Unit 3 Divide and Conquer Algorithms**

Binary search, Merge sort, Closest pair problem, Karatsuba multiplication.

**Unit 4 Dynamic Programming and Greedy Algorithms**

Fibonacci series, Knapsack problem, Dijkstra's algorithm, Prim's algorithm, Huffman coding.

**Unit 5 Graph Algorithms and NP-Completeness**

Depth-First Search (DFS) and Breadth-First Search (BFS), Shortest path algorithms, Introduction to NP-Completeness and the P vs. NP problem.

**Recommended Books:**

1. "Introduction to the Design and Analysis of Algorithms" by Anany Levitin.
2. "Algorithm Design Manual" by Steven S. Skiena.

# SEMESTER 4

**Course: .NET framework & C# (SET/BIT/DSE/E2.1)**

**Course Objective:** The ASP .NET course aims to equip students with a strong foundation in developing dynamic web applications using the ASP .NET framework. Throughout the course, participants will learn to design and build interactive web pages, using languages such as C# for server-side logic. They will grasp the Model-View-Controller (MVC) architecture, which is essential for creating scalable, maintainable web applications.

**Course Outcome:** By the end of this course, students should be able to:

1. To learn the fundamentals of. net framework
2. To enrich knowledge about Windows Forms, Controls, and ASP.NET-based applications.
3. To acquire skills to create web-based applications and reports using .NET technologies

**Course Content:**

**Unit 1: Introduction to .NET Framework and Managed Code**

NET Framework - Common Language Runtime (CLR) - .NET Framework Class Library - .NET Windows Forms – Uses of Web Forms & Web Services - Common Language Runtime (CLR) – Common Type System - Microsoft Intermediate Language (MSIL) - Components of the CLR - Distinguish Between the .NET Compilers – Organizing and Executing Managed Code. NET Framework Class Library – Namespace – Input and Output - Serialization – Working with XML – Remoting – Enterprise Services – Interoperability – GUIs

**Unit 2 NET Languages:**

C# Language Fundamentals – Classes and Objects – Methods – Fields and Properties - Inheritance and Polymorphism – Operator Overloading – Struts - Interfaces – Arrays – Indexers and Collections – Strings and Regular Expressions – Handling Exceptions – Delegates and Events.

**Unit 3 VB .NET:**

Language Fundamentals – Classes and Objects – Methods – Fields and Properties - Inheritance and Polymorphism – Operator Overloading – Interfaces – Arrays – Indexers and Collections – Strings and Regular Expressions. Handling Exceptions – Delegates and Events - Accessing Data – ADO.NET Object Model- .NET Data Providers – Direct Access to Data – Accessing Data with Datasets.

**Unit 4 C# and ASP.NET**

C# Tools, Operands, Data types, Classes, Inheritance, Events and Delegates, Multithreading, Collections, Generics, Reflection, Remoting. ActiveX Data Object: ADO.NET Architecture, Connected Architecture, Disconnected Architecture, Dataset, Data Provider, Data Reader. Server Control, State Management, Master Page, Skin and Theme, Caching, Security, Globalization

**Unit 5 J2EE**

Enterprise Edition Overview - Multi-Tier Architecture - Best Practices-Comparison between J2EE and .NET.

**Recommended Books:**


1. "Professional ASP.NET 4.5 in C# and VB" by Jason N. Gaylord, Christian Wenz, Pranav Rastogi, Todd Miranda, and Scott Hanselman
2. "ASP.NET Core 5 for Beginners" by Jonas Fagerberg

# SEMESTER 4

**SET/BIT/DSE/E2.2 Introduction to Django**

**Course Objective:**

To introduce students to the Django framework and its role in modern web application development using Python. develop skills in designing dynamic, database-driven web applications using Django models, views, templates, and forms. Enable students to build secure, scalable web applications and REST APIs, and understand deployment practices.

**Course Outcome:**

1. Understand Django architecture and develop basic web applications using Python and Django.
2. Design and manage databases using Django Models and ORM.
3. Develop dynamic web pages using Views, URL routing, Templates, and Forms.
4. Implement authentication, authorization, and database-driven web applications**.**

**Course Content:**

**Unit–1: Introduction to Django and Python Web Development**

Overview of Web Development and MVC/MVT Architecture, Introduction to Django Framework, Installing Python and Django, Creating a Django Project and Application, Django Project Structure and Configuration, URL Routing and Views.

**Unit–2: Templates and Static Files**

Django Templates and Template Language, Template Inheritance, Passing Data from Views to Templates, Static Files Management (CSS, JavaScript, Images), Working with Forms, Form Validation.

**Unit–3: Models and Database Management**

Introduction to Models, Database Configuration in Django, Creating and Managing Models, Migrations and ORM (Object Relational Mapping), and CRUD Operations using Django ORM Query Sets and Model Relationships.

**Unit–4: Authentication and Administration**

Django Admin Interface, User Authentication and Authorization, User Registration, Login, and Logout, Managing User Permissions, Session and Cookie Management, Security Features in Django

**Unit–5: Advanced Django Development**

Class-Based Views, Django REST Framework Basics, File Upload and Media Handling, Deployment of Django Applications, and Introduction to API Development.

**Recommended Books:**


1. **"Django for Beginners: Build websites with Python and Django "**by William S. Vincent.
2. **"Web development with Django: Learn to Build modern web applications"** by Ben Shaw. Shaurabh Badhwar

# SEMESTER 4

**Course: R Programming (SET/BIT/SEC406)**

**Course Objective:** The R Programming course aims to provide participants with a comprehensive understanding of the R programming language and its applications in data analysis and statistical computing. Participants will start by gaining proficiency in the basics of R syntax, data structures, and control flow. As the course progresses, they will delve into data manipulation, visualization, and statistical analysis using R's extensive ecosystem of packages.

**Course Outcome:** By the end of this course, students:

1. Be able to use and program in the programming language R
2. Be able to use R to solve statistical problems
3. Be able to implement and describe the Monte Carlo technology
4. Be able to minimize and maximize functions using R

**Course Content:**

**Unit 1: Getting Started with R**

Introduction to R Programming, Setting Up R Studio, Basics of R Syntax, Storing Data with Variables, Displaying Data: Input and Output

**Unit 2: Working with Data**

Different Data Types in R, Organizing Data: Vectors and Matrices, Cleaning and Transforming Data, Basic Data Analysis, Creating Simple Charts

**Unit 3: Coding Control and Functions**

Making Choices with if and else, looping with for and while, Building Own Functions, Using Functions Effectively, Handling Mistakes: Debugging

**Unit 4: Creating Visuals**

Introduction to Data Visualization, Simple Plots with R, Customizing Graphics, Creating More Advanced Plots, Interactive Visualizations

**Unit 5: Understanding Data Patterns**

Exploring Data Stats, Basics of Hypothesis Testing, Understanding Regression, Introduction to Machine Learning, Practical Applications: Classification and Clustering

**Recommended Books:**


1. R Programming for Data Science by Roger D. Peng
2. The Art of R Programming by Prashanth Singh, Vivek Mourya, Cengage Learning India.

# SEMESTER 4

## Lab Manual

| Database Management System Lab (SET/BIT/CP402) |
|---|
| **Course Content:**<br>1. Write the queries for the Data Definition and Data Manipulation language.<br>2. Write SQL queries using Logical operators (=, <,>, etc.).<br>3. Write SQL queries using SQL operators (Between…. AND, IN (List), Like, ISNULL, and also with negating expressions).<br>4. Write an SQL query using character, number, date, and group functions.<br>5. Write SQL queries for Relational Algebra (UNION, INTERSECT, and MINUS, etc.).<br>6. Write SQL queries for extracting data from more than one table (Equip-Join, Non-Equip-Join, Outer Join)<br>7. Write SQL queries for sub-queries and nested queries.<br>8. Write programs using PL/SQL.<br>9. Concepts for ROLLBACK, COMMIT & CHECKPOINTS.<br>10. Create VIEWS, CURSORS, and TRIGGRS & write ASSERTIONS,<br>11. Create FORMS and REPORTS. |

| Design and Analysis of Algorithms (SET/BIT/CP404) |
|---|
| **Course Content:**<br>1. Analyze the time and space complexity of algorithms using asymptotic notations.<br>2. Implement searching algorithms such as Linear Search and Binary Search.<br>3. Develop programs for sorting algorithms, including Bubble Sort, Selection Sort, and Insertion Sort.<br>4. Implement Divide and Conquer algorithms such as Merge Sort and Quick Sort.<br>5. Design and implement recursive algorithms for mathematical and computational problems.<br>6. Develop programs using the Greedy Method for optimization problems.<br>7. Implement Dynamic Programming algorithms such as the Fibonacci and Knapsack problems.<br>8. Design and implement algorithms for graph traversal using Breadth First Search (BFS) and Depth First Search (DFS).<br>9. Develop programs for the shortest path and minimum spanning tree algorithms.<br>10. Compare the performance of different algorithms based on execution time and computational complexity. |

# SEMESTER 4

| .NET framework & C# Lab (SET/BIT/DSE/EP2.1) |
|---|
| **Course Content:**<br>1. Create and execute simple C# programs using input, output, variables, and data types.<br>2. Develop programs using operators, expressions, conditional statements, and loops in C#.<br>3. Create classes and objects to demonstrate object-oriented programming concepts.<br>4. Implement inheritance, polymorphism, encapsulation, and abstraction in C# applications.<br>5. Develop programs for exception handling and file handling in .NET applications.<br>6. Design Windows Forms applications using common controls such as labels, text boxes, buttons, and menus.<br>7. Create ASP.NET web pages using server controls and web forms.<br>8. Develop ASP.NET applications for form validation and user input processing.<br>9. Implement database connectivity in ASP.NET using ADO.NET for CRUD operations.<br>10. Develop a mini web application integrating ASP.NET, C#, and database management features. |

| Django Lab (SET/BIT/DSE/EP2.2) |
|---|
| **Course Content:**<br>1. Install Python and Django, and create a basic Django project.<br>2. Create and configure Django applications within a project.<br>3. Implement URL routing and develop function-based views.<br>4. Design web pages using Django templates and template inheritance.<br>5. Create and process forms with validation in Django.<br>6. Develop database models and perform migrations using Django ORM.<br>7. Implement CRUD (Create, Read, Update, Delete) operations on database records.<br>8. Develop user registration, login, logout, and authentication modules.<br>9. Manage static files, media files, and file upload functionality.<br>10. Develop and deploy a mini web application integrating templates, forms, databases, and user authentication. |

| R Programming Lab (SET/BIT/DSE/SEP406) |
|---|
| **Course Content:**<br>1. Write a program to perform basic arithmetic operations using variables and operators in R.<br>2. Create and manipulate vectors, matrices, arrays, and lists using R data structures.<br>3. Write programs using conditional statements (if, if-else, and switch) for decision making.<br>4. Write programs using loops (for, while, and repeat) to generate series and perform repetitive tasks.<br>5. Create user-defined functions for solving mathematical and statistical problems.<br>6. Perform data frame operations, including creation, modification, sorting, filtering, and data extraction.<br>7. Read and write data files using CSV and Excel formats for data analysis.<br>8. Perform statistical analysis, including mean, median, mode, variance, standard deviation, and correlation.<br>9. Create data visualizations including bar charts, pie charts, histograms, line graphs, and scatter plots.<br>10. Implement simple regression and predictive analysis models using R for data interpretation and decision making. |

# SEMESTER 5

**Course: Programming with JavaScript (SET/BIT/DSE/E3.1)**

**Course Objective:**

The objective of this course is to provide B.Sc. students with a comprehensive understanding of client-side web scripting using JavaScript. The course focuses on building computational thinking within a browser environment, mastering fundamental programming constructs, manipulating dynamic webpage structures through the Document Object Model (DOM), handling interactive events, and introduces foundational asynchronous programming paradigms.

**Course Outcome:** By the end of this course, students should be able to:

1. Apply standard structural programming logic, expressions, and data handling structures within client-side scripts.
2. Design robust logical modules using scoped functions, array manipulation methods, and JavaScript objects.
3. Manipulate runtime page components dynamically by traversing, restructuring, and formatting the browser DOM tree.
4. Implement adaptive web event interfaces by capturing user interactions and styling behaviors dynamically.
5. Evaluate client-side validation logic and manage data communication using JavaScript object notations.

**Course Content:**

**Unit I: Introduction to JavaScript and Core Fundamentals**

Introduction to JavaScript, features and applications of JavaScript, JavaScript execution in web browsers, embedding JavaScript in HTML (Inline, Internal, and External), syntax, statements, comments, input and output operations (alert(), prompt(), console.log()), variables (var, let, const), data types, type conversion, operators, strings, string methods, Number and Math objects.

**Unit II: Control Structures, Arrays and Functions**

Conditional statements (if, if-else, if-else-if, switch), looping statements (for, while, do-while, for...of), loop control statements (break, continue), arrays, array methods (push, pop, shift, unshift, splice, slice, forEach), functions, function declaration, function expressions, arrow functions, parameters, return statement, variable scope.

**Unit III: Objects, Browser Object Model and Built-in Objects**

JavaScript objects, object literals, properties and methods, object iteration, Browser Object Model (BOM), Window object, dialog boxes (alert, confirm, prompt), timers (setTimeout, setInterval), Location, Navigator and History objects, Date object, introduction to JSON.

**Unit IV: Document Object Model (DOM)**

Introduction to Document Object Model (DOM), DOM tree structure, selecting elements (getElementById, getElementsByClassName, getElementsByTagName, querySelector, querySelectorAll), DOM manipulation, creating, appending, replacing and removing elements, modifying content (innerHTML, textContent), attributes, CSS manipulation using style and classList.

**Unit V: Event Handling, Forms and Client-Side Storage**

JavaScript events, event handling, addEventListener(), mouse events, keyboard events, form events, form validation, handling text fields, radio buttons, checkboxes and select elements, localStorage, sessionStorage, introduction to exception handling (try, catch, finally), debugging techniques.

**Recommended Books:**


1. "JavaScript: The Definitive Guide" by David Flanagan.
2. "Eloquent JavaScript: A Modern Introduction to Programming" by Marijn Haverbeke.

# SEMESTER 5

**Course: PHP (SET/BIT/DSE/E3.2)**

**Course Objective:** The PHP programming course aims to provide participants with a comprehensive understanding of the PHP programming language and its applications for handling HTML forms. Participants will start by gaining proficiency in the basics of PHP syntax, functions, and control flow. As the course progresses, they will delve into string manipulation and regular expressions.

**Course Content:**

**Unit 1: Introduction to PHP**

PHP introduction, inventions and versions, important tools and software requirements (like Web Server, Database, Editors etc.), PHP with other technologies, scope of PHP, Basic Syntax, PHP variables and constants, Types of data in PHP, Expressions, scopes of a variable (local, global), PHP Operators: Arithmetic, Assignment, Relational, Logical operators, Bitwise, ternary and MOD operator. PHP operator Precedence and associativity

**Unit 2: Handling HTML form with PHP**

Capturing Form Data, GET and POST form methods, dealing with multi-value fields, and redirecting a form after submission.

**Unit 3: PHP Conditional Events and Loops:**

PHP IF Else conditional statements (Nested IF and Else), Switch case, while, For and Do While Loop, Goto, Break, Continue, and exit

**Unit 4: PHP Functions:**

Function, Need of Function, declaration and calling of a function, PHP Function with arguments, Default Arguments in Function, Function argument with call by value, call by reference, Scope of Function, Global and Local

**Unit 5: String Manipulation and Regular Expression:**

Creating and accessing String, Searching & Replacing String, Formatting, joining and splitting String, String Related Library functions, Use and advantage of regular expression over inbuilt function, Use of preg_match(), preg_replace(), preg_split() functions in regular expression

**Unit 6: Array:**

Anatomy of an Array, creating index-based and associative arrays, accessing arrays, looping with index-based arrays, with associative arrays using each() and foreach(), Some useful library functions

**Recommended Books:**


1. Steven Holzner, "PHP: The Complete Reference Paperback", McGraw-Hill Education (India), 2007.
2. Timothy Boronczyk, Martin E. Psinas, "PHP and MYSQL (Create-Modify-Reuse)", Wiley India Private Limited, 2008.
3. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5", 3rd Edition, Paperback, O'Reilly, 2014.
4. Luke Welling, Laura Thompson, PHP and MySQL Web Development", 4th Edition, Addison-Wesley Professional,2008.
5. David Sklar, Adam Trachtenberg, "PHP Cookbook: Solutions & Examples for PHP Programmers", 2014.

# SEMESTER 5

**Course: Computer Graphics (SET/BIT/DSE/E4.1)**

**Course Objective:** The objective of this course is to provide students with a solid foundation in computer graphics principles and techniques. The course aims to develop students' skills in designing and rendering 2D and 3D graphics, understanding graphics algorithms, and applying graphics concepts in interactive applications.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the fundamentals of computer graphics and its applications.
2. Design and render 2D and 3D graphics using appropriate tools and libraries.
3. Implement graphics algorithms for transformations, rasterization, and shading.
4. Apply computer graphics concepts in interactive applications and virtual environments.
5. Analyze and optimize graphics performance in real-time applications.

**Course Content:**

**Unit 1 Introduction to Computer Graphics**

Overview of computer graphics and its applications, Graphics hardware and software, Graphics pipeline and rendering techniques

**Unit 2 2D Graphics and Transformations**

2D coordinate systems and transformations, Clipping and windowing techniques, 2D viewing and projection transformations

**Unit 3 3D Graphics and Transformations**

3D coordinate systems and transformations, Viewing and projection in 3D space, Hidden surface removal and visibility algorithms

**Unit 4 Rasterization and Shading**

Rasterization techniques: scanline, polygon filling, Shading models and illumination techniques, Texture mapping, and image-based rendering

**Unit 5 Interactive Graphics and Virtual Environments**

User interaction techniques in computer graphics, Virtual reality and augmented reality concepts, Real-time graphics programming and optimization

**Recommended Books:**


1. "Computer Graphics: Principles and Practice" by John F. Hughes, Andries van Dam, James D. Foley, Steven K. Feiner, and Kurt Akeley.
2. "OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.5" by John Kessenich, Graham Sellers, and Dave Shreiner.

# SEMESTER 5

**Course: Distributed System (SET/BIT/DSE/E4.2)**

**Course Objective:**

1. To have a broad and up-to-date coverage of the principles and practices in the area of Distributed Systems.
2. To understand the heterogeneous systems, such as computers, mobile phones, other devices, and the Internet) and their functionalities.

**Course Content:**

**UNIT I Basic Concepts**

Definition of a distributed system, Examples, Resource sharing and the Web, Challenges, System models, Architectural and fundamental models, Networking, Interprocess communication, External data representation and marshaling, Client-server and Group communication.

**UNIT II Distributed Objects and Processes**

Distributed objects and remote invocation, Communication between distributed objects, Remote procedure call, Events and notifications - The operating system layer, Protection, Processes and

Threads, Communication and invocation, OS Architecture. Security techniques, Cryptographic algorithms, Access control, Digital signatures, Cryptographic pragmatics, Needham-Schroeder, Kerberos, securing electronic transactions, IEEE 802.11 WiFi.

**UNIT III Operating System Issues**

Distributed file systems - Name services, Domain name system, Directory and discovery services, Peer to peer systems, Napster file sharing system, Peer to peer middleware routing overlays – Clocks, Events and process states, Clock Synchronization - Logical clocks, Global states - Distributed debugging, Distributed mutual exclusion, Elections, Multicast communication.

**UNIT IV Distributed Transaction Processing**

Transactions - Nested transactions - Locks - Optimistic concurrency control - Timestamp ordering - Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions - Distributed deadlocks - Transaction recovery - Overview of replication, Distributed shared memory, and Web services.

**UNIT V Distributed Algorithms**

Synchronous network model - Algorithms: leader election, maximal independent set -

Asynchronous system model: I/O automata, operations on automata, fairness - Asynchronous shared memory model - Mutual exclusion: model, the problem, stronger conditions, lockout-free mutual exclusion algorithms, lower bound on the number of registers - Asynchronous network model - Asynchronous network algorithms: leader election in a ring and an arbitrary network.

**Recommended Books:**


1. George Coulouris, Jean Dollimore, and Tim Kindberg, “Distributed Systems Concepts and Design”, 5th ed., Pearson Education, 2011.
2. Andrew S. Tanenbaum, Maarten van Steen, “Distributed Systems Principles and Paradigms”, 2nd ed., Pearson Education, 2006.
3. Nancy A. Lynch, “Distributed Algorithms”, Harcourt Asia Pvt. Ltd., Morgan Kaufmann, 2000.

# SEMESTER 5

**Course: Pattern Recognition (SET/BIT/DSE/E5.1)**

**Course Objective:** This course aims to provide students with a comprehensive understanding of pattern recognition and classification techniques. Starting with an introduction to the significance of pattern recognition, feature extraction, and classification methods, it covers supervised, unsupervised, and semi-supervised learning. The course delves into theoretical foundations, including Bayes Decision Theory, discriminant functions, and Gaussian PDF

**Course Outcome:** By the end of this course, students should be able to:

1. Identify areas where Pattern Recognition and Machine Learning can offer a solution.
2. Describe the strengths and limitations of some techniques used in computational Machine Learning for classification, regression, and density estimation problems
3. Describe genetic algorithms, validation methods, and sampling techniques
4. Describe and model data to solve problems in regression and classification
5. Implement learning algorithms for supervised tasks.

**Course Content:**

**Unit 1: Introduction to Pattern Recognition and Classification**

Importance of pattern recognition, Features, Feature Vectors, and Classifiers, Supervised, Unsupervised, and Semi-supervised learning, Introduction to Bayes Decision Theory, Discriminant Functions and Decision Surfaces, Gaussian PDF and Bayesian Classification for Normal Distributions.

**Unit 2 Dimensionality Reduction Techniques**

Introduction, Basis Vectors, The Karhunen Loeve (KL) Transformation, Singular Value Decomposition, Independent Component Analysis (Introduction only). Nonlinear Dimensionality Reduction, Kernel PCA.

**Unit 3 Probability Estimation and Bayesian Inference**

Maximum Likelihood Parameter Estimation, Maximum a Posteriori Probability estimation, Bayesian Interference, Maximum Entropy Estimation, Mixture Models, Naive-Bayes Classifier, The Nearest Neighbor Rule.

**Unit 4 Linear Discriminant Analysis and Perceptron Algorithm**

Introduction, Linear Discriminant Functions and Decision Hyperplanes, The Perceptron Algorithm, Mean Square Error Estimate, Stochastic Approximation of LMS Algorithm, Sum of Error Estimate.

**Unit 5 Neural Networks and Clustering Concepts**

The XOR Problem, The Two Layer Perceptron, The Three Layer Perceptron, Back Propagation Algorithm, Basic Concepts of Clustering, Introduction to Clustering, Proximity Measures.

**Recommended Books:**


1. "Pattern Recognition and Machine Learning" by Christopher M. Bishop
2. "Pattern Recognition: Principles" by Joachim M. Buhmann

# SEMESTER 5

**Course: Network Simulation & Modelling (SET/BIT/DSE/E5.2)**

**Course Objective:** The objective of this course is to provide students with an understanding of multimedia technology and its applications in various domains. The course aims to develop students' skills in designing and developing multimedia content, integrating multimedia elements, and applying multimedia technologies.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the concepts and components of multimedia technology.
2. Design and develop multimedia content using appropriate tools and techniques.
3. Integrate various multimedia elements such as text, images, audio, and video.
4. Apply multimedia technologies in interactive applications and presentations.
5. Evaluate and optimize multimedia content for different platforms and devices.

**Course Content:**

**Unit 1 Introduction to Multimedia Technology**

Overview of multimedia technology and its components, Multimedia elements: text, images, audio, video, Multimedia file formats and compression techniques

**Unit 2 Multimedia Authoring Tools and Techniques**

Multimedia authoring software and tools, Design principles for multimedia content, Multimedia scripting and programming languages

**Unit 3 Image and Video Processing in Multimedia**

Image and video acquisition and editing, Image and video compression techniques, Image and video enhancement and effects.

**Unit 4 Audio and Animation in Multimedia**

Digital audio concepts and formats, Audio editing and processing techniques, Animation principles and techniques.

**Unit 5 Multimedia Integration and Application Development**

Integration of multimedia elements in interactive applications, Multimedia in web design and development, Optimization and delivery of multimedia content.

**Recommended Books**


1. Keshav, S., *An Engineering Approach to Computer Networking*, Addison-Wesley.
2. James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach*, Pearson.
3. William Stallings, *Data and Computer Communications*, Pearson.
4. The NS-3 Consortium, *The ns-3 Network Simulator Documentation* (Official Documentation).
5. George F. Riley and Thomas R. Henderson, *The ns-3 Manual*.

# SEMESTER 5

**Course: Multimedia Application (SET/BIT/SEC504)**

**Course Objective:** The objective of this course is to provide students with an understanding of multimedia technology and its applications in various domains. The course aims to develop students' skills in designing and developing multimedia content, integrating multimedia elements, and applying multimedia technologies.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the concepts and components of multimedia technology.
2. Design and develop multimedia content using appropriate tools and techniques.
3. Integrate various multimedia elements such as text, images, audio, and video.
4. Apply multimedia technologies in interactive applications and presentations.
5. Evaluate and optimize multimedia content for different platforms and devices.

**Course Content:**

**Unit 1 Introduction to Multimedia Technology**

Overview of multimedia technology and its components, Multimedia elements: text, images, audio, video, Multimedia file formats and compression techniques

**Unit 2 Multimedia Authoring Tools and Techniques**

Multimedia authoring software and tools, Design principles for multimedia content, Multimedia scripting and programming languages

**Unit 3 Image and Video Processing in Multimedia**

Image and video acquisition and editing, Image and video compression techniques, Image and video enhancement and effects

**Unit 4 Audio and Animation in Multimedia**

Digital audio concepts and formats, Audio editing and processing techniques, Animation principles and techniques

**Unit 5 Multimedia Integration and Application Development**

Integration of multimedia elements in interactive applications, Multimedia in web design and development, Optimization and delivery of multimedia content

**Recommended Books:**


1. "Multimedia: Making It Work" by Tay Vaughan.
2. "Multimedia Systems: Algorithms, Standards, and Industry Practices" by Parag Havaldar and Gerard Medioni.

# SEMESTER 5

# Lab Manual

| Programming with Javascript Lab (SET/BIT/DSE/EP3.1) |
|---|
| **Course Content:**<br>1. Installation and configuration of a JavaScript development environment, embedding JavaScript in HTML documents, implementation of variables, data types, operators, input/output operations, and basic string, number, and Math object operations.<br>2. Development of programs using conditional statements, looping constructs, arrays, array methods, functions, arrow functions, and variable scope.<br>3. Implementation of JavaScript objects, object properties and methods, Date object, JSON handling, and Browser Object Model (BOM) components including Window, Location, Navigator, History, and timer functions.<br>4. Document Object Model (DOM) manipulation, including element selection, creation, modification, deletion, attribute handling, and dynamic HTML content generation.<br>5. Event-driven programming using mouse, keyboard, and form events, implementation of event listeners, dynamic CSS manipulation using style and classList.<br>6. Development of client-side form validation, handling text fields, radio buttons, checkboxes, select controls, and implementation of browser storage using localStorage and sessionStorage.<br>7. Implementation of exception handling using try, catch, and finally, debugging JavaScript programs, and error handling techniques.<br>8. Mini project involving the development of an interactive web application using JavaScript, DOM manipulation, event handling, form validation, browser storage, and dynamic user interface components. |

| PHP Lab (SET/BIT/DSE/EP3.2) |
|---|
| **Course Content:**<br>1. Create basic PHP programs demonstrating variables, constants, operators, and input/output statements.<br>2. Develop programs using decision-making and looping constructs such as if-else, switch, for, while, and foreach.<br>3. Implement functions and arrays, including user-defined functions and array manipulation techniques.<br>4. Perform string and date operations using built-in PHP functions.<br>5. Develop web forms and process user input using GET and POST methods.<br>6. Implement file handling operations, including file creation, reading, writing, and uploading.<br>7. Manage session and cookie handling for maintaining user state and authentication.<br>8. Establish database connectivity using PHP and MySQL and perform CRUD (Create, Read, Update, Delete) operations.<br>9. Develop dynamic web applications using PHP with HTML, CSS, and MySQL integration.<br>10. Create a mini web-based project such as a student management system, employee management system, or online registration system using PHP and MySQL. |

# SEMESTER 5

| Computer Graphics Lab (SET/BIT/DSE/EP4.1) |
|---|
| **Course Content:**<br>1. Introduction to computer graphics and graphics programming environment, including drawing basic geometric shapes and objects.<br>2. Implementation of line drawing algorithms such as DDA (Digital Differential Analyzer) and Bresenham's Line Drawing Algorithm.<br>3. Implementation of circle and ellipse drawing algorithms using Bresenham's and Midpoint methods.<br>4. Implementation of two-dimensional transformations, including translation, rotation, scaling, reflection, and shearing.<br>5. Implementation of line clipping algorithms such as Cohen-Sutherland and Liang-Barsky algorithms.<br>6. Implementation of polygon clipping and window-to-viewport transformations for graphical object display.<br>7. Implementation of two-dimensional viewing and projection techniques for graphical scene representation.<br>8. Implementation of basic animation techniques, including object movement and frame-by-frame animation.<br>9. Implementation of three-dimensional transformations, including translation, rotation, scaling, and projection.<br>10. Development of simple computer graphics applications using graphics libraries to create interactive graphical scenes and animations. |

| Distributed System Lab (SET/BIT/DSE/EP4.2) |
|---|
| **Course Content:**<br>1. Study and configuration of distributed computing environments using client-server architecture and network communication tools.<br>2. Implementation of inter-process communication (IPC) using pipes, message queues, and shared memory mechanisms.<br>3. Development of client-server applications using socket programming for data exchange over a network.<br>4. Implementation of Remote Procedure Call (RPC) mechanisms for communication between distributed processes.<br>5. Development of multi-threaded distributed applications for concurrent task execution and resource sharing.<br>6. Implementation of distributed file system operations for file sharing and remote access.<br>7. Implementation of synchronization techniques using semaphores and mutexes in distributed environments.<br>8. Simulation of distributed mutual exclusion and deadlock handling algorithms for resource management.<br>9. Implementation of distributed communication protocols for reliable message passing and coordination among nodes.<br>10. Development of a mini distributed application demonstrating client-server communication, resource sharing, and distributed processing |

# SEMESTER 5

| Pattern Recognition Lab (SET/BIT/DSE/EP5.1) |
|---|
| **Course Content:**<br>1. Implementation of data preprocessing techniques, including data cleaning, normalization, and feature extraction.<br>2. Implementation of distance and similarity measures for pattern classification and recognition.<br>3. Implementation of Bayesian classification techniques for supervised pattern recognition.<br>4. Implementation of the k-Nearest Neighbor (KNN) algorithm for pattern classification and prediction.<br>5. Implementation of Decision Tree classification for recognizing and categorizing patterns.<br>6. Implementation of clustering techniques such as K-Means for unsupervised pattern recognition.<br>7. Implementation of Artificial Neural Networks (ANN) for pattern learning and classification tasks.<br>8. Implementation of a pattern recognition application involving classification, clustering, and performance evaluation on a real-world dataset. |

| Network Simulation & Modeling Lab (SET/BIT/DSE/EP5.2) |
|---|
| **Course Content:**<br>1. Study of network simulation tools and configuration of basic network topologies for simulation experiments.<br>2. Simulation of LAN and WAN topologies to analyze network connectivity and communication.<br>3. Implementation of network performance analysis, including throughput, delay, packet loss, and bandwidth utilization.<br>4. Simulation of routing protocols and evaluation of route selection and packet forwarding mechanisms.<br>5. Implementation of TCP and UDP communication models to analyze transport-layer performance.<br>6. Simulation of congestion control mechanisms and their impact on network efficiency.<br>7. Implementation of wireless network models and analysis of communication between mobile nodes.<br>8. Simulation of network traffic generation and monitoring for performance evaluation under different load conditions.<br>9. Implementation of queue management techniques and packet scheduling algorithms in network environments.<br>10. Development of a network simulation project involving topology design, protocol configuration, performance analysis, and result interpretation. |

# SEMESTER 6

**Course: Operating System (SET/BIT/CC601)**

**Course Objective:** The objective of this course is to provide students with a comprehensive understanding of operating systems and their functionalities. The course aims to develop students' knowledge of process management, memory management, file systems, and device management in an operating system environment.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the basic concepts and components of operating systems.
2. Explain the functionalities and mechanisms of process management in an operating system.
3. Understand memory management techniques and algorithms.
4. Demonstrate knowledge of file systems and file management in an operating system.
5. Understand the principles of device management and I/O operations in an operating system.

**Course Content:**

**Unit 1: Introduction to Operating Systems**

Overview of operating systems and their role, Types of operating systems: batch processing, time-sharing, real-time, distributed, Operating system components and architecture

**Unit 2 Process Management & Deadlock**

Process concept and process control block, Process scheduling algorithms: FCFS, SJF, Round Robin, etc., Inter-Process communication and synchronization, Deadlock, Deadlock prevention, avoidance, detection, and recovery, Resource allocation graphs and deadlock handling algorithms, Banker's algorithm for resource allocation and safety

**Unit 3 Memory Management**

Memory hierarchy and memory management techniques, Paging, segmentation, and virtual memory, Memory allocation and deallocation strategies, Page Replacement algorithms

**Unit 4 File Systems**

File concepts and file organization, File operations: creation, deletion, read, write, File allocation methods: contiguous, linked, indexed.

**Unit 5 Device Management**

I/O devices and device controllers, I/O operations and I/O scheduling, Disk scheduling algorithms

**Recommended Books:**


1. "Operating System Concepts" by Abraham Silberschatz, Peter B. Galvin, and Greg Gagne.
2. "Modern Operating Systems" by Andrew S. Tanenbaum and Herbert Bos.

# SEMESTER 6

**Course: Artificial Intelligence (SET/BIT/DSE/E6.1)**

**Course Objective:** The objective of this course is to provide students with an understanding of artificial intelligence and its various techniques and applications. The course aims to develop students' skills in designing and implementing AI systems, solving AI problems, and exploring the ethical considerations of AI.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the fundamental concepts and techniques of artificial intelligence.
2. Apply AI algorithms and methodologies to solve real-world problems.
3. Design and develop AI systems using appropriate tools and frameworks.
4. Evaluate and optimize AI models for performance and accuracy.
5. Recognize and analyze the ethical implications of AI technologies.

**Course Content:**

**Unit 1: Introduction to Artificial Intelligence**

Overview of artificial intelligence and its applications, History and foundations of AI, Ethical considerations in AI development and deployment

**Unit 2 Problem Solving and Search Algorithms**

Problem-solving techniques and algorithms, Search algorithms: uninformed and informed search, Heuristic search and optimization algorithms

**Unit 3 Knowledge Representation and Reasoning**

Knowledge representation techniques: logic, semantic networks, and frames, Inference mechanisms and reasoning algorithms, Uncertainty and probabilistic reasoning in AI

**Unit 4 Machine Learning and AI Models**

Introduction to machine learning algorithms, Supervised, unsupervised, and reinforcement learning, Deep learning and neural networks for AI applications

**Unit 5 AI Systems and Applications**

Natural language processing and understanding, Computer vision and image recognition, AI in robotics and autonomous systems

**Recommended Books:**

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
2. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy.

# SEMESTER 6

**Course: Social Network Analysis (SET/BIT/DSE/E6.2)**

**Course Objective**

The objective of this course is to introduce students to the fundamentals of social networks, Semantic Web technologies, and social network analysis. The course aims to develop an understanding of network structures, community analysis, user behaviour, privacy, and visualization techniques, along with their applications in various domains.

**Course Outcomes**

By the end of this course, students should be able to:

1. Understand the concepts of social networks, the Semantic Web, and their applications.
2. Analyze social network structures using basic graph and network analysis techniques.
3. Apply methods for modelling, representing, and mining social network data.
4. Understand user behaviour, privacy, trust, and security issues in online social networks.
5. Interpret and visualize social network data for solving real-world problems.

**Unit I: Introduction**

Introduction to the Semantic Web, limitations of the traditional Web, evolution of the Semantic Web, Social Web, social networks, social network analysis, network concepts and measures, electronic discussion networks, blogs, online communities, web-based networks, applications of social network analysis.

**Unit II: Modelling, Aggregating and Knowledge Representation**

Ontology and knowledge representation, Semantic Web ontologies, Resource Description Framework (RDF), Web Ontology Language (OWL), social network data representation, modelling social individuals and relationships, data aggregation, reasoning with social network data, introduction to advanced representations.

**Unit III: Extraction and Mining Communities in Web Social Networks**

Web community evolution, web archives, community detection, community evaluation, community mining methods, applications of community mining, social network analysis tools, online social network infrastructure, decentralized social networks, dynamic social network communities.

**Unit IV: Predicting Human Behaviour and Privacy Issues**

User behaviour analysis, user data management, inference and information distribution, context awareness, privacy in online social networks, trust models, trust network analysis, reputation systems, trust comparison, cyber attacks, security measures and countermeasures.

**Unit V: Visualization and Applications of Social Networks**

Graph theory, centrality, clustering, node-link diagrams, matrix representation, network visualization techniques, hybrid visualization methods, collaboration networks, co-citation networks, community welfare, social network applications.

**Recommended Books**


1. Matthew A. Russell, *Mining the Social Web*, O'Reilly Media.
2. Easley, D. and Kleinberg, J., *Networks, Crowds, and Markets: Reasoning About a Highly Connected World*, Cambridge University Press.
3. John Scott, *Social Network Analysis*, Sage Publications.
4. Peter Mika, *Social Networks and the Semantic Web*, Springer.

# SEMESTER 6

**Course: Machine Learning (SET/BIT/DSE/E7.1)**

**Course Objective:** The course aims to introduce the basic concepts and techniques of machine learning so that a student can apply them to a given problem.

**Course Outcome:** By the end of this course, students should be able to:

1. Differentiate between supervised and unsupervised learning tasks.
2. Differentiate between linear and non-linear classifiers.
3. Describe the theoretical basis of SVM
4. Implement various machine learning algorithms learned in the course.

**Course Content:**

**Unit 1: Introduction to Machine Learning and Types**

Introduction: Well-Posed learning problems, Basic concepts, Designing a learning system, Issues in machine learning. Types of machine learning: Learning associations, Supervised learning, Unsupervised learning, Reinforcement learning

**Unit 2 Decision Tree Learning**

Decision tree representation, appropriate problems for decision tree learning, Univariate Trees (Classification and Regression), Multivariate Trees, Basic Decision Tree Learning algorithms, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

**Unit 3 Bayesian Learning**

Bayes theorem and concept learning, Bayes optimal classifier, Gibbs' algorithms, Naive Bayes Classifier, Bayesian belief networks, and the EM algorithm.

**Unit 4 Artificial Neural Network**

Neural network representation, Neural Networks as a paradigm for parallel processing, Linear discrimination, pairwise separation, Gradient Descent, Logistic discrimination, Perceptron, Training a perceptron, Multilayer perceptron, Back propagation Algorithm. Recurrent Networks, dynamically modifying network structure.

**Unit 5 Genetic Algorithms and Data Mining Techniques**

Genetic Algorithms: Basic concepts, Hypothesis space search, Genetic programming, Models of evolution and learning, Parallelizing Genetic Algorithms. Data Mining Techniques for Analysis: Classification: Decision tree induction, Bayes classification, Rule-based classification, Support Vector Machines, Classification Using Frequent Patterns, k-Nearest-Neighbor, Fuzzy-set approach Classifier, Clustering: K-Means, k-Medoids, Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, Mean-shift Clustering

**Recommended Books:**


1. Mitchell T.M., Machine Learning, McGraw-Hill
2. Bishop C., Pattern Recognition and Machine Learning, Springer-Verlag

# SEMESTER 6

**Course: Big Data Analytics (SET/BIT/DSE/E7.2)**

**Course Objective:** The course aims at introducing the basic concepts and techniques of BIG DATA ANALYTICS so that a student can apply BIG DATA AND HADOOP techniques to a problem at hand.

**Course Outcomes**

By the end of this course, students should be able to:

1. Understand the fundamental concepts of Big Data, Hadoop, and distributed computing.
2. Apply Hadoop Distributed File System (HDFS) and MapReduce for storing and processing large datasets.
3. Utilize Hadoop ecosystem tools such as Pig, Hive, HBase, and Big SQL for data management and analysis.
4. Perform basic data analytics and machine learning tasks using R for Big Data applications.
5. Analyze and solve real-world data processing problems using Big Data technologies and Hadoop ecosystem tools.

**Course Content:**

**Unit 1: 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 BigInsights and Big Sheets

**Unit 2: 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 3: Map Reduce**

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types 0and Formats, Map Reduce Features.

**Unit 4: 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 5: Data Analytics with R**

Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering—Big Data Analytics with Big R.

**Recommended Books:**


1. Big data, Black Book: Covers Hadoop 2, map reduce, Hive, YARN, PIG, R, and data Visualization, Dreamtech, Wiley India
2. Seema Acharya, "Big Data Analytics," Wiley, 2015

# SEMESTER 6

**Course: Communication Skills (SET/BIT/AEC604)**

**Course Objective:** This course outline covers essential communication skills, broken down into five key units, each focusing on a specific aspect of communication:

**Course Content:**

**Unit 1 Listening Skills**

Topics Covered: Introduction to communication skills, differentiation between listening and hearing, the listening process, types of listening (active vs. passive), and strategies for improving listening comprehension.

• Objectives: Understand the fundamental aspects of listening, distinguish between hearing and active listening, and develop the ability to comprehend both general content and specific information.

**Unit 2 Non-Verbal Communication Skills**

• Topics Covered: Importance and types of non-verbal communication, body language, facial expressions, eye contact, spatial awareness (proxemics), tone of voice, and gestures.

• Objectives: Recognize and utilize various forms of non-verbal communication effectively, develop awareness of body language and tone, and improve interpersonal communication.

**Unit 3 Written Communication Skills**

• Topics Covered: Basics of written communication, grammar, spelling, punctuation, clarity, conciseness, structuring content, developing strong openings and conclusions, and revising/editing.

• Objectives: Enhance written communication proficiency by focusing on clarity, organization, and correctness, while also building skills for effective content structuring and editing

**Unit 4Emotional Intelligence Skills**

• Topics Covered: Understanding emotional intelligence, self-awareness, impulse control, stress management, adaptability, empathy, and effective communication.

• Objectives: Develop self-awareness, learn to manage emotions effectively

**Unit 5 Interview Skills**

Topics Covered: Interview preparation, effective verbal and non-verbal communication during interviews, handling challenging questions, asking insightful questions, and demonstrating suitability for a role.

• Objectives: Gain strategies for successful interview preparation, hone communication skills

**Recommended Books:**


1. Basic Communication Skills for Technology by Andrea J. Rutherfoord, Pearson
2. High School English Grammar and Composition by Wren and Martin, S Chand
3. A Communicative Grammar Of English by Geoffrey Leech and Fan Svartvik, Routledge
4. Oxford Guide to Writing and Speaking by John Seely, Oxford University Press
5. Professional Communication by Aruna Koneru, McGraw-Hill

# SEMESTER 6

## Lab Manual

| **Operating System Lab (SET/BIT/CP601)** |
|---|
| **Course Content:**<br>1. Execution of basic Linux/Unix commands for file, directory, and user management.<br>2. Implementation of CPU scheduling algorithms, including FCFS, SJF, Priority Scheduling, and Round Robin.<br>3. Implementation of process creation and management using system calls and process control techniques.<br>4. Implementation of inter-process communication (IPC) using pipes, message queues, and shared memory.<br>5. Implementation of synchronization techniques using semaphores and mutexes to solve critical section problems.<br>6. Implementation of deadlock avoidance and detection algorithms, including Banker's Algorithm.<br>7. Implementation of memory management techniques, including paging, segmentation, and page replacement algorithms.<br>8. Implementation of disk scheduling algorithms, including FCFS, SSTF, SCAN, and C-SCAN.<br>9. Implementation of file management operations, including file creation, access, modification, and protection mechanisms. |

| **Artificial Intelligence Lab (SET/BIT/DSE/EP6.1)** |
|---|
| **Course Content:**<br>1. Implementation of state space search techniques using Breadth First Search (BFS) and Depth First Search (DFS) algorithms.<br>2. Implementation of heuristic search algorithms, including Best First Search and A* Search.<br>3. Implementation of problem-solving techniques for the Water Jug Problem, Missionaries and Cannibals Problem, or Tower of Hanoi.<br>4. Implementation of uninformed and informed search strategies for path-finding and optimization problems.<br>5. Implementation of game-playing algorithms using Minimax and Alpha-Beta Pruning techniques.<br>6. Implementation of knowledge representation techniques using semantic networks and rule-based systems.<br>7. Implementation of expert systems for decision-making and inference generation.<br>8. Implementation of machine learning algorithms for classification and prediction tasks.<br>9. Implementation of Artificial Neural Networks (ANN) for pattern recognition and learning applications.<br>10. Development of an AI-based mini project involving search, reasoning, classification, or intelligent decision-making. |

# SEMESTER 6

| Social Network Analysis Lab (SET/BIT/DSE/EP6.2) |
|---|
| **Course Content:**<br>1. Introduction to social network analysis tools, creation of simple social network datasets, importing and visualizing network data.<br>2. Construction and visualization of social network graphs using nodes, edges, and graph visualization tools.<br>3. Analysis of basic network measures, including degree, closeness, betweenness, and network density.<br>4. Identification and visualization of communities using basic community detection techniques.<br>5. Representation and analysis of social network data using graph structures and basic network statistics.<br>6. Analysis of user interactions, collaboration networks, and communication patterns using sample social network datasets.<br>7. Visualization and interpretation of social network structures using node-link diagrams and matrix representations.<br>8. Mini project on social network analysis involving network construction, visualization, basic network analysis, community detection, and report generation. |

| Machine Learning Lab (SET/BIT/DSE/EP7.1) |
|---|
| **Course Content:**<br>1. Implementation of data preprocessing techniques, including data cleaning, normalization, feature selection, and dataset preparation.<br>2. Implementation of Linear Regression algorithms for prediction and trend analysis on numerical datasets.<br>3. Implementation of Classification techniques using algorithms such as Logistic Regression and Naïve Bayes.<br>4. Implementation of the k-Nearest Neighbor (KNN) algorithm for classification and pattern recognition tasks.<br>5. Implementation of Decision Tree algorithms for supervised learning and predictive modeling.<br>6. Implementation of Clustering techniques using the K-Means algorithm for unsupervised learning and data grouping.<br>7. Implementation of Artificial Neural Networks (ANN) for classification and prediction problems.<br>8. Development of a Machine Learning mini project involving data preprocessing, model training, evaluation, and performance analysis. |

# SEMESTER 6

| Big Data Analytics Lab (SET/BIT/DSE/EP7.2) |
|---|
| **Course Content:**<br>1. Installation and configuration of Big Data tools, including Hadoop ecosystem components and distributed processing environments.<br>2. Implementation of Hadoop Distributed File System (HDFS) operations, including file storage, retrieval, and management.<br>3. Implementation of MapReduce programs for processing and analyzing large-scale datasets.<br>4. Implementation of data processing techniques using Apache Hive for querying and managing structured big data.<br>5. Implementation of data analysis using Apache Pig for transforming and processing large datasets.<br>6. Implementation of data ingestion and storage techniques for handling structured and unstructured data.<br>7. Implementation of big data visualization and analytics techniques for extracting insights from large datasets.<br>8. Implementation of machine learning techniques on big data datasets for classification, clustering, and prediction tasks.<br>9. Analysis of real-world big data datasets using distributed computing frameworks and analytical tools.<br>10. Development of a Big Data Analytics mini project involving data collection, processing, analysis, visualization, and result interpretation. |

## SEMESTER 7 (UG with Honours and UG Honours with Research*)

**Course: Mental Health & Wellbeing (SET/BIT/MDE701)**

**Course Objective**

The objective of this course is to develop an understanding of mental health and emotional well-being by exploring psychological, social, and holistic approaches. The course aims to promote self-awareness, stress management, emotional resilience, mindfulness, and healthy lifestyle practices for overall personal and professional development.

**Course Outcomes**

By the end of this course, students should be able to:

1. Understand the concepts and determinants of mental health and well-being.
2. Apply positive psychology principles to enhance emotional resilience and personal growth.
3. Identify sources of stress and adopt appropriate coping and emotional management strategies.
4. Practice mindfulness, yoga, and other holistic approaches for maintaining mental wellness.
5. Recognize the importance of mental health awareness, prevention, and support systems in society.

**Course Content**

**Unit 1: Introduction to Mental Health**

Concept of mental health, WHO definition of mental health, mental hygiene, importance of mental health, determinants of mental health, biological, psychological, social and spiritual factors, historical perspectives of mental health, stigma associated with mental health, mental health and mental illness.

**Unit 2: Positive Psychology and Wellbeing**

Positive psychology, gratitude, optimism, resilience, flow, psychological well-being, emotional well-being, social well-being, physical well-being, Values in Action (VIA) classification of strengths, communication skills, interpersonal relationships, mental well-being.

**Unit 3: Stress and Emotional Management**

Concept of stress, types of stress, causes and symptoms of stress, emotional intelligence, mixed model of emotional intelligence, coping strategies, stress management techniques, emotional regulation, social support systems.

**Unit 4: Holistic Approaches to Wellbeing Promotion and Prevention in Mental Health**

Yoga for mental well-being, mindfulness practices, meditation techniques, lifestyle management, nature therapy, creative therapies, Panchkosh model, self-awareness, holistic self-development, mental health promotion, mental health education, mental health policies, prevention strategies.

**Recommended Books**


1. Daniel Goleman, *Emotional Intelligence*, Bantam Books.
2. Martin E. P. Seligman, *Authentic Happiness*, Free Press.
3. Barbara L. Fredrickson, *Positivity*, Crown Publishing.
4. World Health Organization, *Investing in Mental Health*.
5. World Health Organization, *Mental Health: Strengthening Our Response*.
6. UGC, *Guidelines on Mental Health and Well-being in Higher Educational Institutions*.


***Note: In cases where a subject appears in both the UG Honours and UG Honours with Research programme structures, the syllabus prescribed for that subject shall be the same.***

## SEMESTER 7 (UG with Honours and UG Honours with Research*)

**Course: Research Methodology (SET/BIT/CC701) ***

**Course Objective:** To provide a detailed plan for conducting research and to ensure that the research is conducted systematically and rigorously.

**Course Outcome:** By the end of this course, students should be able to:

1. Define research and describe the research process and research methods
2. Understand and apply basic research methods, including research design, data analysis, and interpretation.
3. Perform literature review effectively.
4. Understand how to write and publish research papers.
5. Understand the importance of research ethics and IPR

**Course Content:**

**Unit 1**

Basics of Research: Objective of research; Types of Research approaches: fundamental research, theoretical research, applied research, evaluation research, survey research, empirical research, and scientific research; Sources of research problem; Characteristics of a good research problem; Scope of research problem; Formulation of a research problem, identifying variables, constructing hypotheses, errors in selecting a research problem. Research Process.

**Unit 2**

Research planning and design. Research plan: Features of a good research design, Exploratory Research Design– concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent and Dependent Variables. Qualitative and Quantitative Research.

**Unit 3**

Literature survey Significance of literature review; Source for literature: books, journals, proceedings, theses and dissertations, and unpublished items. Survey using Web of Science/ Scopus; Literature survey writing up, Academic Databases for Computer science and maintenance discipline; UGC CARE/ SCI/ SCOPUS databases, etc. CitaOon Index, Impact Factor, H-index, etc.

**Unit 4**

Writing and Publishing Papers: Layout of a Research Paper; Abstract, Introduction, Background and literature review, data analysis, proposed research, experimental setup, results and discussion, conclusions, references (IEEE format), acknowledgments; Publication review process; Thesis Writing; and research presentation.

**Unit 5**

Research Ethics and IPR Ethics in Research, Ethics and Research Process, Importance of Ethics in Research, Plagiarism: Introduction to Plagiarism, Dimensions of Plagiarism, Detect Plagiarism, Strategies to Minimize Plagiarism. Plagiarism and Self- Plagiarism. Intellectual property rights: Copyright, patent, and IPR registration in India.

**Recommended Books:**


1. J. W. Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 3rd. ed. Sage Publications, 2008.
2. Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd. ed. Indian: PE, 2005.
3. B. C. Nakra and K. K. Chaudhry, Instrumentation, Measurement and Analysis,2nd. ed. New Delhi: TMH Publishing Co. Ltd., 2005.


***Note: In cases where a subject appears in both the UG Honours and UG Honours with Research programme structures, the syllabus prescribed for that subject shall be the same.***

## SEMESTER 7 (UG with Honours and UG Honours with Research*)

**Course: Computer Organization & Architecture (SET/BIT/CC702)**

**Course Objective:** The objective of this course is to introduce students to the fundamental principles and concepts of computer organization, architecture, and digital electronics. The course aims to provide students with a solid understanding of how computers are designed and how digital circuits operate, enabling them to comprehend the interactions between hardware and software components.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the architecture and organization of a computer system, including the CPU, memory, and I/O devices.
2. Comprehend the basic principles of digital electronics, including logic gates, flip-flops, and combinational and sequential circuits.
3. Analyze and design digital circuits using Boolean algebra and logic gate representations.
4. Explain the functioning of various computer components, such as registers, ALU, control unit, and memory hierarchy.
5. Evaluate the performance of computer systems and understand the trade-offs involved in hardware design.

**Course Content:**

**Unit 1 Introduction to Digital Electronics**

Number systems and binary arithmetic, Boolean algebra and logic gates, Combinational logic circuits, Sequential logic circuits, and flip-flops.

**Unit 2 Combinational Logic Design**

Multiplexers and demultiplexers, Encoders and decoders, Adders, subtractors, and ALU design.

Introduction to HDL (Hardware Description Language) for circuit design.

**Unit 3 Sequential Logic Design**

Latches and flip-flops, Counters and shift registers, Finite State Machines (FSMs) and their design.

**Unit 4 Computer Organization and Architecture**

Von Neumann architecture, CPU organization and instruction execution cycle, Memory hierarchy and caching, Input and output devices and interfaces, DMA.

**Unit 5 Advanced Topics**

Pipeline architecture and instruction pipelining, Introduction to parallel processing and multi-core systems, Introduction to RISC (Reduced Instruction Set Computer) and CISC (Complex Instruction Set Computer) architectures, Overview of emerging trends in computer architecture.

**Recommended Books:**


1. Mano, M. M., & Ciletti, M. D. (2017). Digital Design.
2. Patterson, D. A., & Hennessy, J. L. (2017). Computer Organization and Design: The Hardware/Software Interface.


***Note: In cases where a subject appears in both the UG Honours and UG Honours with Research programme structures, the syllabus prescribed for that subject shall be the same.***

## SEMESTER 7 (UG with Honours and UG Honours with Research*)

**Course: Basic Java Programming (SET/BIT/DSE/E8.1)**

**Course Objective:** The objective of this course is to introduce students to the Java programming language and its applications in software development. The course aims to develop students' skills in writing Java programs and understanding object-oriented principles.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the fundamentals of the Java programming language.
2. Develop object-oriented programs using Java.
3. Apply Java concepts for solving real-world programming problems.
4. Understand and implement exception handling, file I/O, and multithreading in Java.
5. Develop graphical user interfaces (GUIs) using Java Swing or JavaFX.

**Course Content:**

**Unit 1: Introduction to Java**

Overview of the Java programming language, Java development environment setup, Data types, variables, and operators.

**Unit 2 Control Structures and Functions**

Decision-making constructs: if-else, switch, Looping constructs: for, while, do-while, Methods and functions in Java.

**Unit 3 Object-Oriented Programming in Java**

Classes and objects in Java, Inheritance, Polymorphism, and Encapsulation, Abstract classes and interfaces.

**Unit 4 Exception Handling and File I/O**

Handling exceptions in Java, file input and output operations, serialization, and Deserialization.

**Unit 5 Java GUI and Event Handling**

Java Swing library for GUI, Event handling, and listeners, creating interactive GUI applications.

**Recommended Books:**

1. "Java: A Beginner's Guide" by Herbert Schildt.
2. "Head First Java" by Kathy Sierra and Bert Bates.

***Note: In cases where a subject appears in both the UG Honours and UG Honours with Research programme structures, the syllabus prescribed for that subject shall be the same.***

## SEMESTER 7 (UG with Honours and UG Honours with Research*)

**Course: Basic Introduction to DevOps (SET/BIT/DSE/E8.2)**

**Course Objective:**

The objective of this course is to introduce students to the fundamentals of DevOps, its principles, practices, and tools used in modern software development. The course aims to develop an understanding of continuous integration, continuous delivery, automation, version control, containerization, and cloud-based deployment for efficient software development and operations.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the concepts, principles, and lifecycle of DevOps.
2. Use version control systems and collaboration tools for software development.
3. Apply Continuous Integration and Continuous Deployment (CI/CD) practices using DevOps tools.
4. Understand containerization, cloud platforms, and infrastructure automation concepts.
5. Develop and deploy simple applications using basic DevOps tools and workflows.

**Course Content:**

**Unit I: Introduction to DevOps**

Introduction to DevOps, Software Development Life Cycle (SDLC), Agile methodology, DevOps principles, DevOps lifecycle, DevOps culture, collaboration between development and operations teams, benefits and challenges of DevOps, overview of DevOps tools.

**Unit II: Version Control and Source Code Management**

Version control concepts, distributed version control systems, Git architecture, Git installation and configuration, Git repositories, Git commands, branching, merging, GitHub, collaborative development, repository management.

**Unit III: Continuous Integration and Continuous Deployment**

Continuous Integration (CI), Continuous Delivery (CD), Continuous Deployment, CI/CD pipeline, build automation, Jenkins architecture, Jenkins installation, creating build jobs, automated testing concepts, deployment workflow.

**Unit IV: Containerization and Cloud Services**

Virtualization and containerization, Docker architecture, Docker installation, Docker images, containers, Dockerfile, Docker Compose, Docker Hub, introduction to Kubernetes, cloud computing fundamentals, DevOps on cloud platforms.

**Unit V: Configuration Management, Monitoring and DevOps Applications**

Infrastructure as Code (IaC), Ansible fundamentals, configuration management, monitoring and logging concepts, DevSecOps basics, software deployment strategies, DevOps applications, case studies, future trends in DevOps.

**Recommended Books**


1. Gene Kim, Jez Humble, Patrick Debois and John Willis, *The DevOps Handbook*, Addison-Wesley.
2. Jez Humble and David Farley, *Continuous Delivery*, Addison-Wesley.
3. Joakim Verona, *Practical DevOps*, Packt Publishing.
4. Nigel Poulton, *Docker Deep Dive*, Leanpub.
5. Kief Morris, *Infrastructure as Code*, O'Reilly Media.


***Note: In cases where a subject appears in both the UG Honours and UG Honours with Research programme structures, the syllabus prescribed for that subject shall be the same.***

## SEMESTER 7 (UG with Honours and UG Honours with Research*)

**Course: Graph Theory (SET/BIT/DSE/E9.1)**

**Course Objective:** The objective of this course is to introduce students to the fundamental principles and concepts of graph theory and their applications in various domains. The course aims to develop students' skills in analyzing and solving problems related to graphs and networks.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the fundamentals of graph theory and its terminology.
2. Analyze and represent problems using graph models.
3. Apply graph algorithms to solve problems such as shortest paths, minimum spanning trees, and network flows.
4. Apply graph theory concepts to solve real-world problems in different domains.
5. Understand the applications of graph theory in computer science, operations research, and other fields.

**Course Content:**

**Unit 1 Introduction to Graph Theory**

Basic concepts: Graphs, Vertices, Edges, Types of graphs: Directed, Undirected, Weighted, etc., Graph representation: Adjacency matrix, Adjacency list.

**Unit 2 Graph Traversal and Shortest Paths**

Breadth-First Search (BFS) and Depth-First Search (DFS), Dijkstra's algorithm for single-source shortest path, Bellman-Ford algorithm for single-source shortest path.

**Unit 3 Spanning Trees and Connectivity**

Minimum Spanning Tree (MST) algorithms: Prim's, Kruskal's, connected components, and Strongly Connected Components (SCC).

**Unit 4 Network Flows and Matching**

Maximum Flow and Minimum Cut problem, Bipartite matching and applications, Applications of graph theory in various fields.

**Unit 5 Graph Algorithms**

Topological sorting, Eulerian and Hamiltonian cycles, Traveling Salesman Problem (TSP), Introduction to NP-completeness

**Recommended Books:**

1. "Introduction to Graph Theory" by Douglas B. West.
2. "Graph Theory and Its Applications" by Jonathan L. Gross and Jay Yellen

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## SEMESTER 7 (UG with Honours and UG Honours with Research*)

**Course: Theory of Computation (SET/BIT/DSE/E9.2)**

**Course Objective:**

The objective of this course is to introduce students to the concepts and algorithms of the Theory of Computation and their applications in various domains. The course aims to develop students' skills in analyzing and solving problems related to Automata and grammar.

**Course Outcomes**

By the end of this course, students should be able to:

1. Understand the fundamental concepts of formal languages, automata theory, and the Chomsky hierarchy.
2. Design and analyze deterministic and nondeterministic finite automata, regular expressions, and their equivalence.
3. Construct and simplify context-free grammars and apply pushdown automata for recognizing context-free languages.
4. Explain the working of Turing machines and analyze recursive, recursively enumerable, and undecidable problems.
5. Apply theoretical models of computation to solve problems related to language recognition, parsing, and computational complexity.

**Course Content:**

**Unit 1 Finite Automata**

Introduction to defining language, Kleene closures, Arithmetic expressions, defining grammar, Chomsky hierarchy, Finite Automata (FA), Transition graph, generalized transition graph. Nondeterministic finite Automata (NFA), Deterministic finite Automata (DFA), Construction of DFA from NFA and optimization, FA with output: Moore machine, Mealy machine, and Equivalence, Applications and Limitations of FA, Arden Theorem, Pumping Lemma for regular expressions, Myhill - Nerode theorem

**Unit 2 Context-free grammar**

Ambiguity, Simplification of CFGs, Normal forms for CFGs, Pumping lemma for CFLs, Decidability of CFGs, Ambiguous to Unambiguous CFG

**Unit 3 Push Down Automata**

Description and definition, Working of PDA, Acceptance of a string by PDA, PDA and CFG, Introduction to auxiliary PDA, and Two-stack PDA

**Unit 4 Turing Machines**

Basic model, definition and representation, Language acceptance by TM, TM and Type – 0 grammar, Halting problem of TM, Modifications in TM, Universal TM, Properties of recursive and recursively enumerable languages, unsolvable decision problem, undecidability of Post correspondence problem, Church's Thesis, Recursive function theory, Godel Numbering.

**Recommended Books:**

1. K.L.P. Mishra and N.Chandrasekaran, “Theory of Computer Science (Automata, Languages and Computation)”, PHI

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## SEMESTER 7 (UG with Honours and UG Honours with Research*)

## Lab Manual

| Basic of Java Programming Lab (SET/BIT/DSE/E8.1) |
|---|
| **Course Content:**<br>1. Write and execute simple Java programs using basic input and output statements.<br>2. Implement programs using variables, data types, operators, and expressions.<br>3. Develop programs using decision-making statements such as if-else and switch.<br>4. Create programs using looping constructs such as for, while, and do-while loops.<br>5. Implement programs using arrays and string manipulation techniques.<br>6. Develop programs using methods and parameter passing concepts.<br>7. Create classes and objects to demonstrate object-oriented programming concepts.<br>8. Implement inheritance, polymorphism, encapsulation, and abstraction in Java programs.<br>9. Develop programs for exception handling using try-catch-finally blocks.<br>10. Create applications using file handling and basic collection framework classes. |

| Introduction to DevOps Lab (SET/BIT/DSE/E8.2) |
|---|
| **Course Content:**<br>1. Installation and configuration of DevOps tools, including Git, GitHub, Docker, and Jenkins in a development environment.<br>2. Version control using Git, including repository creation, commit operations, branching, merging, and collaboration through GitHub.<br>3. Source code management using GitHub, including repository hosting, pull requests, issue tracking, and project collaboration.<br>4. Continuous Integration using Jenkins, including job creation, automated build, testing, and basic deployment.<br>5. Containerization of applications using Docker, including image creation, container deployment, Docker file, and container management.<br>6. Development and deployment of multi-container applications using Docker Compose.<br>7. Introduction to configuration management, infrastructure automation, and basic Continuous Deployment workflows using Ansible and Jenkins.<br>8. Mini project involving version control, Continuous Integration, containerization, automated deployment, and application monitoring. |

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## SEMESTER 8 (UG with Honours and UG Honours with Research*)

**Course: Deep Learning (SET/BIT/DSE/E10.1)**

**Course Objective:** The objective of this course is to provide students with an in-depth understanding of deep learning principles, algorithms, and applications. The course aims to develop students' skills in designing and implementing deep neural networks for solving complex machine learning tasks.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the principles and architectures of deep neural networks.
2. Implement and train deep neural networks using appropriate frameworks and libraries.
3. Apply deep learning techniques to solve real-world problems in various domains.
4. Evaluate and optimize deep learning models for performance and accuracy.
5. Stay updated with the latest advancements and trends in deep learning research.

**Course Content:**

**Unit 1: Introduction to Deep Learning**

Overview of deep learning concepts and their significance, Basics of neural networks and gradient-based optimization, Activation functions and loss functions in deep learning

**Unit 2 Deep Neural Network Architectures**

Feedforward neural networks and backpropagation algorithm, Convolutional neural networks (CNNs) for image processing, Recurrent neural networks (RNNs) for sequential data analysis

**Unit 3 Deep Learning Frameworks and Libraries**

Introduction to popular deep learning frameworks (e.g., TensorFlow, PyTorch), Building and training deep neural networks using frameworks, Transfer learning and pre-trained models

**Unit 4 Advanced Deep Learning Techniques**

Generative adversarial networks (GANs) for data generation, Autoencoders and variational autoencoders (VAEs), Reinforcement learning with deep neural networks

**Unit 5 Applications of Deep Learning**

Deep learning for image classification and object detection, Natural language processing and sentiment analysis with deep learning, Deep learning in recommendation systems and autonomous vehicles

**Recommended Books:**

1. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
2. "Deep Learning with Python" by Francois Chollet.

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## SEMESTER 8 (UG with Honours and UG Honours with Research*)

**Course: Data Visualization Using R (SET/BIT/DSE/E10.2)**

**Course Objective:** After successful completion of this course, students will be able to:

1. Understand the fundamentals of data visualization and its importance in data analysis and decision-making.
2. Learn the R programming environment and use R packages for data visualization.
3. Import, clean, transform, and manage datasets for visualization purposes.
4. Create various statistical and graphical visualizations, including bar charts, histograms, line graphs, scatter plots, box plots, and pie charts.

**Course Outcome:** Student will be able to -

1. Understand the fundamentals of data visualization and its role in data analysis.
2. How to use R tools and libraries to create different types of graphs and charts.
3. Analyze and interpret data patterns, trends, and relationships using visual techniques.
4. Develop effective visual reports and dashboards for data-driven decision making.

**Course Content:**

**Unit I: Introduction to R and Data Visualization**

Introduction to R and RStudio, installation and working environment, data types, variables, vectors, matrices, arrays, lists, data frames, importing and exporting datasets (CSV and Excel), principles of data visualization, data visualization workflow.

**Unit II: Data Preparation and Manipulation**

Data cleaning and preprocessing, handling missing values, data transformation, data aggregation and summarization, filtering and sorting data, merging and reshaping datasets.

**Unit III: Basic Graphics in R**

Scatter plots, line charts, bar charts, histograms, pie charts, box plots, frequency distribution plots, customizing plots using titles, labels, colors, legends, and axes.

**Unit IV: Advanced Visualization using ggplot2**

Introduction to Grammar of Graphics, layers and aesthetics, geometric objects, scales and themes, faceting, customization of plots, visualization of multiple variables, statistical graphics.

**Unit V: Interactive Visualization and Dashboarding**

Interactive visualization using Plotly, introduction to dashboards, dashboard development using R, storytelling with data, data visualization best practices, mini project using real-world datasets.

**Recommended Books:**


1. Hadley Wickham, *ggplot2: Elegant Graphics for Data Analysis*, Springer.
2. Winston Chang, *R Graphics Cookbook*, O'Reilly Media.
3. Kieran Healy, *Data Visualization: A Practical Introduction*, Princeton University Press.
4. Hadley Wickham and Garrett Grolemund, *R for Data Science*, O'Reilly Media.
5. Claus O. Wilke, *Fundamentals of Data Visualization*, O'Reilly Media.


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## SEMESTER 8 (UG with Honours and UG Honours with Research*)

**Course: Blockchain & its Application (SET/BIT/DSE/E11.1)**

**Course Objective:** The objective of this course is to provide students with a comprehensive understanding of blockchain technology and its applications. The course aims to develop students' skills in designing, implementing, and evaluating blockchain solutions for various industries.

**Course Outcome:** By the end of this course, students should be able to:

1. Understand the underlying concepts and principles of blockchain technology.
2. Design and develop blockchain applications using appropriate frameworks and tools.
3. Analyze and evaluate the security and privacy aspects of blockchain systems.
4. Apply smart contracts and decentralized applications (DApps) in blockchain development.
5. Explore the potential use cases and implications of blockchain technology in different industries.

**Course Content:**

**Unit 1 Introduction to Blockchain Technology**

Overview of blockchain concepts, decentralized systems, and consensus algorithms, Blockchain types: public, private, and consortium, Cryptography fundamentals for blockchain

**Unit 2 Blockchain Development Platforms and Tools**

Introduction to blockchain development frameworks (e.g., Ethereum, Hyperledger), Setting up the blockchain development environment, Smart contracts and programming languages (e.g., Solidity)

**Unit 3 Blockchain Security and Privacy**

Blockchain security challenges and attacks, Cryptographic techniques for securing blockchain transactions, Privacy and anonymity considerations in blockchain systems

**Unit 4 Smart Contracts and Decentralized Applications (DApps)**

Smart contract development and testing, interacting with smart contracts using web interfaces and APIs, building and deploying decentralized applications (DApps)

**Unit 5 Blockchain Applications and Industry Use Cases**

Blockchain applications in finance, supply chain, healthcare, and other domains, Regulatory and legal considerations for blockchain adoption, Evaluating the potential impact of blockchain on various industries

**Recommended Books:**

1. "Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications" by Imran Bashir.
2. "Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher.

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## SEMESTER 8 (UG with Honours and UG Honours with Research*)

**Course: Wireless and Mobile Computing (SET/BIT/DSE/E11.2)**

**Course Objective:** The Wireless and Mobile Computing course aims to provide students with a comprehensive understanding of the principles, technologies, and applications of wireless and mobile computing. Participants will learn the fundamentals of wireless communication, network protocols, and mobile device architectures. The course covers topics like cellular networks, Wi-Fi, Bluetooth, and emerging wireless technologies. Participants will explore mobile application development and optimization techniques, including responsive design and app performance considerations.

**Course Outcome:** By the end of this course, students should be able to:

1. Explain the basics of mobile telecommunication systems
2. Illustrate the generations of telecommunication systems in wireless networks
3. Determine the functionality of the MAC, network layer, and identify a routing protocol for a given Ad hoc network
4. Explain the functionality of Transport and Application layers

**Course Content:**

**Unit 1 Existing Wireless Systems**

Introduction, Global System for Mobile Communications (GSM), Personal Communications Services (PCS), International Mobile Telecommunications 2000 (IMT-2000). Wireless local area networks. Wireless local loops.

**Unit 2 Wireless and Mobile Computing**

Overview of the history, evolution, and compatibility of wireless standards; the special problems of wireless and mobile computing.

**Unit 3 Mobile Communication Systems**

Introduction, mobile Internet protocol; mobile aware adaptation; extending the client-server model to accommodate mobility; mobile data access; the software packages to support mobile and wireless computing; Mobile/Cellular System Infrastructure, Registration, Handoff Parameters, and Underlying Support. Roaming Support Using System Backbone. The role of middleware

**Unit 4 Satellite Systems**

Introduction, Types of Satellite Systems, Characteristics of Satellite Systems, Satellite System Infrastructures, Call Setup, Global Positioning System.

**Unit 5 Recent Advances**

Introduction, Ultra-Wideband Technology, Multimedia Services Requirements. Mobility Management for Integrated Systems; Multicast in Wireless Networks; MANET Route Maintenance/Repair; Design Issues in Sensor Networks; Bluetooth Networks; Threats and Security Issues.

**Recommended Books:**


1. Introduction to Wireless and Mobile Systems, Dharma P. Agrawal.
2. Internetworking with TCP/IP Vol. 1: Principles, Protocols, and Architecture, 4/e, Comer, Douglas E., Prentice Hall.


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## SEMESTER 8 (UG with Honours and UG Honours with Research*)

**Course: Basics of Data Analytics Using Spreadsheet (SET/BIT/DSE/E12.1)**

**Course Objective:**

- introduce the fundamentals of data analytics and spreadsheet applications.
- To develop skills in organizing, cleaning, analyzing, and visualizing data using spreadsheets.
- To enable students to perform basic statistical analysis and create reports for decision-making.
- To familiarize students with spreadsheet functions, formulas, charts, and data management tools.

**Course Outcome:** Student will be able to -

- Apply spreadsheet functions, formulas, and data management techniques for organizing and analyzing data effectively.
- Perform data analysis using sorting, filtering, Pivot Tables, and basic statistical tools.
- Create charts, graphs, and dashboards to visualize data and communicate insights clearly.
- Interpret analytical results and develop spreadsheet-based solutions for real-world decision-making problems.

**Course Content:**

**Unit I: Introduction to Data Analytics and Spreadsheets**

Introduction to Data Analytics: Concepts and Applications, Types of Data and Data Sources

Overview of Spreadsheet Software (MS Excel, Google Sheets, LibreOffice Calc)

Workbook and Worksheet Management, Data Entry, Editing, Formatting, and Cell Referencing

Basic Formulas and Arithmetic Operations

**Unit II: Data Organization and Management**

Sorting and Filtering Data, Data Validation Techniques, Conditional Formatting, Managing Large Datasets, Text Functions, Date and Time Functions, Importing and Exporting Data

**Unit III: Spreadsheet Functions for Data Analysis**

Mathematical and Statistical Functions, Logical Functions (IF, AND, OR), Lookup Functions (VLOOKUP, HLOOKUP, XLOOKUP)

Aggregate Functions (SUM, AVERAGE, COUNT, MAX, MIN)

Error Handling Functions, Working with Named Ranges

**Unit IV: Data Visualization and Reporting**

Creating and Customizing Charts, Bar, Line, Pie, Scatter, and Histogram Charts

Sparklines and Trend Analysis, Dashboard Fundamentals

Report Design and Presentation, Data Storytelling Using Visualizations

**Unit V: Advanced Data Analytics Using Spreadsheets**

Pivot Tables and Pivot Charts, What-If Analysis (Goal Seek, Scenario Manager)

Basic Forecasting and Trend Analysis, Descriptive Statistics

Introduction to Data Cleaning Techniques, Case Studies, and Real-World Applications

**Recommended Books:**


1. Michael Alexander and Richard Kusleika, *Excel 2021 Bible*, Wiley.
2. Wayne L. Winston, *Microsoft Excel Data Analysis and Business Modeling*, Microsoft Press.
3. John Walkenbach, *Excel 2021 Power Programming with VBA*, Wiley.
4. Conrad Carlberg, *Statistical Analysis: Microsoft Excel 365*, Que Publishing.
5. Paul McFedries, *Excel Data Analysis For Dummies*, Wiley


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## SEMESTER 8 (UG with Honours and UG Honours with Research*)

**Course: Robotic Process Automation (SET/BIT/DSE/E12.2)**

**Course Objective:**

The objective of this course is to introduce students to the fundamentals of Robotic Process Automation and its applications in automating business processes. It helps students understand how software robots are used to reduce manual effort and improve efficiency. The course also develops skills in designing, developing, and deploying automation workflows.

**Course Outcome:**

By the end of this course, students should be able to:

1. Understand the concepts, architecture, and applications of Robotic Process Automation (RPA).
2. Design and develop basic automation workflows using RPA tools.
3. Apply RPA techniques to automate repetitive business processes.
4. Implement error handling, debugging, and basic security practices in automation workflows.
5. Deploy and manage simple software bots for real-world automation tasks.

**Course Content:**

**Unit 1: Introduction to RPA**

Introduction to Robotic Process Automation (RPA), need, scope and benefits of RPA, types of automation, business process automation, real-world applications of RPA, overview of RPA tools used in industry.

**Unit 2: RPA Basics and Architecture**

RPA architecture, components of RPA, bots, studio, orchestrator/control room, attended and unattended bots, workflow concepts, RPA lifecycle.

**Unit 3: RPA Tool Fundamentals**

Introduction to UiPath and Automation Anywhere, RPA tool interface, creating automation workflows, variables and data types, activities, control flow, sequences, flowcharts, decision making.

**Unit 4: Process Automation**

Process identification and analysis, desktop automation, web automation, file and folder automation, Excel automation, email automation, data extraction, data entry automation.

**Unit 5: Error Handling and Debugging**

Exception handling, debugging techniques, logging, monitoring automation processes, deployment of automation workflows, bot management, basic security and best practices in RPA.

**Recommended Books:**


1. Alok Mani Tripathi, **Learning Robotic Process Automation**, Packt Publishing.
2. Tom Taulli, **The Robotic Process Automation Handbook**, Apress.
3. Richard Murdoch, Rob Patrick, **Intelligent Automation: Learn How to Harness Artificial Intelligence to Boost Business and Make Our World More Human**, Wiley.


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## SEMESTER 8 (UG with Honours and UG Honours with Research*)

## Lab Manual

| Deep Learning Lab (SET/BIT/DSE/EP10.1) |
|---|
| **Course Content:**<br>1. Installation and configuration of Python, Jupyter Notebook, TensorFlow, Keras, and PyTorch, implementation of basic tensor operations and introduction to deep learning libraries.<br>2. Implementation of Artificial Neural Networks (ANNs), including dataset preparation, model creation, training, evaluation, and performance visualization.<br>3. Development and training of Feedforward Neural Networks (FNNs) using backpropagation for classification and regression problems.<br>4. Implementation of Convolutional Neural Networks (CNNs) for image classification using standard image datasets and performance evaluation.<br>5. Implementation of Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks for sequence prediction and text analysis.<br>6. Application of transfer learning using pre-trained deep learning models for image classification and feature extraction.<br>7. Implementation of basic Autoencoders and Generative Adversarial Networks (GANs) for feature learning and synthetic data generation.<br>8. Mini project involving data preprocessing, deep learning model development, training, evaluation, visualization, and performance comparison using a real-world dataset. |

| Data Visualization Using R Lab (SET/BIT/DSE/EP10.2) |
|---|
| **Course Content:**<br>1. Installation and configuration of R and RStudio, introduction to the R environment, creation and manipulation of vectors, matrices, arrays, lists, and data frames.<br>2. Importing and exporting datasets using CSV and Excel files, data cleaning, handling missing values, data transformation, filtering, sorting, and summarization.<br>3. Creation of basic graphical visualizations, including bar charts, line charts, scatter plots, histograms, pie charts, box plots, and customization of plots using titles, labels, colors, legends, and axes.<br>4. Development of advanced visualizations using **ggplot2**, including layers, aesthetics, geometric objects, themes, faceting, and statistical graphics.<br>5. Creation of interactive visualizations using **Plotly**, including interactive charts, graphs, and visualization of multidimensional datasets.<br>6. Development of dashboards and visual reports using R, integration of multiple visualizations, and storytelling with data.<br>7. Analysis and visualization of real-world datasets using appropriate graphical techniques for identifying patterns, trends, and relationships.<br>8. Mini project involving data import, preprocessing, visualization, dashboard creation, and presentation of analytical findings using R. |

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# SEMESTER 7 (UG Honours with Research)

| **Basics of Data Analytics Using Spreadsheet Lab (SET/BIT/DSE/EP12.1)** |
|---|
| **Course Content:**<br>1. Creation and management of workbooks and worksheets, data entry, formatting, cell referencing, and basic arithmetic operations using spreadsheet software.<br>2. Data organization and management using sorting, filtering, conditional formatting, data validation, text functions, date and time functions, and importing/exporting datasets.<br>3. Implementation of spreadsheet functions, including mathematical, statistical, logical, lookup, and aggregate functions for data analysis.<br>4. Creation and customization of charts and graphs, including bar, line, pie, scatter, histogram, and sparklines for data visualization.<br>5. Data analysis using Pivot Tables, Pivot Charts, data summarization, grouping, and report generation.<br>6. Application of What-If Analysis tools, including Goal Seek, Scenario Manager, descriptive statistics, and basic forecasting techniques.<br>7. Data cleaning, preparation, and visualization of real-world datasets for identifying trends, patterns, and insights.<br>8. Mini project involving data collection, preprocessing, analysis, visualization, dashboard creation, and presentation of analytical findings using spreadsheet software. |

| **Robotic Process Automation Lab (SET/BIT/DSE/EP12.2)** |
|---|
| **Course Content:**<br>1. Creation and management of workbooks and worksheets, data entry, formatting, cell referencing, and basic arithmetic operations using spreadsheet software.<br>2. Data organization and management using sorting, filtering, conditional formatting, data validation, text functions, date and time functions, and importing/exporting datasets.<br>3. Implementation of spreadsheet functions, including mathematical, statistical, logical, lookup, and aggregate functions for data analysis.<br>4. Creation and customization of charts and graphs, including bar, line, pie, scatter, histogram, and sparklines for data visualization.<br>5. Data analysis using Pivot Tables, Pivot Charts, data summarization, grouping, and report generation.<br>6. Application of What-If Analysis tools, including Goal Seek, Scenario Manager, descriptive statistics, and basic forecasting techniques.<br>7. Data cleaning, preparation, and visualization of real-world datasets for identifying trends, patterns, and insights.<br>8. Mini project involving data collection, preprocessing, analysis, visualization, dashboard creation, and presentation of analytical findings using spreadsheet software. |

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