# PERIYAR UNIVERSITY

State University - NAAC 'A++' Grade - NIRF Rank 94

State Public University Rank 40 - SDG Institutions Rank Band: 11-50

Salem - 636 011, Tamil Nadu, India.

## DEPARTMENT OF COMPUTER SCIENCE

### M. Sc., COMPUTER SCIENCE

### CHOICE BASED CREDIT SYSTEM (CBCS)

# OBE REGULATIONS AND SYLLABUS

**(Effective from the academic year 2026-2027 and thereafter)**

**CONTENTS**



| **REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION** | |
|---|---|
| **Programme** | **M.Sc., Computer Science** |
| **Programme Code** | CSC02 |
| **Duration** | **PG - Two Years** |
| **Programme Outcomes (POs)** | **PO1: Problem Solving Skill**<br>Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.<br>**PO2: Decision Making Skill**<br>Foster analytical and critical thinking abilities for data-based decision-making.<br>**PO3: Ethical Value**<br>Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.<br>**PO4: Communication Skill**<br>Ability to develop communication, managerial and interpersonal skills.<br>**PO5: Individual and Team Leadership Skill**<br>Capability to lead themselves and the team to achieve organizational goals.<br>**PO6: Employability Skill**<br>Inculcate contemporary business practices to enhance employability skills in the competitive environment. |

| | |
|---|---|
| | **PO7: Entrepreneurial Skill**<br>Equip with skills and competencies to become an entrepreneur.<br>**PO8: Contribution to Society**<br>Succeed in career endeavors and contribute significantly to society.<br>**PO9: Multicultural competence**<br>Possess knowledge of the values and beliefs of multiple cultures and a global perspective.<br>**PO10: Moral and ethical awareness/reasoning**<br>Ability to embrace moral/ethical values in conducting one's life. |
| **Programme Specific Outcomes (PSOs)** | **PSO1: Placement**<br>Prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.<br>**PSO2: Entrepreneur**<br>To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.<br>**PSO3: Research and Development**<br>Design and implement HR systems and practices grounded in researches that comply with employment laws, leading the organization towards growth and development.<br>**PSO4: Contribution to Business World**<br>To produce employable, ethical and innovative professionals to sustain in the dynamic business world.<br>**PSO5: Contribution to the Society**<br>To contribute to the development of the society by collaborating with stakeholders for mutual benefit |

# Master of Science in Computer Science

## Curriculum Structure for each Semester

### Semester – I

| Course Code | Category | Course Name | Number of Credits | Hours per Week |
|---|---|---|---|---|
| 26UPCSC2C01 | Core I | Design and Analysis of Algorithms | 4 | 4 |
| 26UPCSC2C02 | Core II | Theory of Computation | 4 | 4 |
| 26UPCSC2C03 | Core III | Python Programming | 4 | 4 |
| 26UPCSC2C04 | Core IV | Advanced Operating Systems | 4 | 4 |
| 26UPCSC2L01 | Core VI - Lab | Algorithm Lab | 2 | 4 |
| 26UPCSC2L02 | Core VII – Lab | Python Programming Lab | 2 | 4 |
| Discipline Centric Elective –I | Elective I | Elective Course –Theory | 4 | 4 |
| Generic Elective – I 26UPCSC2S01 | Elective – II | Soft Skill Development Lab | 1 | 2 |
| | | **Total** | **25** | **30** |

### Semester - II

| Course Code | Category | Course Name | Number of Credits | Hours per Week |
|---|---|---|---|---|
| 26UPCSC2C05 | Core VIII | Computational Intelligence | 4 | 4 |
| 26UPCSC2C06 | Core IX | Big Data Analytics | 4 | 4 |
| 26UPCSC2C07 | Core X | Advanced Java Programming | 4 | 4 |
| 26UPCSC2L03 | Core XI – Lab | Computational Intelligence Lab | 2 | 4 |
| 26UPCSC2L04 | Core XII – Lab | Advanced Java | 2 | 4 |

| | | | | |
|---|---|---|---|---|
| | | Programming Lab | | |
| 26UPCSC2P01 | Core XIII | Mini Project | 2 | 2 |
| Discipline Centric Elective – II | Elective III | Elective Course – Theory | 4 | 4 |
| 26UPCSC2X01 | Core XIV-Extension Activity | Extension Activity – | 1 | 1 |
| NME – I | Non-Major Elective (Online Courses) | SWAYAM/NPTEL/MOOC etc…-Online Courses | 2 | 2 |
| Generic Elective - II 23UPPGC1H01 | Elective-IV | Fundamentals of Human Rights | 1 | 1 |
| | | **Total** | **26** | **30** |

**Semester - III**

| Course Code | Category | Course Name | Number of Credits | Hours per Week |
|---|---|---|---|---|
| 26UPCSC2C08 | Core XV | Mobile Computing | 4 | 4 |
| 26UPCSC2C09 | Core XVI | Web technologies and Cloud Computing | 4 | 4 |
| 26UPCSC2C10 | Core XVII | Artificial Intelligence and Machine Learning | 4 | 4 |
| 26UPCSC2L05 | Core XVIII – Lab | Mobile Computing Lab | 2 | 3 |
| 26UPCSC2L06 | Core XIX - Lab | Web Technologies and Cloud Computing Lab | 2 | 4 |
| 26UPCSC2L07 | Core XX-Lab | Internet of Things Lab | 2 | 2 |
| Discipline Centric Elective – III | Elective V | Elective Course –Theory | 4 | 4 |
| 26UPCSC2I01 | Core XXI- | Internship | 2 | - |
| NME-II | Non Major Elective | Supportive Course | 2 | 3 |
| Generic Elective –II 26UPGEN1V01 | Elective VI | Peace Education | 2 | 2 |

| | | |
|---|---|---|
| **Total** | **28** | **30** |

**Semester IV**

| Course Code | Category | Course Name | Number of Credits | Hours per Week |
|---|---|---|---|---|
| 26UPCSC2P02 | Core XXII | Project with viva voce | 16 | - |
| | | **Total** | **16** | **-** |
| | | **Total Credits** | **95** | - |

## LIST OF ELECTIVE SUBJECTS

**GENERIC ELECTIVE SUBJECTS**

26UPCSC2S01 - Soft Skill Development Lab

**DISCIPLINE CENTRIC ELECTIVE SUBJECTS**

**VERTICAL I: Artificial Intelligence and Data Science (AIDS)**

26UPCSC2E01 - Generative AI

26UPCSC2E02 - Advanced Large Language Models

26UPCSC2E03 - Agentic AI

**VERTICAL II: Full Stack Development for IT**

26UPCSC2E04 - App Development

26UPCSC2E05 - User Interface and User Experience (UI and UX) Design

26UPCSC2E06 - Software Testing and Automation

**VERTICAL III: Cloud Computing and Data Centre Technologies**

26UPCSC2E07 - Cloud Computing

26UPCSC2E08 - Virtualization

| | | |
|---|---|---|
| 26UPCSC2E09 | - | Cloud Security |

**VERTICAL IV: Cyber Security and Data Privacy**

| | | |
|---|---|---|
| 26UPCSC2E10 | - | Network Security and Ethical Hacking |
| 26UPCSC2E11 | - | Digital and Mobile Forensics |
| 26UPCSC2E12 | - | Modern Cryptography and Blockchain Technologies |

**Regulation on Discipline-Centric Elective Verticals**

Students shall select **one vertical** from the prescribed Discipline-Centric Elective Subject Verticals and complete all the courses offered under the chosen vertical. The selection of the vertical shall be **final**, and students shall **not be permitted to change** to another vertical at any stage during the course of study.

**NONMAJOR ELECTIVE -II**

| | | |
|---|---|---|
| 26UPCSC1N01 | - | Advanced Microsoft Office Lab |
| 26UPCSC1N02 | - | Bio Python Programming Lab |

**VALUE ADDED / ADD ON COURSES**

| | | |
|---|---|---|
| 26UPCSCVA01 | - | MS-Office (Excel) |
| 26UPCSCVA02 | - | R Programming |
| 26UPCSCVA03 | - | Bio-python |
| 26UPCSCVA04 | - | Large Language Models (LLMs) |
| 26UPCSCVA05 | - | Basics of Computer Hardware & Introduction to Networking |

## Framework (LOCF) Guideline Based Credits and Hours Distribution System

## For M. Sc. Computer Science Courses including Lab Hours

### I .Semester-wise Credit Distribution

| Semester | Core Theory | Core Lab | Projects | Electives | Open Elective/ Extension | Internship | Total Credits |
|---|---|---|---|---|---|---|---|
| Semester I | 16 | 4 | – | 4 | 1 | – | **25** |
| Semester II | 12 | 4 | 2 | 4 | 3+1 | – | **26** |
| Semester III | 12 | 6 | – | 4 | 4 | 2 | **28** |
| Semester IV | – | – | 16 | – | – | – | **16** |
| **Total** | **40** | **14** | **18** | **12** | **9** | **2** | **95** |

## II. Category-wise Credit Distribution

| Type of Courses | Component | No. of Courses | Credits | Total Credits |
|---|---|---|---|---|
| Core | Theory courses | 10 | 04 | 40 |
| | Lab courses | 07 | 02 | 14 |
| | Mini project | 01 | 02 | 02 |
| | Major Project | 01 | 16 | 16 |
| | Internship | 01 | 02 | 02 |
| Elective | Discipline Centric -Theory courses | 03 | 04 | 12 |
| | Generic Centric courses (Soft Skill Development Lab) | 01 | 01 | 01 |
| | Generic Centric courses (Fundamental of Human Rights) | 01 | 01 | 01 |
| | Generic Centric courses (Peace Education) | 01 | 02 | 02 |
| NME-I | Skill enhancement courses / Online courses (SWAYAM /NPTEL/ MOOC etc… | 01 | 02 | 02 |
| NME-II | NME-II (Supportive course) | 01 | 02 | 02 |
| Extension Activity | | 01 | 01 | 01 |
| | | | **Total Credits** | **95** |

## III. Credit Distribution by LOCF Component

| LOCF Dimension | Academic Component | Credits | Percentage (%) | Academic Purpose |
|---|---|---|---|---|
| **Knowledge Foundation** | Core Theory Courses | 40 | 42.11% | Conceptual depth in Computing, Mathematics, AI, Systems, and Algorithms |
| **Skill & Technical Competency** | Core Laboratory Courses | 14 | 14.74% | Practical proficiency, programming expertise, tool-based learning |
| **Research & Professional Competency** | Mini Project (2) + Major Project (16) | 18 | 18.95% | Research capability, innovation, problem-solving, independent work |
| **Disciplinary Breadth** | Discipline-Centric Electives | 12 | 12.63% | Advanced/specialized domain knowledge |
| **Interdisciplinary & Value-Based Learning** | Generic Electives (Soft Skills + Human Rights/Peace Education) | 4 | 04.21% | Ethics, communication, social awareness |
| **Interdisciplinary Exposure** | Open Electives (MOOC + Supportive Course) | 4 | 04.21% | Cross-disciplinary learning and flexibility |
| **Social Learning** | Extension Activity | 1 | 01.04 | |
| **Experiential Learning** | Internship | 2 | 02.11% | Industry readiness and applied exposure |
| | **Total** | **95** | **100%** | |

## IV. LOCF Outcome Mapping Perspective

| LOCF Focus Area | Programme Implementation Mechanism |
|---|---|
| Disciplinary Knowledge | 10 Core Theory Courses |
| Practical & Analytical Skills | 7 Laboratory Courses |
| Research & Innovation | Capstone Major Project (16 Credits) |
| Professional Skills | Mini Project + Internship + Soft Skills Lab |
| Ethical & Social Responsibility | Human Rights / Peace Education/Extension activity |
| Lifelong Learning | SWAYAM/NPTELMOOC Integration |
| Industry Orientation | Internship + Applied Labs |

## V. Consolidated LOCF Classification Matrix

| Sem | Course Name | Credits | KF | SD | E | Primary Orientation |
|---|---|---|---|---|---|---|
| I | Design and Analysis of Algorithms | 4 | ✓ | ✓ | ✓ | System Programming |
| I | Theory of Computation | 4 | ✓ | ✓ | ✓ | Theoretical Foundations |
| I | Python Programming | 4 | ✓ | ✓ | ✓ | Application Development |
| I | Advanced Operating Systems | 4 | ✓ | ✓ | ✓ | Core Technical Competency |
| I | Python Programming Lab | 2 | – | ✓ | ✓ | Coding Skill |
| I | Algorithm Lab | 2 | – | ✓ | ✓ | Analytical Skill |
| I | Discipline-Centric Elective I | 4 | ✓ | ✓ | ✓ | Specialization |
| I | Soft Skill Development Lab | 1 | – | ✓ | ✓ | Communication Skills |
| II | Computational Intelligence | 4 | ✓ | ✓ | ✓ | Intelligent Systems |
| II | Big Data Analytics | 4 | ✓ | ✓ | ✓ | Industry Analytics |
| II | Advanced Java Programming | 4 | ✓ | ✓ | ✓ | Enterprise Development |
| II | Computational Intelligence Lab | 2 | – | ✓ | ✓ | Tool-Based Analytics |
| II | Advanced Java Programming Lab | 2 | – | ✓ | ✓ | Tool-Based Analytics |
| II | Mini Project | 2 | – | ✓ | ✓ | Problem Solving |
| II | Discipline-Centric Elective II | 3 | ✓ | ✓ | ✓ | Domain Expertise |
| II | Online MOOC | 2 | ✓ | ✓ | ✓ | Lifelong Learning |

| Sem | Course Name | Credits | KF | SD | E | Primary Orientation |
|---|---|---|---|---|---|---|
| II | Human Rights | 1 | ✓ | – | ✓ | Ethical Awareness |
| III | Mobile Computing | 4 | ✓ | ✓ | ✓ | Technology Implementation |
| III | Web Technologies and Cloud Computing | 4 | ✓ | ✓ | ✓ | Full Stack Skill |
| III | Artificial Intelligence and Machine Learning | 4 | ✓ | ✓ | ✓ | AI/ML Competency |
| III | Mobile Computing Lab | 2 | – | ✓ | ✓ | Technology Skill |
| III | Web Technologies and Cloud Computing Lab | 2 | – | ✓ | ✓ | Deployment Skill |
| III | Internet of Things Lab | 2 | – | ✓ | ✓ | Model Building |
| III | Discipline-Centric Elective V | 4 | ✓ | ✓ | ✓ | Advanced Specialization |
| III | Supportive Course | 2 | ✓ | ✓ | ✓ | Interdisciplinary Learning |
| III | Internship | 2 | – | ✓ | ✓ | Industry Exposure |
| III | Peace Education | 2 | ✓ | – | ✓ | Value Orientation |
| IV | Major Project | 16 | – | ✓ | ✓ | Research & Innovation |

**Note:** KF – Knowledge Foundation, SD – Skill Development, E – Employability Enhancement

| METHODS OF EVALUATION | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | **25 Marks** |
| | Assignments/Snap Test/Quiz | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | **75 Marks** |
| **Total** | | **100 Marks** |

| METHODS OF ASSESSMENT | |
|---|---|
| **Remembering (K1)** | The lowest level of questions require students to recall information from the course content<br>Knowledge questions usually require students to identify<br>Information in the text book. |
| **Understanding (K2)** | Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words.<br>The questions go beyond imply recall and require<br>Students to combine together. |
| **Application (K3)** | Students have to solve problems by using/applying a concept learned in the class room.<br>Students must use their knowledge to determine an exact<br>response. |
| **Analyze(K4)** | Analyzing the question is one that asks the students to break down something in to its component parts.<br>Analyzing requires students to identify reasons causes<br>Or motives and reach conclusions or generalizations. |

| | |
|---|---|
| **Evaluate(K5)** | Evaluation requires an individual to make judgment to something.<br>Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem.<br>Students are engaged in decision-making and problem– solving.<br>Evaluation questions do not have single right answers. |
| **Create(K6)** | The questions of this category challenge students to get engaged in creative and original thinking.<br>Developing original ideas and problem solving skills. |

## PROGRAMME OUTCOMES (PO) - PROGRAMME SPECIFIC OUTCOMES (PSO) MAPPING

| PO's and PSO's mapping | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **P10** |
| **PSO1** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** |
| **PSO2** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** |
| **PSO3** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** |
| **PSO4** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** |
| **PSO5** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** | **H** |

**Level of Correlation between PO's and PSO's**

*(Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix)*

Assign the value

**1 – Low**

**2 – Medium**

**3 – High**

**0 – No Correlation**

## CANDIDATE ELIGIBILITY FOR M.Sc. PROGRAMME ADMISSION

A candidate who has passed B.Sc. Computer Science / B.C.A / B.Sc. Computer Technology / B.Sc. Information Science / Technology / B.Sc. Computer Science with Artificial Intelligence / B.Sc. Computer Science with Cyber Security/ B.Sc. Computer Science with Artificial Intelligence and Data Science / B.Sc. Computer Science with Artificial Intelligence and Machine Learning / B.Sc. Internet of Things / B.Sc. Data Science / B.Voc. AR & VR degree of this University or any of the degree of any other University accepted by the syndicate as equivalent thereto subject to such conditions as may be prescribed therefore shall be permitted to appear and qualify for the M.Sc. Computer Science degree examination of this University after a course of study of two academic years.

**DURATION OF THE PROGRAMME AND MEDIUM**

The programme shall be of two years duration spread over four semesters under choice based credit system. The Maximum duration to complete the course shall be two academic years after normal completion of the programme. The medium of instruction/study is English

**SCHEME OF EXAMINTAION FOR EACH SEMESTER - M. Sc. COMPUTER SCIENCE**

**SEMESTER- I**

| Course Code | Title of the Course | Credits | Hours | | Maximum Marks | | Total | Exam Duration hours |
|---|---|---|---|---|---|---|---|---|
| | | | T | P | CIA | ESE | | |
| 26UPCSC2C01 | Design and Analysis of Algorithms | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2C02 | Theory of Computation | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2C03 | Python Programming | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2C04 | Advanced Operating Systems | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2L01 | Algorithm Lab | 2 | | 4 | 40 | 60 | 100 | 3 |
| 26UPCSC2L02 | Python Programming Lab | 2 | | 4 | 40 | 60 | 100 | 3 |
| Discipline Centric Elective –I | Elective Course - Theory | 4 | 4 | | 25 | 75 | 100 | 3 |
| Generic Elective – I | Soft Skill Development Lab | 1 | | 2 | 100 | - | 100 | 3 |
| | **Total** | **25** | **20** | **10** | **305** | **495** | **800** | **-** |

## SEMESTER II

| Course Code | Title of the Course | Credits | Hours | | Maximum Marks | | Total | Exam Duration |
|---|---|---|---|---|---|---|---|---|
| | | | T | P | CIA | ESE | | |
| 26UPCSC2C05 | Computational Intelligence | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2C06 | Big Data Analytics | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2C07 | Advanced Java Programming | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2L03 | Computational Intelligence Lab | 2 | | 4 | 40 | 60 | 100 | 3 |
| 26UPCSC2L04 | Advanced Java Programming Lab | 2 | | 4 | 40 | 60 | 100 | 3 |
| 26UPCSC2P01 | Mini Project | 2 | - | 2 | 40 | 60 | 100 | 3 |
| Discipline Centric Elective – II | Elective Course – Theory | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2X01 | Extension Activity | 1 | - | 1 | - | 100 | 100 | 3 |
| NME-I | Non-Major Elective – I (Online Courses) | 2 | | 2 | - | 100 | 100 | 3 |
| Generic Elective - II 23UPPGC1H01 | Fundamentals of Human Rights | 1 | 1 | | 25 | 75 | 100 | 3 |
| | **Total** | **26** | **17** | **13** | **245** | **755** | **1000** | |

## SEMESTER III

| Course Code | Title of the Course | Credits | Hours | | Maximum Marks | | Total | Exam Duration |
|---|---|---|---|---|---|---|---|---|
| | | | T | P | CIA | ESE | | |
| 26UPCSC2C08 | Mobile Computing | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2C09 | Web Technologies and Cloud Computing | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2C10 | Artificial Intelligence and Machine Learning | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2L05 | Mobile Computing Lab | 2 | | 3 | 40 | 60 | 100 | 3 |
| 26UPCSC2L06 | Web Technologies and Cloud Computing Lab | 2 | | 4 | 40 | 60 | 100 | 3 |
| 26UPCSC2L07 | Internet of Things Lab | 2 | | 2 | 40 | 60 | 100 | 3 |
| Discipline Centric Elective – III | Elective Course – Theory | 4 | 4 | | 25 | 75 | 100 | 3 |
| 26UPCSC2I01 | Internship | 2 | | - | 100 | | 100 | 3 |
| NME-II | Non-Major Elective II | 2 | 3 | | 25 | 75 | 100 | 3 |
| Generic Elective – II 26UPGEN1V01 | Peace Education | 2 | 2 | | 25 | 75 | 100 | 3 |
| **Total** | | **30** | **21** | **9** | **410** | **690** | **1100** | **-** |

## SEMESTER – IV

| Course Code | Title of the Course | Credits | Hours | | Maximum Marks | | To tal | Exam Duration |
|---|---|---|---|---|---|---|---|---|
| | | | T | P | CIA | ESE | | |
| 26UPCSC2P02 | Project with viva voce | 16 | | | 50 | 150 | 200 | 3 |
| **Total** | | **16** | | | **50** | **150** | **300** | **-** |
| **Grand Total** | | **95** | **58** | **32** | **1010** | **2090** | **3100** | **-** |

**CREDIT CALCULATION**

| Method of Teaching | Hours | Credits |
|---|---|---|
| Lecture | 1 | 1 |
| Tutorial/Demonstration | 2 | 1 |
| Practical/Internship/self-Learning | 2/1 | 1 |

**ATTAINMENT RUBRICS FOR THEORY COURSES**

**THEORY EXAMINATION EVALUATION OF INTERNAL ASSESSMENT**

Test : 5 Marks (Best one out of Two Tests)

Model Examination : 5 Marks

Seminar : 5 Marks

Assignment : 5 Marks

Attendance : 5 Marks

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Total : 25 Marks

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***** No Internal Minimum**

**EVALUATION OF END SEMESTER EXAMINATIONS QUESTION PAPER PATTERN**

**(THEORY)**

| Section | Approaches | Mark Pattern | K Level | CO Coverage |
|---|---|---|---|---|
| A | One word (Answer all questions) | 20×1 = 20 (Multiple Choice Questions) | K1-K2 | CO1 - CO5 |
| B | 100 to 200 words (Answer any three out of five questions) | 3×5 = 15 (Analytical type questions) | K3-K6 | |
| C | 500 to 1000 words | 5×8 = 40 (Essay | K1-K6 | |

**ATTAINMENT RUBRICS FOR LAB COURSES**

**PRACTICAL / MINI PROJECT EXAMINATION EVALUATION OF INTERNAL ASSESSMENT**

| | | |
|---|---|---|
| Test 1 | : | 20 Marks |
| Test 2 | : | 20 Marks (Best one out of Two Tests) |
| Test 3 | : | 20 Marks |
| Total: | | 40 Marks |

***** No Internal Minimum**

**QUESTION PAPER PATTERN**

Time duration : 3 Hours

Max. Marks : 60 Marks

Two Questions (Without Choice) may be taken from the list of practical problems: 60 Marks

Distribution of the Marks

**(i) Practical / Mini Project**

| | | |
|---|---|---|
| Record Note Book | - | 10 |
| Problem Understanding | - | 10 |
| Implementation | - | 20 |
| Debugging and Modification | - | 10 |
| For correct output and viva | - | 10 |

**(ii) Industrial Training**

| | | |
|---|---|---|
| Internal Assessment | - | 40 |
| Joint Viva-Voce | - | 60 |

(Internal Examiner 30 and External Examiner 30)

**(iii) Dissertation**

| | | |
|---|---|---|
| Internal Assessment | - | 50 |
| Report Evaluation by External Examiner | - | 50 |
| Joint Viva-Voce | - | 100 |

(Internal Examiner 50 and External Examiner 50)

**REGULATIONS FOR DISSERTATION WORK**

- Students should attach themselves with well reputed Industry/Company/ Institutions to do their five months dissertation work.
- The Candidate should submit the filled in format to the department for approval during the First week of December during the even semester
- The review of the dissertation will be carried out periodically
- The student should submit three copies of their dissertation work
- The students may use Power Point presentation during their Dissertation Viva-Voce Examinations..

**PASSING MINIMUM**

The candidate shall be declared to have passed in the Theory/Practical/Dissertation Examination if the candidate secures:

i. 50% marks in the ESE and
ii. 50% in ESE and CIA put together

**GRADING SYSTEM**

Evaluation of performance of students is based on ten-point scale grading system as given below.

| Ten Point Scale | | | |
|---|---|---|---|
| Grade of Marks | Grade points | Letter Grade | Description |
| 90-100 | 9.0-10.0 | O | Outstanding |
| 80-89 | 8.0-8.9 | D+ | Excellent |
| 75-79 | 7.5-7.9 | D | Distinction |
| 70-74 | 7.0-7.4 | A+ | Very Good |
| 60-69 | 6.0-6.9 | A | Good |
| 50-59 | 5.0-5.9 | B | Average |
| 00-49 | 0.0 | U | Re-appear |
| ABSENT | 0.0 | AAA | ABSENT |

## SEMESTER - I

**Course code: 26UPCSC2C01** **Credits: 4**

## DESIGN AND ANALYSIS OF ALGORITHMS

**COURSE OBJECTIVES:**

- Understand algorithm design principles and performance analysis
- Develop knowledge of fundamental data structures
- Apply various algorithm design techniques
- Design efficient solutions for optimization and search problems
- Explore advanced problem-solving strategies

**Unit I – Introduction**

Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation Big oh notation, Omega notation, Theta notation and Little oh notation Elementary Data Structures: Stacks and Queues- Trees-Dictionaries-Priority Queues-Sets and Disjoint Set Union- Graphs

**Unit II – Divide and Conquer**

General Sorting method Bubble, Selection, Insertion, Divide and conquer -Merge & Quicksort, applications-Binary search, Quick sort, Merge sort, Linear Search

**Unit III – Greedy Method**

The Greedy Method: General Method-Container Loading-Knapsack Problem-Tree Vertex Splitting-Job Sequencing with Deadlines- Minimum Cost Spanning Trees-Optimal Storage on Tapes-Optimal Merge Patterns-Single Source Shortest Paths

**Unit IV – Dynamic Programming**

Dynamic Programming: The General Method-Multistage Graphs- All-Pairs Shortest Paths -Single-Source Shortest Paths - Optimal Binary Search Trees -String Editing- 0/1 Knapsack- Reliability Design-The Traveling Salesperson Problem-Flow Shop Scheduling. Basic Traversal and Search Techniques: Techniques for Binary Trees- Techniques for Graphs-Connected Components and Spanning Trees- Biconnected Components and DFS

**Unit V – Backtracking**

Backtracking The General Method-The 8-Queens Problem- Sum of Subsets-Graph Coloring - Hamiltonian Cycles- Knapsack Problem Branch and Bound: Least Cost searched

**Text Book**

Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson, 2017.

**Reference Books**


1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 4th Edition, MIT Press, 2022.
2. Mark Allen Weiss., Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson, 2014.
3. Robert Sedgewick, Kevin Wayne, Algorithms, 4th Edition, Addison-Wesley, 2011.
4. G. A. Vijayalakshmi Pai, A Textbook of Data Structures and Algorithms, 1st Edition, Wiley-ISTE, 2023.
5. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, 3rd Edition, Pearson, 1996.


**COURSE OUTCOMES**

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

| | | |
|---|---|---|
| CO1 | Understand and apply knowledge of computing and mathematics to find the algorithm efficiency. | K1-K6 |
| CO2 | Analyze a problem and identify the computing requirements appropriate for its solution. | |
| CO3 | Create, implement, and evaluate a Dynamic Programming algorithm to meet desired needs. | |
| CO4 | Create, implement, and evaluate a Backtracking and Knapsack to meet desired need | |
| CO5 | Evaluate and approximate NP-hard problems – Travelling salesman problem – Knapsack problem. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | L | L | L | L | H | H | H | L |
| **CO2** | H | H | H | M | M | L | L | L | L | L |
| **CO3** | H | H | H | L | L | L | M | M | M | M |
| **CO4** | H | H | H | L | L | L | M | M | M | L |
| **CO5** | H | H | H | L | M | M | H | H | H | H |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2C02** **Credits: 4**

## THEORY OF COMPUTATION

**COURSE OBJECTIVES:**

- Able to understand fundamental concept of automata, formal languages, grammars, and their classification using the Chomsky hierarchy
- Explore the students to analyze finite automata and regular languages, study DFA, NFA, regular expressions, and their interconversions.
- Explore context-free languages and grammars and understand derivations, ambiguity, simplification, and normal forms of CFGs
- Examine advanced computational models and learn Pushdown Automata and Turing Machine as models of computation.
- Evaluate computational power and applications and compare different automata models and understand their real-world applications and limitations.

### Unit I: Basics of Automata theory and computation

History of automata- Grammar-Chomsky hierarchy - use of automata - characteristics of automata - finite automata - graphical and tabular representation -transactional system -DFA and NFA – conversion of NFA to DFA -Equivalence of DFA and NFA -Dead state -Finite automata with output-conversion of one machine to another-minimization of finite automata - Two way finite automata.

### Unit II: Finite State Machine

Finite state machine - state equivalence and minimization of machine - incompletely specified machine - merger graph - merger table - finite memory and definite memory - information lossless machine – inverse machine – minimal inverse machine - Arden's theorem-construction of finite automata from regular expression.

### Unit III: Finite Automata

Equivalence of two finite automata- Equivalence of two regular expression - construction of regular grammar from an RE - constructing FA from regular grammar – Pumping lemma for RE - context free grammar - derivation and parse tree - Ambiguity in context free grammar - left recursion and left factoring - simplification of context free grammar - linear grammar - normal form – Pumping lemma for CFL – Ogdens lemma for CFL.

**Unit IV: Pushdown Automata**

Pushdown automata - acceptance PDA - DPDA and NPDA - Construction of PDA from CFG - construction of CFG equivalent to PDA - Graphical notation for PDA -Turing Machine - transactional representation of Turing machine – non deterministic Turing – conversion of regular expression to Turing machine.

**Unit V: Turing Machine**

Variations of Turing machine - Turing machine as an integer function - Universal Turing machine - linear bounded automata – Undecidability - reducibility.

**Text Book:**

Shyamlendu Kandar, "Introduction to automata theory, formal languages and Computation" First Edition, Pearson Education, 2013.

**Reference Books**


1. K.V.N. Sunitha, "Formal Languages and Automata theory", Ist edition, Pearson Education, 2015
2. John E Hopcraft, "Introduction to Automata theory, Languages and Computation", 3rd edition, Pearson Education, 2011.


**COURSE OUTCOMES**

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

| | | |
|---|---|---|
| CO1 | Explain core concepts and describe automata theory, formal languages, and the Chomsky hierarchy. | K1-K6 |
| CO2 | Design and convert automata, construct and minimize DFA/NFA and convert between automata and regular expressions | |
| CO3 | Apply context-free grammar techniques and develop, simplify, and transform CFGs, and analyze ambiguity and normal forms. | |
| CO4 | Construct and analyze advanced machines and design Pushdown Automata and simulate Turing Machine for problem-solving | |
| CO5 | Assess computational limits and Compare FA, PDA, and TM, and explain decidability, recursive, and recursively enumerable languages | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | H | M | H | M | M | M | H | H |
| **CO2** | H | M | H | M | H | M | H | M | H | H |
| **CO3** | H | M | H | L | H | M | H | L | H | H |
| **CO4** | H | H | H | L | H | M | H | L | H | H |
| **CO5** | H | H | H | M | H | M | H | L | H | H |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2C03** **Credits: 4**

## PYTHON PROGRAMMING

**COURSE OBJECTIVES:**

- To acquire programming skills in core Python
- To learn Strings and function
- To develop object oriented skills in Python
- To comprehend various Python Packages
- To develop web application applications using Django

**Unit I: Introduction**

Introduction : Fundamental ideas of Computer Science - Strings, Assignment and Comments - Numeric Data types and Character sets - Expressions - Loops and Selection Statements: Definite iteration: the for Loop -selection: if and if-else statements -Conditional iteration: the while Loop

**Unit II: Code Structures**

Strings and Text Files: Accessing Characters and substrings in strings - Data encryption-Strings and Number systems- String methods - Text - Lists and Dictionaries: Lists - Dictionaries -Design with Functions: A Quick review - Problem Solving with top-Down Design - Design with recursive Functions - Managing a Program's namespace - Higher-Order Functions

**Unit III: Class and GUI**

Design with Classes: Getting inside Objects and Classes - Data-Modeling Examples - Building a New Data Structure - The Two - Dimensional Grid - Structuring Classes with Inheritance and Polymorphism-Graphical User Interfaces-The Behavior of terminal-Based programs and GUI-Based programs - Coding Simple GUI-Based programs - Windows and Window Components - Command Buttons and responding to events

**Unit IV: Python Packages**

Working with Python Packages: NumPy Library-Ndarray- Basic Operations - Indexing, Slicing and Iteration – Array manipulation - Pandas - The Series - The Data Frame -The Index Objects - Data Vizualization with Matplotlib- The Matplotlib Architecture -Pyplot- The Plotting Window - Adding Elements to the Chart - Line Charts - Bar Charts - Pie charts

**Unit V: Web Development Django**

Django: Installing Django- Building an Application - Project Creation - Designing the Data Schema - Creating an administration site for models - Working with Query Sets and Managers - Retrieving Objects - Building List and Detail Views

**Text Books:**


1. K.A.Lambert, Fundamentals of Python: first programs", Second Edition, Cengage Learning, 2018
2. Fabio Nelli, "Python Data Analytics: With Pandas, NumPy, and Matplotlib", Second Edition, Kindle, Edition, 2018
3. Antonio Mele, "Django 3 By Example", Third Edition, 2020


**Reference Books:**


1. Beazley, David M. *Python: Essential Reference*. Addison-Wesley, 2012.
2. Naveen, Kumar, and Taneja Sheet et al. *Python Programming: A Modular Approach*. Pearson Education India, 2017.


**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Comprehend the programming skills in python and develop applications Using conditional branches and loop | K1-K6 |
| CO2 | Create python applications with strings and functions | |
| CO3 | Understand and implement the Object Oriented Programming paradigm with the concept of objects and classes, Inheritance and polymorphism | |
| CO4 | Evaluate the use of Python packages to perform numerical computations and data visualization | |
| CO5 | Design interactive web applications using Django | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | H | M | H | H | H | H | M |
| **CO2** | H | H | H | M | H | H | H | H | H | H |
| **CO3** | H | M | H | H | M | H | M | H | H | M |
| **CO4** | H | H | H | H | H | H | H | M | H | H |
| **CO5** | H | H | H | H | H | H | H | H | H | M |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2C04** **Credits: 4**

## ADVANCED OPERATING SYSTEMS

**COURSE OBJECTIVES:**

- To provide in-depth knowledge of operating system structures, process management, and synchronization mechanisms.
- To study distributed operating systems, communication models, and consistency techniques.
- To understand modern OS trends such as virtualization, containers, and cloud resource management.
- To analyze memory management, file systems, and distributed storage techniques.
- To study OS security, real-time systems, and emerging trends like edge computing and AI integration.

**Unit I – Basics of OS and System Structure**

Evolution of operating systems (simple overview) - Types of OS architectures: monolithic, layered, microkernel (basic idea) - System calls and user–kernel interaction - Process and thread concepts - Basics of CPU scheduling - Inter-process communication (IPC): shared memory and message passing - Introduction to synchronization (semaphores, basic locks) - Basic deadlock concepts (definition, simple handling methods)

**Unit II – Introduction to Distributed Systems**

What is a distributed system? (concept and examples) -Basic communication methods: message passing and RPC - Simple idea of logical clocks (ordering of events) - Basic distributed coordination concepts - Introduction to distributed file systems - Basic idea of data consistency and replication - Simple case studies: Google File System, Hadoop Distributed File System

**Unit III – Virtualization and Cloud Basics**

Introduction to virtualization (concept and need) - Types of virtualization (basic idea only) - Virtual machines and hypervisors (simple explanation) - Introduction to containers using Docker - Basic idea of orchestration using Kubernetes - Cloud computing basics: IaaS, PaaS, SaaS - Introduction to scalability and load balancing

**Unit IV – Memory and File Systems**

Basics of memory management -Paging and segmentation (introductory level) - Virtual memory (basic concept) - File system basics and operations - Disk management and simple scheduling methods - Introduction to storage systems - Simple overview of modern file systems like ZFS and Ceph -

**Unit V – Security and Modern OS Trends**

Basic OS security concepts (authentication and access control) - Introduction to system protection -

Basics of real-time operating systems - Introduction to embedded systems - Overview of modern trends: - Cloud and edge computing - Energy-efficient systems - OS support for AI applications - Case studies: Linux and Android

**Textbook:**

Andrew S. Tanenbaum, Herbert Bos, "Modern Operating Systems", Pearson, 5th Edition, 2022.

**Reference Books:**


1. Docker Up and Running, O'Reilly Media, Latest Edition, 2023.
2. Morgan Kaufmann, Cloud Computing Theory and Practice, Elsevier, 2nd Edition.
3. The Kubernetes Book, Latest Edition, 2025.
4. Cloud Native DevOps with Kubernetes, O'Reilly Media.
5. Future Networking Essentials, Springer / Latest Edition.


**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Understand kernel architectures, process management, synchronization, and deadlock handling. | K1-K6 |
| CO2 | Apply concepts of distributed communication, consistency models, and fault tolerance. | |
| CO3 | Work with virtualization, containers, and orchestration tools in modern computing environments. | |
| CO4 | Analyze advanced memory management, file systems, and storage architectures. | |
| CO5 | Evaluate OS security mechanisms, real-time constraints, and future trends in operating systems | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | H | M | H | M | M | M | H | H |
| **CO2** | H | M | H | M | H | M | H | M | H | H |
| **CO3** | H | M | H | L | H | L | H | L | H | H |
| **CO4** | H | H | H | L | H | M | H | L | H | H |
| **CO5** | H | H | H | M | H | L | H | L | H | H |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2L01** **Credits: 2**

## ALGORITHMS LAB

**COURSE OBJECTIVES:**

- To understand the fundamental concepts of algorithms and data structures.
- To analyze the time and space complexity of algorithms.
- To apply divide and conquer, greedy, dynamic programming, and backtracking techniques for solving computational problems.
- To develop programs for sorting, searching, optimization, and graph-related problems.
- To enhance problem-solving and programming skills through practical implementation of algorithms.

## LIST OF EXPERIMENTS

1. Develop a program to implement Stack operations using Array.
2. Develop a program to implement Queue operations using Array.
3. Apply the Merge Sort technique to sort a list of elements.
4. Apply the Quick Sort technique to sort a list of elements.
5. Implement the Fractional Knapsack Problem using Greedy Method.
6. Implement Job Sequencing with Deadlines using Greedy Technique.
7. Develop a Dynamic Programming solution for the 0/1 Knapsack Problem.
8. Implement the Floyd Warshall Algorithm to determine shortest paths between all pairs of vertices.
9. Develop a solution for the 8-Queens Problem using Backtracking Technique.
10. Implement Graph Coloring using Backtracking Technique.

**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Implement fundamental data structures such as stacks and queues using appropriate programming techniques. | K1-K6 |
| CO2 | Apply divide and conquer strategies for solving sorting and searching problems efficiently. | |
| CO3 | Develop greedy algorithm solutions for optimization problems such as knapsack and job sequencing. | |
| CO4 | Design dynamic programming algorithms for shortest path and optimization problems. | |
| CO5 | Implement backtracking techniques to solve constraint satisfaction problems such as 8-Queens and graph coloring. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | M | L | H | H | H | M | L | H |
| **CO2** | H | H | M | L | H | H | M | M | L | H |
| **CO3** | H | H | H | M | M | L | H | L | H | H |
| **CO4** | H | H | H | M | H | M | H | L | H | H |
| **CO5** | M | H | H | M | M | L | H | L | H | H |

*H-High; M-Medium; L-Low

**Subject Code: 26UPCSC2L02** **Credits: 02**

# PYTHON PROGRAMMING LAB

**COURSE OBJECTIVES:**

This course enables the students:

- To master the fundamentals of writing python scripts
- To create program using elementary data items
- To implement Python programs with conditionals and loops
- To use functions for structuring Python programs
- To develop web programming with Django

**IMPLEMENT THE FOLLOWING IN PYTHON:**

## LIST OF EXPERIMENTS

1. Develop a student performance management system using lists, dictionaries, and tuples for structured data handling.
2. Create a payroll processing system using conditional statements and loops for salary computation and tax calculation.
3. Design a loan eligibility evaluation module using user-defined functions and validation logic.
4. Build a library management system using classes and objects to manage books and members.
5. Implement an employee hierarchy system using inheritance to model roles, responsibilities, and salary structures.
6. Develop a banking transaction system demonstrating polymorphism for different account types and interest calculations.
7. Perform financial risk analysis and portfolio return computation using NumPy for numerical modeling.
8. Conduct sales trend analysis and customer segmentation using Pandas for business intelligence.
9. Generate COVID-19 or stock market trend visualizations using Matplotlib for analytical reporting.
10. Develop a student admission or online feedback management portal using Django forms for dynamic web interaction.

**COURSE OUTCOMES**

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

| | | |
|---|---|---|
| **CO1** | Demonstrate proficiency in Python programming constructs and develop structured scripts for problem-solving. | **K1-K6** |
| **CO2** | Develop Python applications using core data structures such as lists, dictionaries, tuples, and sets for real-world scenarios. | |
| **CO3** | Design and implement object-oriented solutions using classes, inheritance, and polymorphism to model practical systems. | |
| **CO4** | Analyze and apply Python libraries (NumPy, Pandas, Matplotlib) for numerical computation and data visualization. | |
| **CO5** | Develop and deploy dynamic web applications using the Django framework. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze,K5-Evaluate,K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | M | M | H | L | M | L | M |
| **CO2** | H | H | L | M | M | H | M | M | L | M |
| **CO3** | H | H | M | H | H | H | M | M | L | M |
| **CO4** | H | H | L | M | M | H | L | M | M | L |
| **CO5** | H | H | M | H | H | H | H | M | M | M |

H-High; M-Medium; L-Low

**Subject Code: 26UPCSC2S01** **Credits: 01**

# SOFT SKILL DEVELOPMENT LAB

**COURSE OBJECTIVE**

This course enables the students:

- To enable students to gain basic communication skills in professional and social contexts effectively.
- To acquire useful words and apply the min situational context.
- To develop listening and reading skills through comprehension passages
- To enrich the leadership qualities and interpersonal communication
- To enhance essential characteristics in writing

## LIST OF EXPERIMENTS

1. Analyze and rewrite a poorly drafted technical document to demonstrate the characteristics of effective technical writing.
2. Develop a personal employability skills portfolio including SWOT analysis and career goal mapping.
3. Create a contextual vocabulary journal by identifying, defining, and applying new professional terms in sentences.
4. Complete sentence construction exercises focusing on clarity, coherence, and professional tone.
5. Identify and correct grammatical and syntactical errors in business and technical passages.
6. Interpret and solve verbal analogy problems to strengthen logical reasoning skills.
7. Analyze reading comprehension passages to interpret main ideas and conceptual understanding.
8. Evaluate reasoning-based comprehension passages to infer conclusions and critical insights.
9. Draft professional emails, technical blog posts, and forum responses following industry standards.
10. Prepare and deliver a technical presentation using structured slides with effective visual aids.
11. Design a professional resume and cover letter tailored to a specific job role.
12. Participate in mock interview sessions including HR and technical rounds with feedback analysis.

13. Conduct and evaluate group discussion sessions on current industry topics.
14. Practice listening comprehension exercises using recorded lectures or interviews and summarize key points.
15. Deliver short speeches and role-play situational conversations in professional contexts.
16. Analyze English usage in mass media (news articles, advertisements, editorials) for communication effectiveness.
17. Perform structured grammar practice covering tense consistency, subject–verb agreement, and sentence transformation.
18. Engage in peer collaboration activities to solve case-based communication challenges.
19. Participate in team-building exercises to demonstrate leadership and conflict resolution skills.
20. Develop and present persuasive communication speeches addressing contemporary social or professional issues.

**TEXT BOOKS:**


1. Uma Narula, "Development Communication: Theory and Practice", Revised Edition, Har-Aanad Publication, 2019.
2. Annette Capel and Wendy Sharp, "Cambridge English: Objective First", Fourth Edition, Cambridge University Press, 2013.
3. EmmaSue-Prince,"TheAdvantage:The7SoftSkillsYouNeedtoStayOneStepAhead", First Edition, FT Press, 2013.
4. Guy Brook-Hart, "Cambridge English: Business Benchmark", Second Edition, Cambridge University Press, 2014.
5. NormanLewis,"HowtoReadBetter&Faster",BinnyPublishingHouse,NewDelhi, 1978.


**REFERENCE BOOKS**


1. Michael McCarthy and Felicity O,,Dell,"English Vocabulary in Use:100 Units of Vocabulary Reference and Practice", Cambridge University Press,1996.
2. Murphy, Raymond,"Intermediate English Grammar",Second Edition,Cambridge University Press, 1999.

**COURSE OUTCOMES**

On the successful completion of the course, students will be able

| | | |
|---|---|---|
| CO1 | Demonstrate effective verbal and written communication skills in professional and social contexts. | K1-K6 |
| CO2 | Apply appropriate vocabulary, grammar, and sentence structures in technical and workplace communication. | |
| CO3 | Analyze reading and listening comprehension passages to interpret concepts, reasoning, and contextual meaning. | |
| CO4 | Exhibit leadership, teamwork, and interpersonal communication skills in collaborative environments. | |
| CO5 | Create professional documents and presentations including resumes, emails, blogs, and technical presentations. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | M | H | H | H | H | M | M | M | H |
| CO2 | M | M | H | H | M | H | L | M | M | H |
| CO3 | H | H | M | M | M | M | L | M | M | M |
| CO4 | M | M | H | H | H | H | H | H | M | H |
| CO5 | M | H | H | H | M | H | M | H | M | H |

H-High; M-Medium; L-Low

**Semester II**

**Course Code: 26UPCSC2C05** **Credits: 4**

## COMPUTATIONAL INTELLIGENCE

**COURSE OBJECTIVES:**

- To introduce the fundamental concepts and applications of Computational Intelligence.
- To understand fuzzy logic systems and their role in decision-making processes.
- To learn the architecture and learning mechanisms of artificial neural networks.
- To study genetic algorithms and evolutionary computing techniques for optimization problems.
- To explore swarm intelligence techniques and real-world applications of computational intelligence systems.

**Unit I – Computational Intelligence**

Introduction to Computational Intelligence – Characteristics and Applications – Difference between Artificial Intelligence and Computational Intelligence – Intelligent Systems – Problem Solving Methods – Search Techniques: Breadth First Search, Depth First Search – State Space Representation – Introduction to Soft Computing – Basics of Machine Learning and Pattern Recognition.

**Unit II – Fuzzy Sets**

Introduction to Fuzzy Sets – Crisp Sets and Fuzzy Sets – Membership Functions – Operations on Fuzzy Sets – Fuzzy Relations – Fuzzy Rules and Inference Systems – Fuzzification and Defuzzification Methods – Fuzzy Logic Controllers – Applications of Fuzzy Logic.

**Unit III – Neural Networks**

Introduction to Neural Networks – Biological Neuron and Artificial Neuron Models – Architecture of Neural Networks – Activation Functions – Learning Methods – Single Layer Perceptron – Multi Layer Perceptron – Back Propagation Algorithm – Applications of Neural Networks.

**Unit IV – Genetic Algorithms and Evolutionary Computing**

Introduction to Genetic Algorithms – Basic Concepts of Evolutionary Computing – Chromosome Representation – Fitness Function – Selection, Crossover and Mutation Operations – Simple Genetic Algorithm – Applications of Genetic Algorithms – Optimization Problems

**Unit V – Swarm Intelligence and Applications**

Introduction to Swarm Intelligence – Particle Swarm Optimization (PSO) – Ant Colony Optimization (ACO) – Intelligent Agents – Basics of Data Mining and Computational Intelligence Applications – Applications in Image Processing, Robotics, Medical Diagnosis and Business Intelligence – Ethical Issues in Intelligent Systems

**Textbook:**

S. N. Sivanandam and S. N. Deepa, "Principles of Soft Computing", 3rd Edition, Wiley India Pvt. Ltd 2019.

**Reference Books:**


1. Amit Konar, "Computational Intelligence: Principles, Techniques and Applications", First edition, Springer (Springer Science & Business Media), 2005
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", 3rd, Edition, Pearson education, 2009.


**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Explain the basic concepts, techniques, and applications of Computational Intelligence. | K1-K6 |
| CO2 | Apply fuzzy logic principles for modeling and decision-making problems.. | |
| CO3 | Develop simple artificial neural network models for pattern recognition and prediction tasks. | |
| CO4 | Implement genetic algorithms and evolutionary techniques for optimization problems. | |
| CO5 | Analyze swarm intelligence methods and computational intelligence applications in various domains | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | H | M | H | M | M | M | H | H |
| **CO2** | H | M | H | M | H | M | H | M | H | H |
| **CO3** | H | M | H | L | H | L | H | L | H | H |
| **CO4** | H | H | H | L | H | M | H | L | H | H |
| **CO5** | H | H | H | M | H | L | H | L | H | H |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2C06** **Credits: 4**

## BIG DATA ANALYTICS

### COURSE OBJECTIVES

- To understand Big Data concepts and NoSQL data management systems.
- To learn Hadoop architecture, HDFS, and distributed computing concepts.
- To implement distributed data processing using MapReduce.
- To explore Big Data ecosystem tools such as Hive and Pig.
- To analyze large-scale data processing using Spark.

### UNIT-I: Big Data Introduction and NoSQL Data Management

Introduction to Big Data; Characteristics of Big Data; Need for Big Data; Big Data versus other techniques; Structured and Unstructured Data; Industry Applications of Big Data; Introduction to Apache Hadoop; Hadoop Ecosystem.

Introduction to NoSQL Databases; Terminologies in NoSQL and RDBMS; Types of NoSQL Databases – Key-Value, Document, Column Family, Graph Databases; SQL versus NoSQL; Data Consistency Issues; ACID versus BASE; Relaxing Consistency; Introduction to HBase

### UNIT- II: Hadoop Fundamentals and HDFS

Basics of Hadoop; Data Distribution; Hadoop Distributed File System (HDFS); NameNode and DataNode; Data Flow (File Read and Write); Hadoop I/O; Compression; Serialization; Avro File-based Data Structures; Hadoop Installation – Standalone Mode, Fully Distributed Mode; Multi-node Cluster Configuration

### UNIT- III: MapReduce Framework

MapReduce Architecture; MapReduce Data Types; File Input and Output Formats; Java MapReduce; Partitioner and Combiner; **MapReduce Applications**: MapReduce Workflow; Debugging MapReduce Job; Job Chaining and Control; MapReduce 1 and MapReduce 2 (YARN); Failure Handling in MapReduce

### UNIT –IV: Hive and Pig

Apache Hive – Architecture; Data Types; File Formats; HiveQL – DDL and DML; Schema on Read versus Schema on Write; Transactions and Indexes;

Apache Pig – Installation; Execution Type; Pig Data Model; PigLatin Scripts; Relational Operations; User-Defined Functions; Comparison between Hive and traditional database.

**UNIT –V: Apache Spark**

Introduction to Apache Spark; Spark Programming Model; Resilient Distributed Datasets (RDD); Spark methods for Data processing; Example of programs using Scala: Shuffling; Memory Management Issues;

**TEXT BOOKS**

1. Mayank Bhushan, *Big Data and Hadoop: Fundamentals, Tools, and Techniques for Data-Driven Success*, 2nd Edition, BPB Publications, 2024.

**REFERENCE BOOKS:**

1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publications, First Edition,2015
2. Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, "Big data for dummies", John Wiley & Sons, Inc. (2013)
3. TomWhite,"HadoopTheDefinitiveGuide",O"ReillyPublications,FourthEdition,2015
4. Dirk Deroos,PaulC.Zikopoulos, RomanB. Melnky, Bruce Brown, Rafael Coss, "Hadoop For Dummies", Wiley Publications, 2014
5. Robert D.Schneider,"Hadoop For Dummies",John Wiley&Sons, Inc.(2012)
6. Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw Hill, 2012 Chuck Lam, "Hadoop In Action", Dream tech Publications, 2010

**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Demonstrate comprehensive understanding of Big Data concepts, characteristics, NoSQL data management models, and distributed computing paradigms. | K1-K6 |
| CO2 | Design and implement distributed storage solutions and resource management mechanisms using Apache Hadoop and HDFS architecture. | |
| CO3 | Develop, optimize, and evaluate MapReduce programs for large-scale parallel data processing in distributed environments. | |
| CO4 | Apply data warehousing and large-scale data transformation techniques using Apache Hive and Apache Pig for analytical queries | |
| CO5 | Analyze, process, and interpret large datasets using Apache Spark to support scalable and real-time analytics applications. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | M | L | M | L | M | M | M |
| **CO2** | H | H | L | M | M | H | M | M | L | M |
| **CO3** | H | H | L | M | M | H | M | M | L | M |
| **CO4** | H | H | M | H | M | H | M | M | L | M |
| **CO5** | H | H | M | H | H | H | H | H | M | H |

*H-High; M-Medium; L-Low

**Subject Code: 26UPCSC2C07** **Credits: 04**

## ADVANCED JAVA PROGRAMMING

### COURSE OBJECTIVES

- To understand core Java programming fundamentals and program structure
- To apply object-oriented programming principles in application development
- To design GUI-based desktop applications using AWT and Swing
- To develop restful web applications using Spring Boot
- To integrate database connectivity and micro service concepts in Java applications

### UNIT –I: JAVA BASICS

Java Architecture – JVM, JRE, JDK – Java Development Environment Setup – Compilation and Execution – Structure of a Java Program – Data Types – Variables – Operators – Type Casting – Control Statements (if, if-else, switch) – Looping Statements (for, while, do-while) – Arrays (1D and 2D) – Strings – Methods – Parameter Passing – Command Line Arguments.

### UNIT -II: OBJECT ORIENTED PROGRAMMING

OOP Concepts – Abstraction – Encapsulation – Inheritance – Polymorphism – Classes and Objects – Constructors – Method Overloading – Method Overriding – Access Modifiers – Static Members – this and super keywords – Interfaces – Packages – Exception Handling (Basics) – Composition vs Inheritance.

### UNIT- III: GUI PROGRAMMING

Introduction to GUI Programming – AWT Components (Label, Button, TextField) – Event Handling – Event Classes – Listener Interfaces – Adapter Classes – Swing Architecture – JFrame – Content Pane – Layout Managers – Handling Mouse and Key Events – Development of Simple GUI Applications.

### UNIT-IV: SPRING BOOT FUNDAMENTALS

(Aligned with Chapters 1–3 – Hands-on Application Development using Spring Boot)

Introduction to Spring Boot – Features and Advantages – Microservices Architecture – Setting up Development Environment – Spring Initializr – Maven and Gradle – Project Structure – pom.xml and build.gradle – Starter Dependencies – Auto-Configuration – Core Annotations – Dependency Injection – Configuration Properties – Profiles – Building First Spring Boot Application – Embedded Tomcat – 12-Factor Application Principles.

### UNIT- V: RESTFUL SERVICES AND DATABASE INTEGRATION

Spring Boot Annotations – @Rest Controller – @Request Mapping – @Auto wired – @Component – @Service – @Repository – Spring Data JPA – Working with H2 and My SQL – Caching – RESTful API Development – Exception Handling using @Controller Advice – Actuator Endpoints – Service Discovery (Introduction) – Environment Profiles – Basic Micro services Concepts.

**TEXT BOOKS:**

1. **Michael B. White**, "*Mastering Java: An Effective Project-Based Approach Including Web Development, Data Structures, GUI Programming and Object-Oriented Design"*, Mercury Learning and Information, 2018.
2. **Shagun Bakliwal**, "*Hands-on Application Development using Spring Boot: Building Modern Cloud Native Applications",* BPB Publications, First Edition, 2022

**REFERENCE BOOKS:**

1. Herbert Schildt,"JavatheCompleteReference",10th edition,McGraw Hill Publishing Company Ltd, New Delhi, 2017.
2. Tony Goddis,"Starting out with Java from Control Structures Through Objects", 6th, Edition, Pearson Education Limited, 2016
3. John Dean, Raymond Dean, "Introduction to Programming with JAVA – A Problem Solving Approach", TMGH Publishing Company Ltd, New Delhi, 2012.

**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Develop Java programs using core language constructs. | K1-K6 |
| CO2 | Apply object-oriented programming principles in application development. | |
| CO3 | Design GUI-based applications using AWT and Swing. | |
| CO4 | Develop restful web applications using Spring Boot framework. | |
| CO5 | Build database-driven and micro service-based applications using Spring Boot and JPA. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | M | H | M | L | M | M | M |
| **CO2** | H | H | M | M | H | M | L | M | M | M |
| **CO3** | H | M | M | H | H | H | M | M | M | H |
| **CO4** | H | H | H | H | H | H | H | M | M | H |
| **CO5** | H | H | H | H | H | H | H | H | H | H |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2L03** **Credits: 2**

**COMPUTATIONAL INTELLIGENCE LAB**

## COURSE OBJECTIVES:

- To provide hands-on experience in implementing computational intelligence techniques using programming tools.
- To develop understanding of graph search algorithms such as BFS and DFS.
- To enable students to implement fuzzy logic systems for real-world decision-making problems.
- To build neural network models for basic classification and learning tasks.
- To apply evolutionary and swarm intelligence algorithms for optimization problems.

### LIST OF EXPERIMENTS

1. Develop a program to apply Breadth First Search (BFS) algorithm to traverse a given graph.
2. Develop a program to apply Depth First Search (DFS) algorithm to traverse a given graph.
3. Implement fuzzy set operations (Union, Intersection, Complement) using programming techniques.
4. Design and implement a fuzzy logic system for temperature control using fuzzification and defuzzification methods.
5. Implement a Single Layer Perceptron model for classification of linearly separable data.
6. Design and develop a Multi Layer Perceptron using Backpropagation algorithm for pattern recognition.
7. Develop a program to apply Genetic Algorithm to solve a function optimization problem.
8. Develop and implement a Genetic Algorithm to solve the Knapsack problem.
9. Implement and analyze Particle Swarm Optimization (PSO) for optimization problems.
10. Design and apply Ant Colony Optimization (ACO) algorithm for finding the shortest path in a graph.

**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Implement graph traversal algorithms such as BFS and DFS for problem solving. | K1-K6 |
| CO2 | Design and execute fuzzy logic-based systems using fuzzy set operations and inference techniques. | |
| CO3 | Develop simple neural network models using perceptron and backpropagation algorithms. | |
| CO4 | Apply genetic algorithms to solve optimization problems such as function maximization and knapsack. | |
| CO5 | Implement swarm intelligence techniques like PSO and ACO for solving real-world optimization problems. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | H | M | H | M | M | M | H | H |
| **CO2** | H | M | H | M | H | M | H | M | H | H |
| **CO3** | H | M | H | L | H | L | H | L | H | H |
| **CO4** | H | H | H | L | H | M | H | L | H | H |
| **CO5** | H | H | H | M | H | L | H | L | H | H |

***H-High; M-Medium; L-Low**

**Course Code: 26UPCSC2L04** **Credits: 2**

# ADVANCED JAVA PROGRAMMING LAB

## COURSE OBJECTIVES

- To provide practical exposure to core Java programming constructs.
- To implement object-oriented programming principles through application development.
- To design and develop GUI-based desktop applications using AWT and Swing.
- To build RESTful web applications using Spring Boot framework.
- To develop database-driven applications using Spring Data JPA.

## LIST OF EXPERIMENTS

1. Develop a Java program to perform arithmetic operations using control statements, loops, arrays (1D & 2D), and command-line arguments.
2. Implement a menu-driven application to demonstrate object-oriented concepts such as classes, constructors, method overloading, method overriding, inheritance, and use of this and super.
3. Design a package-based Java application that demonstrates interfaces, abstraction, static members, and basic exception handling with user-defined exceptions.
4. Develop a file-handling program using byte streams and character streams to read, write, and append data to files with proper exception management.
5. Create a GUI-based application using AWT to perform simple form validation and event handling using action and item listeners.
6. Develop a Swing-based desktop application (e.g., Student Information System or Calculator) using JFrame, layout managers, mouse/key events, and adapter classes.
7. Create a basic Spring Boot application using Spring Initialize and Maven/Gradle to expose a simple REST endpoint.
8. Develop a RESTful CRUD application using Spring Boot with MySQL/H2 database integration using Spring Data JPA.
9. Implement exception handling and global error management in a Spring Boot REST application using @Controller Advice.
10. Develop a mini micro service-based application with multiple REST endpoints and database connectivity, demonstrating profiles and basic actuator endpoints.

**COURSEOUTCOMES**

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

| | | |
|---|---|---|
| CO1 | Implement Java programs using control structures, arrays, methods, and string handling. | K1-K6 |
| CO2 | Develop object-oriented applications demonstrating inheritance, polymorphism, interfaces, and exception handling. | |
| CO3 | Design GUI-based desktop applications using AWT and Swing with event handling mechanisms. | |
| CO4 | Develop RESTful web services using Spring Boot framework. | |
| CO5 | Build database-driven applications integrating Spring Boot with JPA and relational databases. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | M | H | M | L | M | M | L |
| **CO2** | H | H | H | M | H | M | L | M | M | L |
| **CO3** | H | M | H | H | H | H | M | M | M | M |
| **CO4** | H | H | H | H | H | H | M | M | M | H |
| **CO5** | H | H | H | H | H | H | H | M | M | H |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2X01** **Credits: 01**

## EXTENSION ACTIVITY

Course Description

This course focuses on developing a **working prototype or model addressing a real-world societal need**, encouraging students to apply technical knowledge for community benefit and sustainable development.

**COURSE OBJECTIVES**

- To identify real-world societal problems and analyze their impact on communities.
- To design and develop innovative prototypes or models using appropriate technologies.
- To apply interdisciplinary knowledge for solving social, environmental, or economic challenges.
- To promote teamwork, communication, and project management skills.
- To encourage ethical responsibility and community engagement through technology-driven solutions.

**COURSE OUTCOMES**

| CO | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Identify and analyze societal problems requiring technological solutions. | K1- K6 |
| CO2 | Design feasible solutions and develop working prototypes or models. | |
| CO3 | Apply appropriate tools and technologies to address real-world challenges. | |
| CO4 | Demonstrate teamwork, communication, and project presentation skills. | |
| CO5 | Evaluate the societal impact and sustainability of the developed solution. | |

**Subject Code: 23UPPGC1H01** **Credits: 01**

## FUNDAMENTALS OF HUMAN RIGHTS

**UNIT-I:**

**INTRODUCTION:** Meaning and Definitions of Human Rights - Characteristics and Importance of Human Rights - Evolution of Human Rights - Formation, Structure and Functions of the UNO - Universal Declaration of Human Rights - International Covenants - Violations of Human Rights in the Contemporary Era.

**UNIT-II:**

**HUMANRIGHTS IN INDIA:** Development of Human Rights in India - Constituent Assembly and Indian Constitution - Fundamental Rights and its Classification - Directive Principles of State Policy - Fundamental Duties.

**UNIT-III**

**Rights of Marginalized and other Disadvantaged People**: Rights of Women - Rights of Children - Rights of Differently Abled - Rights of Elderly - Rights of Scheduled Castes - Rights of Scheduled Tribes - Rights of Minorities - Rights of Prisoners - Rights of Persons Living with HIVAIDS - Rights of LGBT.

**UNIT-IV**

**Human Rights Movements**: Peasant Movements (Tebhaga and Telangana) - Scheduled Caste Movements (Mahar and Ad-Dharmi) - Scheduled Tribes Movements (Santhal and Munda) - Environmental Movements (Chipko and Narmada Bachao Andolan) - Social Reform Movements (Vaikom and Self Respect).

**UNIT-V**

**Redressal Mechanisms**: Protection of Human Rights Act, 1993 (Amendment 2019) - Structure and Functions of National and State Human Rights Commissions-National Commission for SCs

- National Commission for STs - National Commission for Women - National Commission for Minorities - Characteristics and Objectives of Human Rights Education.

**REFERENCE BOOKS**


1. Sudarshanam Gankidi,Human Rights in India: Prospective and Retrospective, Rawat Publications, Jaipur, 2019.
2. Satvinder Juss, Human Rights in India, Routledge, NewDelhi, 2020.
3. Namita Gupta, Social Justice and Human Rights in India, Rawat Publications, Jaipur, 2021.

4. Mark Frezo, The Sociology of Human Rights, John Willy & Sons, U.K. 2014.
5. ChiranjiviJ.Nirmal, Human Rights in India: Historical, Social and Political Perspectives, Oxford University Press, New York, 2000.
6. Dr.S.Mehartaj Begum, Human Rights in India: Issues and perspectives,A PH Publishing Corporation, New Delhi, 2010.
7. Asha Kiran, The History of Human Rights, Mangalam Publications, Delhi, 2011.
8. Bani Borgohain, Human Rights, Kanishka Publishers &Distributors, New Delhi-2,2007.
9. Jayan Chudhary, A Text book of Human Rights,Wisdom Press,New Delhi, 2011.

**Semester III**

**Course Code: 26UPCSC2C08** **Credits: 4**

## MOBILE COMPUTING

**COURSE OBJECTIVES:**

- To introduce the concepts of wireless devices with signal, Antenna, Radio Frequencies, Signal Propagation.
- To introduce wireless communication and networking principles, that support connectivity to cellular networks, Wireless LAN, GSM, CDMA
- To learn the Applications of Cryptographic Hash Functions
- To understand various Digital Signature Schemes
- To Introduce the WAP Architecture, MANET and Routing

**Unit I: Wireless Communication**

Introduction – Applications – History of wireless communication – A Simplified reference model - Wireless transmission – Frequencies for radio transmission – Regulations – Signals –Antennas - Signal propagation: Path loss of radio signals - Additional signal propagation effects - Multi-path propagation – Multiplexing –Modulation

**Unit II: Medium Access Control**

Spread spectrum – Direct sequence spread spectrum – Frequency hopping spread spectrum – Cellular systems. Medium access control: Hidden and exposed terminals – Near and far terminals – SDMA, FDMA, TDMA, Fixed TDM, Classical Aloha, slotted Aloha, Carrier sense multiple access – Reservation TDMA – Multiple access with collision avoidance – Polling – CDMA – Spread-Aloha multiple access

**Unit III: GSM and Routing Protocols**

GSM - Mobile services – System architecture – Radio interface – Protocols – Localization and calling – Handover – Security – New Data services. UMTS and IMT-2000 - Satellite Systems: Applications – Basics – Routing – Localization – Handover.

**Unit IV: GSM and Routing Protocols**

Wireless LAN: Infrared vs. radio transmission – Infrastructure and ad-hoc network – IEEE 802.11 – System architecture – Protocol architecture – Physics layer – Medium access control layer – MAC management – Blue tooth. Mobile network layer: Mobile IP: Goals, assumptions and requirements – entities and terminology – packet delivery – Agent discovery – Registration – Tunneling and encapsulation Recent technologies

**Unit IV: WAP and MANETs**

WAP: Architecture – wireless datagram Protocol, Wireless transport layer security, Wireless

transaction protocol, Wireless session protocol, Wireless application environment, Mobile ad-hoc networks – MANET Characteristics – Classification of MANETs, Routing of MANETs, Proactive Routing Protocol - DSDV, Reactive Routing Protocols – DSR, AODV

**Text Books:**

1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education, 2013.
2. Kum Kum Garg, "Mobile Computing Theory and Practice", Pearson Education, 2014.

**Reference Books:**

1. Rifaat A. Dayen, "Mobile Data & Wireless LAN Technologies", Prentice Hall, 1997.
2. Steve Mann and Scoot Schibli, "The Wireless Application Protocol", John Wiley & Inc., 2000.

**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Understand the basic concepts of Wireless Communication | K1-K6 |
| CO2 | Analyze the concepts of Medium Access Control and Global System | |
| CO3 | Understand the basic concepts of WLAN and Mobile Network Layer | |
| CO4 | Understand the basic concepts of Wireless Application Protocol | |
| CO5 | Analyze the concepts of Routing Protocols in MANET | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | M | H | H | H | H | H | L |
| **CO2** | H | M | M | M | M | L | M | L | L | M |
| **CO3** | H | M | M | M | M | M | H | L | M | M |
| **CO4** | H | M | M | M | M | L | M | L | L | M |
| **CO5** | H | M | M | M | M | H | M | L | H | L |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2C09** **Credits: 4**

## WEB TECHNOLOGIES AND CLOUD COMPUTING

**COURSE OBJECTIVES:**

- Understand the fundamentals of web technologies, client-server architecture, and frontend development using HTML, CSS, and JavaScript.
- Apply client-side and server-side programming concepts to develop interactive and dynamic web applications.
- Design and integrate databases with web applications using SQL, NoSQL, and CRUD operations while implementing basic security mechanisms.
- Explain cloud computing concepts, service models, deployment models, and the benefits of cloud-based systems.
- Deploy and manage web applications on cloud platforms using basic DevOps, CI/CD, automation, and monitoring techniques.

**UNIT I – Fundamentals of Web Technologies**

Web Development basics: **Introduction -** Meaning of web technologies - Client-server architecture - Internet vs Web; **Frontend Basics:** HTML (structure of web pages) - CSS (styling and layout) - JavaScript (interactivity) - **Web Page Structure -** Elements, tags, attributes - Forms and input handling - Multimedia embedding - **Basic Tools:** Browsers (Chrome, Firefox) - Code editors (VS Code)

**UNIT II – Client-Side & Server-Side Programming**

**Client-side Programming:** JavaScript fundamentals - DOM (Document Object Model) - Events and event handling - Form validation - **Server-side Programming -** Introduction to backend -Concepts of server processing - **Web Architecture:** Client → Server → Database flow - HTTP request and response - Introduction to REST APIs

**UNIT III – Database and Web Integration**

**Databases:** Introduction to databases - SQL basics (MySQL) - NoSQL basics (MongoDB) - **Database Operations -** CRUD operations (Create, Read, Update, Delete) - Queries and joins - **Web + Database Integration -** Connecting backend to database - Data storage and retrieval - Session management - **Security Basics -** Authentication and authorization - Password encryption basics

**UNIT IV – Cloud Computing Fundamentals**

**Introduction:** Meaning of cloud computing - Traditional computing vs cloud - **Cloud Service Models -** IaaS (Infrastructure as a Service) - PaaS (Platform as a Service) - SaaS (Software as a Service) - **Deployment Models -** Public cloud - Private cloud - Hybrid cloud – **Benefits:** Scalability - Cost efficiency - Reliability - On-demand services

**UNIT V – Cloud Platforms and Web Deployment**

**Major Cloud Providers:** Amazon Web Services (AWS) - Microsoft Azure - Google Cloud Platform - **Cloud Services -** Virtual machines - Storage services - Cloud databases - App hosting - **Deployment:** Hosting websites on cloud - Domain and DNS basics - CI/CD basics (continuous deployment) - **Introduction to DevOps -** Automation in deployment - Monitoring web applications

**Text Book**

1. Web Technologies: TCP/IP, Web/Java Programming, and Cloud Computing, Tata McGraw-Hill Education, 3rd Edition, 2017.

**Reference Books**

1. Foundations of Web Technology, Springer, 2002.
2. Cloud Computing: Concepts, Technology, and Architecture, Pearson Education, 2nd Edition, 2023.

**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Develop structured and responsive web pages using HTML, CSS, and JavaScript. | K1-K6 |
| CO2 | Implement client-side scripting, form validation, and basic server-side communication in web applications. | |
| CO3 | Perform database operations and integrate databases with web applications securely. | |
| CO4 | Demonstrate understanding of cloud computing models, cloud platforms, and cloud services. | |
| CO5 | Deploy web applications on cloud environments and apply basic DevOps and monitoring practices effectively. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | H | H | H | H | H | H | L |
| **CO2** | H | M | M | M | M | M | M | L | L | M |
| **CO3** | M | M | M | H | M | M | H | L | M | M |
| **CO4** | H | M | M | M | M | L | M | M | L | M |
| **CO5** | H | M | M | M | M | H | M | L | H | L |

***H-High; M-Medium; L-Low**

**Course Code: 26UPCSC2C10** **Credits: 4**

## ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

**Course Objectives**

- To introduce the fundamental concepts and applications of AI and ML.
- To understand various problem-solving and search techniques used in AI systems.
- To learn supervised and unsupervised machine learning algorithms and their applications.
- To gain knowledge of neural networks, deep learning basics, and model evaluation methods.
- To develop practical understanding of AI/ML tools, ethical issues, and real-world deployment concepts.

**Unit I – Fundamentals of Artificial Intelligence and Machine Learning**

Introduction to Artificial Intelligence – Meaning and scope of AI – History and evolution of AI – Applications of AI in real-world systems – Introduction to Machine Learning – AI vs ML vs Deep Learning – Types of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning – AI system components – Intelligent agents – Problem-solving concepts – Python for AI/ML – AI development environments and tools.

**Unit II – Problem Solving and Search Techniques**

AI Problem Solving – State space representation – Production systems – Search techniques – Breadth First Search (BFS) – Depth First Search (DFS) – Heuristic search – Best First Search – A* Algorithm – Knowledge representation – Logic and reasoning – Rule-based systems – Introduction to Expert Systems – Applications of search algorithms in AI.

**Unit III – Supervised and Unsupervised Machine Learning**

Data preprocessing – Data cleaning and transformation – Training and testing datasets – Supervised learning concepts – Regression and classification – Linear Regression – Logistic Regression – Decision Trees – K-Nearest Neighbor (KNN) – Support Vector Machine (SVM) – Unsupervised learning – Clustering techniques – K-Means clustering – Hierarchical clustering – Dimensionality reduction basics – Model evaluation metrics: Accuracy, Precision, Recall, F1-score.

**Unit IV – Neural Networks and Deep Learning Basics**

Introduction to Neural Networks – Biological neuron vs Artificial neuron – Perceptron model – Multi-layer neural networks – Activation functions – Forward and backward propagation – Deep Learning fundamentals – Introduction to Convolutional Neural Networks (CNN) – Recurrent Neural Networks (RNN) basics – Applications in image processing and natural language processing – Overfitting and regularization – Introduction to TensorFlow and Keras.

**Unit V – AI Applications, Ethics and Deployment**

AI applications in healthcare, education, finance, agriculture, and business – Natural Language Processing basics – Chatbots and recommendation systems – Introduction to Generative AI – AI ethics and bias – Privacy and security issues – Explainable AI – AI model deployment basics – Cloud-based AI services – Introduction to MLOps – Future trends in AI and Machine Learning.

**Text Book**

Stuart Russell, Peter Norvig, "*Artificial Intelligence: A Modern Approach* ", 1st Edition, Pearson Education, 2021

**Reference Books**


1. Andreas C. Müller, Sarah Guido, "*Introduction to Machine Learning with Python: A Guide for Data Scientists*", 1st Edition, O'Reilly Media, 2016
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, " *Deep Learning",* 1st Edition, MIT Press, 2016


**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Understand the basics of Artificial Intelligence and Machine Learning. | K1-K6 |
| CO2 | Apply AI search and reasoning techniques to solve simple computational problems. | |
| CO3 | Build and evaluate basic machine learning models using suitable algorithms. | |
| CO4 | Analyze data using classification, clustering, and neural network techniques. | |
| CO5 | Demonstrate awareness of AI ethics, deployment challenges, and emerging AI technologies. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | H | H | H | H | H | H | L |
| **CO2** | H | M | M | M | M | M | M | L | L | M |
| **CO3** | M | M | M | H | M | M | H | L | M | M |
| **CO4** | H | M | M | M | M | L | M | M | L | M |
| **CO5** | H | M | M | M | M | H | M | L | H | L |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2L05** **Credits: 2**

## MOBILE COMPUTING LAB

### Course Objectives

- To understand the fundamentals of wireless communication systems and signal propagation techniques.
- To learn medium access control protocols and multiple access techniques used in wireless networks.
- To study GSM architecture, wireless LAN technologies, and mobile communication protocols.
- To understand Mobile IP, WAP, Bluetooth, and MANET routing protocols.
- To develop practical skills in configuring, simulating, and analyzing wireless and mobile communication networks.

### LIST OF EXPERIMENTS

1. Demonstrate the basic components and working principles of a wireless communication system.
2. Simulate signal propagation models and path loss in wireless communication environments.
3. Implement modulation techniques such as FDMA, TDMA, CDMA, ASK, FSK, and PSK.
4. Simulate Medium Access Control protocols including ALOHA, Slotted ALOHA, and CSMA/CA.
5. Demonstrate the working principle of the architecture, services, and handover mechanisms of a GSM network.
6. Configure and test a Wireless LAN using IEEE 802.11 infrastructure and ad-hoc modes.
7. Simulate Mobile IP communication and analyze agent discovery, registration, tunneling, and packet delivery mechanisms.
8. Analyze the WAP protocol stack and demonstrate wireless web communication using WDP, WTLS, WTP, and WSP protocols.
9. Simulate and evaluate DSR MANET routing protocol under different network conditions.
10. Simulate and evaluate AODV MANET routing protocol under different network conditions.

### Suggested Software/Tools

- NS-2 Network Simulator
- NS-3 Network Simulator
- Cisco Packet Tracer
- Wireshark
- MATLAB
- GNS3

**COURSE OUTCOMES:**
**On the successful completion of the course, students will be able to:**

| | | |
|---|---|---|
| CO1 | Implement wireless communication principles, signal propagation, and transmission techniques. | K1-K6 |
| CO2 | Analyze the performance of multiple access and medium access control protocols. | |
| CO3 | Configure and evaluate GSM, WLAN, Bluetooth, and Mobile IP systems. | |
| CO4 | Implement and compare MANET routing protocols and wireless application protocols. | |
| CO5 | Use simulation and networking tools to model wireless and mobile communication systems. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | M | L | H | H | H | M | L | H |
| **CO2** | H | H | M | L | H | H | M | M | L | H |
| **CO3** | H | H | H | M | M | L | H | L | H | H |
| **CO4** | H | H | H | M | H | M | H | L | H | H |
| **CO5** | M | H | H | M | M | L | H | L | H | H |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2L06** **Credits: 2**

## WEB TECHNOLOGIES AND COMPUTING LAB

**Course Objectives**

- To understand the fundamentals of web technologies, internet architecture, and client-server communication.
- To develop basic frontend web applications using HTML, CSS, and JavaScript.
- To learn server-side programming concepts and integrate web applications with databases.
- To understand cloud computing models, deployment methods, and major cloud platforms.
- To gain practical exposure to deploying and monitoring web applications in cloud environments.

## LIST OF EXPERIMENTS

1. Develop a static web page using HTML that includes headings, paragraphs, lists, images, links, and multimedia elements.
2. Create a responsive web page using CSS that demonstrates layout design, colors, fonts, and positioning techniques.
3. Implement JavaScript programs to demonstrate variables, functions, and basic interactivity in a web page.
4. Design and implement a web form with client-side validation using JavaScript (validate name, email, password, and phone number).
5. Develop a web page that demonstrates DOM manipulation using JavaScript (add, update, and delete HTML elements dynamically).
6. Create a simple client-server model application that demonstrates HTTP request and response flow.
7. Design a web application that performs CRUD operations using SQL database (MySQL) and displays data on a web page.
8. Implement session management in a web application for user login and logout functionality with basic authentication.
9. Deploy a simple static website on a cloud platform (AWS/Azure/GCP).
10. Demonstrate automated deployment of a web application using cloud services or DevOps tools.

**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Design and develop static and dynamic web pages using HTML, CSS, and JavaScript with proper structure, styling, and interactivity. | K1-K6 |
| CO2 | Apply client-side scripting techniques and DOM manipulation to implement interactive and validated web applications. | |
| CO3 | Develop and integrate web applications with backend systems using HTTP communication, server-side concepts, and database operations (CRUD). | |
| CO4 | Implement authentication, session management, and basic security mechanisms in web applications for safe data handling. | |
| CO5 | Deploy and manage web applications using cloud platforms and understand basic DevOps concepts such as hosting, CI/CD, and monitoring. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | M | L | H | H | H | M | L | H |
| **CO2** | H | H | M | L | H | H | M | M | L | H |
| **CO3** | H | H | H | M | M | L | H | L | H | H |
| **CO4** | H | H | H | M | H | M | H | L | H | H |
| **CO5** | M | H | H | M | M | L | H | L | H | H |

*H-High; M-Medium; L-Low

**Course Code: 26UPCSC2L07** **Credits: 2**

## INTERNET OF THINGS LAB

**Course Objectives**

- To understand the fundamental concepts of IoT architecture, devices, and communication systems.
- To develop skills in interfacing sensors and microcontrollers for real-time data acquisition.
- To implement wireless communication techniques for IoT device connectivity and data transmission.
- To integrate cloud platforms for storage, processing, and visualization of IoT data.
- To apply concepts of mobile computing, security, and protocol evaluation in IoT systems.

## LIST OF EXPERIMENTS

1. Design and demonstrate the basic architecture of an IoT system by identifying sensors, actuators, microcontrollers, and communication modules.
2. Demonstrate data acquisition from a sensor (temperature, humidity, or motion sensor) using an IoT development board.
3. Interface a sensor with a microcontroller (Arduino/ESP32) and display real-time sensor data.
4. Develop an IoT application using Wi-Fi or Bluetooth to transmit sensor data to a mobile or web dashboard.
5. Analyze mobile computing concepts used in IoT systems for device-to-device and device-to-cloud communication.
6. Create a cloud-based IoT system that uploads sensor data to platforms like ThingSpeak, Firebase, or AWS IoT.
7. Compare local processing and cloud-based processing of IoT data using real-time applications.
8. Evaluate IoT communication protocols such as MQTT, HTTP, and CoAP for performance and reliability.
9. Design and implement a smart IoT application such as smart home, smart agriculture, or smart health monitoring system using sensors and cloud services.
10. Demonstrate basic security mechanisms for IoT systems such as authentication or secure data transmission.

**Suggested Tools/Platforms**

- Arduino IDE
- Raspberry Pi Official
- ESP32 Microcontroller
- ThingSpeak IoT Cloud
- Firebase
- AWS IoT Core

**COURSE OUTCOMES:**

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

| | | |
|---|---|---|
| CO1 | Explain and demonstrate IoT architecture and communication models using sensors and devices. | K1-K6 |
| CO2 | Implement data collection and processing using embedded systems and wireless modules. | |
| CO3 | Develop IoT applications with cloud integration for real-time data monitoring and storage. | |
| CO4 | Apply mobile and wireless communication concepts for IoT device connectivity. | |
| CO5 | Design and deploy basic IoT systems with security and remote access features. | |

K1-Remember, K2-Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6-Create

**Mapping with Programme Outcome**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | M | L | H | H | H | M | L | H |
| **CO2** | H | H | M | L | H | H | M | M | L | H |
| **CO3** | H | H | H | M | M | L | H | L | H | H |
| **CO4** | H | H | H | M | H | M | H | L | H | H |
| **CO5** | M | H | H | M | M | L | H | L | H | H |

*H-High; M-Medium; L-Low

**Course Code: 26UPGEN1V01** **Credits: 02**

## PEACE EDUCATION

**Course Outcomes (COs)**

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

- Understand the importance of Peace (Level: Understand)
- Explain how to recover the state of Peace (Level: Understand)
- Internalize and Practice the Values of Peace (Level: Apply)
- Understand sustainable Peace and the role of oneself (Level: Understand)
- Become the peace messenger who spreads the culture of Peace (Level: Apply)

**Unit I:**

Introduction to Peace Education and HWPL- Aims and objectives of Peace Education – Development of Peace work of HWPL – Making groups for assignments – Rapport building

**Unit II:**

Finding Peace, and me Diversity – Harmony – Original State of All Creation – Connectivity – Value – Role – Duty – Interpersonal relationship – Greed – Love – Order

**Unit III:**

Peace Values Gratitude – Consideration – Sacrifice – Understanding – Forgiveness – Respect for Parents, Teachers and Peace – Scripture – Cultural sphere

**Unit IV:**

Peace Citizen Heritage – World Peace – Great legacy; a case of Peace – Law – Law-abiding Spirit – Treaty – DPCW – NGO; HWPL – Peace Citizen – Courage – Peace-loving Heart – Messenger of Peace

**Unit V:**

Peace Messenger Peace Messenger – Peace experience – Will for Peace

**Tasks and Assignments:**

- Writing an Essay on World Peace and Gratitude

- Engaging in debates on topics related to Peace

- Group Project for practicing Peace Values

- Group Project to promote the importance of Peace

**References:**

https://www.un.org/en/

https://www.youtube.com/watch?v=18LhBZc6Sn4

https://www.hwpl.kr/language/en/home-hwpl-en/

Heavenly Culture World Peace Restoration of Light (2022), Road to Peace

Oh Ik-soo (1996), Youth Group Counseling

# Electives

**VERTICAL I: Artificial Intelligence and Data Science (AIDS)**

| | |
|---|---|
| 26UPCSC2E01 | Generative AI |
| 26UPCSC2E02 | Advanced Large Language Models |
| 26UPCSC2E03 | Agentic AI |

**VERTICAL II: Full Stack Development for IT**

| | |
|---|---|
| 26UPCSC2E04 | App Development |
| 26UPCSC2E05 | User Interface and User Experience (UI and UX) Design |
| 26UPCSC2E06 | Software Testing and Automation |

**VERTICAL III: Cloud Computing and Data Centre Technologies**

| | |
|---|---|
| 26UPCSC2E07 | Cloud Computing |
| 26UPCSC2E08 | Virtualization |
| 26UPCSC2E09 | Cloud Security |

**VERTICAL IV: Cyber Security and Data Privacy**

| | |
|---|---|
| 26UPCSC2E10 | Network Security and Ethical Hacking |
| 26UPCSC2E11 | Digital and Mobile Forensics |
| 26UPCSC2E12 | Modern Cryptography and Blockchain Technologies |

**Subject Code: 26UPCSC2E01** **Credits:04**

## GENERATIVE AI

### COURSE OBJECTIVES

- Understand the basics of Generative AI and how data is used in real-world applications.
- Learn how Large Language Models work and how they are used in practice.
- Get familiar with different generative models like GANs, Diffusion Models, and Transformers.
- Learn how to improve models using fine-tuning and prompt engineering.
- Understand the importance of ethics, safety, and responsible use of AI.

### Unit I: AI Fundamentals

AI Fundamentals – Learning Approaches in Machine Learning – Supervised, Unsupervised, Semi-supervised and Reinforcement Learning – Representation and Embedding – Training Strategies and Performance Improvement

### Unit II: GenAI Foundation

Mathematics for AI – Deep Learning Concepts – Gradient Descent and Backpropagation – Regularization Techniques – Introduction to Generative AI – Prompt Engineering – Ethics and Use Cases

### Unit III: GenAI for Images

Computer Vision and CNN – Convolution, Pooling and Fully Connected Layers – Autoencoders and Variational Autoencoders – Image Segmentation (U-Net) – Generative Models for Images – GAN and Diffusion Models

### Unit IV: GenAI for Text and ChatGPT

Natural Language Processing – Sequence Models (RNN, LSTM) – Transformer Architecture – Tokenization and Embeddings – ChatGPT and OpenAI Tools – Prompt Engineering Techniques

### Unit V: LLM Frameworks and Applications

LangChain and LLM Frameworks – Vector Stores and Retrieval Augmented Generation (RAG) – LLMOps and Model Deployment – Optimization Techniques – Enterprise Applications of GenAI – Responsible AI and Sustainability

**Text Book:**

1. **Sabeesan, K., Sivagamisundari, S., & Dutta, N. *Generative AI for Everyone: Deep Learning, NLP, and LLMs for Creative and Practical Applications*. BPB Publications. 2025**

**Reference Books**

1. David Baum, *Generative AI and LLMsFor Dummies, Snowflake Special Edition*, Wiley, 2024. (Unit -1-2)
2. Carlos Rodriguez, *Generative AI Foundations in Python*, Packt Publishing, 2024. Unit-3-5

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the basics of enterprise-level Generative AI and data | **K1-K6** |
| **CO2** | Explain how Large Language Models work, including their lifecycle and usage. | |
| **CO3** | Understand and use different generative models like GANs, Diffusion, and Transformers. | |
| **CO4** | Use fine-tuning and prompt engineering to improve AI models for specific tasks. | |
| **CO5** | Understand ethics, risks, and responsible use of Generative AI | |

K1-Remember, K2-Understand, K3- Apply, K4-Analyze, K5-Evaluate, K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | M | M | H | M | L | L | L | M |
| **CO2** | H | H | H | H | H | H | M | M | L | M |
| **CO3** | H | H | H | H | H | M | L | L | L | M |
| **CO4** | H | H | H | H | H | M | M | M | L | M |
| **CO5** | M | H | M | H | M | H | H | H | M | M |

H-High; M-Medium; L-Low

**Subject Code: 26UPCSC2E02** **Credits:04**

## ADVANCED LARGE LANGUAGE MODELS

### COURSE OBJECTIVES

- To understand the fundamental concepts behind Large Language Models (LLMs).
- To implement transformer-based GPT architecture from scratch.
- To perform pre training and fine-tuning of LLMs using PyTorch.
- To evaluate generative models using appropriate metrics.
- To develop practical skills in building and customizing LLM systems.

### UNIT I: Foundations of Large Language Models

Understanding Large Language Models – Applications of LLMs – Stages of Building and Using LLMs – Introducing the Transformer Architecture – A Closer Look at the GPT Architecture – Working with Text Data – Tokenizing Text – Byte Pair Encoding – Data Sampling with Sliding Window – Creating Token Embeddings – Encoding Word Positions

### UNIT II: Attention Mechanisms and GPT Architecture

Coding Attention Mechanisms – Self-Attention Mechanism – Causal Attention – Multi-Head Attention – Implementing Self-Attention with Trainable Weights – Implementing Multi-Head Attention – Coding an LLM Architecture – Layer Normalization – Feed Forward Networks – Transformer Blocks – Coding the GPT Model

### UNIT III: Pretraining Large Language Models

Pretraining on Unlabeled Data – Evaluating Generative Text Models – Training an LLM – Training and Validation Loss – Decoding Strategies – Temperature Scaling – Top-k Sampling – Text Generation – Saving Model Weights – Loading Pretrained Weights

### UNIT IV: Fine-Tuning Large Language Models

Fine-Tuning for Classification – Preparing the Dataset – Creating Data Loaders – Adding a Classification Head – Calculating Loss and Accuracy – Fine-Tuning on Supervised Data – Instruction Fine-Tuning – Preparing Instruction Dataset – Extracting Responses – Evaluating Fine-Tuned LLM – Parameter-Efficient Fine-Tuning

### UNIT V: PyTorch for Large Language Models

Introduction to PyTorch – Tensors – Automatic Differentiation – Neural Network Modules – Dataset and DataLoader – Model Training – GPU Utilization – Optimization Techniques – Building Models in PyTorch

**TEXT BOOK**

1. Sebastian Raschka, **Build a Large Language Model (From Scratch)**, Manning Publications, 2025.

**REFERENCE BOOKS**

1. TanmoyChakraborty, Introduction to Large Language Models, Wiley Publications
2. Jay Alammar, Maarten Grootendorst, Hands on Large Language Models, Language Understanding and Generation, Shroff Publishers.
3. Amaratunga, Thimira, Understanding Large Language Models: Learning Their Underlying Concepts and Technologies, Springer Verlag, 2023
4. Raj Arun R, Mastering Large Language Models with Python, AVA publications 2024

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Explain the theoretical foundations of Large Language Models, transformer architecture, and generative AI mechanisms. | **K1-K6** |
| **CO2** | Implement data preprocessing, tokenization, embedding techniques, and attention mechanisms using PyTorch. | |
| **CO3** | Design and build GPT-based architectures and perform pretraining using next-word prediction objectives. | |
| **CO4** | Apply fine-tuning strategies for classification and instruction-following tasks using labeled datasets. | |
| **CO5** | Evaluate, optimize, and deploy LLM models considering performance, ethical, and societal aspects. | |

K1-Remember, K2-Understand, K3- Apply, K4-Analyze, K5-Evaluate, K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | M | L | L | M | L | L | M | M |
| **CO2** | H | H | M | L | M | H | L | L | L | L |
| **CO3** | H | H | M | M | H | H | M | L | L | L |
| **CO4** | H | H | M | M | H | H | M | M | L | M |
| **CO5** | M | H | H | M | M | H | M | H | H | H |

H-High; M-Medium; L -Low

**Subject Code: 26UPCSC2E03** **Credits: 04**

## AGENTIC AI

### COURSE OBJECTIVES

- To understand the theoretical foundations of generative and agentic AI systems.
- To analyze intelligent agent architectures and reasoning mechanisms.
- To design and implement LLM-powered autonomous agents.
- To explore multi-agent collaboration and workflow orchestration.
- To evaluate trust, safety, and ethical considerations in agentic AI deployment.

### UNIT I: Foundations of Generative AI and Agentic Systems

Fundamentals of Generative AI – Introduction to generative AI – Types of generative AI models – VAEs – GANs – Autoregressive models and Transformer architecture – LLM-powered AI agents - Applications of generative AI - Principles of Agentic Systems: Technical requirements - Understanding self-governance, agency, and autonomy - Reviewing intelligent agents and their characteristics - Exploring the architecture of agentic systems – Understanding multi agent systems- Technical requirements Knowledge representation in intelligent agents- Reasoning in intelligent agents- Decision-making and planning in agentic systems- Enhancing agent capabilities with generative AI

### UNIT II: Reflection and Tool Use in Agents

Reflection and Introspection in Agents – The importance of reflection in agents – Introspection in intelligent agents – Implementing reflective capabilities – Meta-reasoning – Self-explanation – Self-modeling – Use cases and examples -Enabling Tool Use and Planning in Agents – Understanding the concept of tool use in agents – Tool and function calling – Defining tools for agents – Types of tools – Planning algorithms for agents – Integrating tool use and planning – Exploring practical implementations

### UNIT III: Multi-Agent Coordination and Design Techniques

Exploring the Coordinator, Worker, and Delegator Approach – Understanding the CWD model – Designing agents with role assignments – Roles and responsibilities of each agent – Communication and collaboration between agents – Implementing the CWD approach in generative AI systems -Coordination mechanism – Negotiation and conflict resolution – Knowledge sharing – Effective Agentic System Design Techniques : Focused system prompts

and instructions for agents – Defining objectives – Task specifications – Contextual awareness – State space representation – Environment modeling – Agent memory architecture and context management – Short-term memory – Long-term memory – Episodic memory – Sequential and parallel processing in agentic workflows

**UNIT IV: Trust and Ethical AI Systems**

Building Trust in Generative AI Systems Importance of trust in AI -– Techniques for establishing trust – Transparency and explainability – Dealing with uncertainty and biases – User control and consent – Ethical development and responsibility – Implementing transparency and explainability -Handling uncertainty and biases - Managing Safety and Ethical Considerations : Understanding potential risks and challenges – Adversarial attacks – Bias and discrimination – Misinformation and hallucinations – Data privacy violations – Intellectual property risks – Ensuring safe and responsible AI – Exploring ethical guidelines and frameworks – Human-centric design – Accountability and responsibility – Privacy and data protection- Addressing privacy and security concerns

**UNIT V: Applications and Future Directions**

Common Use Cases and Applications – Creative and artistic applications – Natural language processing and conversational agents – Robotics and autonomous systems – Decision support and optimization – Conclusion and Future Outlook – Recap of key concepts – Emerging trends and research directions – Artificial general intelligence – Challenges and opportunities

**TEXT BOOK**

1. Anjanava Biswas & Wrick Talukdar, *Building Agentic AI Systems: Create Intelligent, Autonomous AI Agents that can Reason, Plan, and Adapt*, Packt Publishing, 2025.

**REFERENCE BOOKS**

1. Artificial Intelligence: A Modern Approach, Russell & Norvig, 4th Ed., Pearson, 2021
2. Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Shoham & Leyton-Brown, CUP, 2009
3. Reinforcement Learning: An Introduction, Sutton &Barto, 2nd Ed., MIT Press, 2018

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Explain the theoretical foundations of Generative AI, Large Language Models, and Agentic System architectures. | **K1-K6** |
| **CO2** | Analyze intelligent agent components including knowledge representation, reasoning, reflection, and planning mechanisms. | |
| **CO3** | Design and implement LLM-powered autonomous agents with tool use and multi-agent coordination frameworks. | |
| **CO4** | Evaluate trust, transparency, safety, and ethical considerations in the deployment of agentic AI systems. | |
| **CO5** | Develop real-world agentic AI solutions for complex applications using structured workflows and optimization techniques. | |

K1-Remember, K2-Understand, K3- Apply, K4-Analyze, K5-Evaluate, K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | M | H | M | L | L | L | – |
| **CO2** | H | H | H | H | H | M | L | L | L | – |
| **CO3** | H | H | H | H | H | H | M | M | M | – |
| **CO4** | M | H | M | H | M | H | H | H | M | – |
| **CO5** | H | H | H | H | H | M | M | M | H | – |

H-High; M-Medium; L-Low

## VERTICAL II: Full Stack Development for IT

| | |
|---|---|
| 26UPCSC2E04 | App Development |
| 26UPCSC2E05 | User Interface and User Experience (UI/UX) Design |
| 26UPCSC2E06 | Software Testing and Automation |

**Subject Code: 26UPCSC2E04** **Credits:04**

## APP DEVELOPMENT

### COURSE OBJECTIVES

- To understand the fundamentals of web and mobile application development paradigms.
- To develop native mobile applications using platform-specific technologies.
- To design and implement hybrid and cross-platform mobile applications using modern frameworks.
- To analyze non-functional characteristics such as performance, maintainability, usability, and scalability of mobile application frameworks.
- To develop deployable mobile and web applications with database integration and cloud connectivity.

### UNIT I

**Introduction to Flutter:** Flutter: What is Flutter? – Why Flutter? – The other options – Native solutions – Developing in Flutter: The Flutter toolchain – The Flutter SDK – IDEs – IDE DevTools – Emulators – Keeping the tools up to date – The Flutter development process – Scaffolding the app and files – Running your app

### UNIT II

**Foundational Flutter:** Everything Is Widgets : UI as code – Built-in Flutter widgets – Value widgets – Layout widgets – Navigation widgets – Other widgets – How to create your own stateless widgets – Widgets have keys – Passing a value into your widget – Stateless and Stateful widgets – Value Widgets :The Text widget – The Icon widget – The Image widget – Embedded images – Network images – Sizing an image – Input widgets – Text fields – Form widget – FormField widget

### UNIT III

**Responding to Gestures:** Meet the button family – RaisedButton – FlatButton and IconButton – FloatingActionButton – CupertinoButton – Dismissible – Custom gestures for your custom

widgets – GestureDetector widget – Laying Out Your Widgets – MaterialApp widget – The Scaffold widget – The AppBar widget – SafeArea widget – SnackBar widget – ListView widget – Container widget – Stack widget – GridView widget – The Table widget

**UNIT IV**

**Navigation and Routing:** Stack navigation – Navigating forward and back – Drawer navigation – The Drawer widget – Tab Navigation – TabController – TabBarView – TabBar and Tabs – The Dialog widget – showDialog() and AlertDialog – Styling Your Widgets : Thinking in Flutter Styles – Styling Text – TextStyle – Custom fonts – Container decorations – Border – BorderRadius – BoxShape – Themes – Managing State : What is state? – StatefulWidget – Passing state down – Lifting state back up – InheritedWidget – BLoC – Provider – Redux

**UNIT V**

Flutter App Can Work with Files : Including libraries in your Flutter app – Futures, async, and await – Including a file with your app – Writing a file – Reading a file – Using JSON – Shared preferences – Making RESTful API Calls with HTTP : What is an API call? – HTTP GET or DELETE request – HTTP PUT, POST, or PATCH request – HTTP responses to widgets – FutureBuilder – Strongly typed classes – Using Firebase with Flutter : Introducing Firebase – Cloud Firestore – Cloud Functions – Authentication – Setting up Firebase – Using Firestore

**TEXT BOOK**

1. **Rap Payne**, *Beginning App Development with Flutter: Create Cross-Platform Mobile Apps*, Apress, 2019. ISBN: 978-1484251805.

**REFERENCE BOOKS**

1. Booker Blunt, App Development with Flutter Build Cross Platform Apps: A Step-by-Step
2. Guide to Mastering Mobile App Development with Flutter, Independently Published, 2025
3. Alex Forrester, EranBoudjnah, AlexandruDumbravan, JomarTigcal, How to Build Android
4. Apps with Kotlin: A practical guide to developing, testing, and publishing your first Android apps, Packt Publishing Limited, 2023

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Explain the concepts of web, native, hybrid and cross-platform mobile application development architectures. | **K1-K6** |
| **CO2** | Develop native mobile applications using platform-specific tools and GUI components. | |
| **CO3** | Design and implement hybrid and cross-platform applications using modern frameworks such as React Native and Flutter. | |
| **CO4** | Integrate applications with backend services, databases and cloud platforms. | |
| **CO5** | Analyze and evaluate mobile application frameworks based on performance, security, scalability and maintainability. | |

K1-Remember, K2-Understand, K3- Apply, K4-Analyze, K5-Evaluate, K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | M | L | M | M | L | L | M | L |
| **CO2** | H | H | H | M | H | M | L | L | M | M |
| **CO3** | H | H | H | H | H | M | M | L | M | M |
| **CO4** | H | H | H | H | H | M | M | L | M | M |
| **CO5** | M | H | M | H | M | H | H | M | M | M |

H-High; M-Medium; L-Low

**Subject Code: 26UPCSC2E05** **Credits: 04**

## USER INTERFACE AND USER EXPERIENCE (UI and UX) DESIGN

### COURSE OBJECTIVES

- To provide foundational knowledge in User Interface (UI) and User Experience (UX) design principles.
- To understand the importance of UI and UX in digital product development.
- To explore research methods used in design thinking and user-centered design.
- To familiarize students with modern UI/UX tools and design workflows.
- To develop wireframes, prototypes, and conduct usability testing for digital applications.

### UNIT –I

**FOUNDATIONS OF DESIGN**: UI vs. UX Design – Core Stages of Design Thinking – Divergent and Convergent Thinking – Brainstorming Techniques – Game storming – Observational Empathy – Human-Centered Design Principles – Problem Framing – Creativity in Design.

### UNIT-II

**FOUNDATIONS OF UI DESIGN :** Principles of Visual Design – Elements of UI Design – Layout and Composition – Typography – Color Theory – UI Components and Patterns – Interaction Behaviors and Design Principles – Branding Fundamentals – Design Systems – Style Guides.

### UNIT-III

**FOUNDATIONS OF UX DESIGN :** Introduction to User Experience – Importance of UX – Understanding User Experience – UX Design Process and Methodology – Research in UX Design – Research Tools and Methods – Understanding User Needs and Goals – Aligning UX with Business Goals – User Journey Mapping.

### UNIT-IV

**WIREFRAMING, PROTOTYPING AND TESTING:** Sketching Principles – Rapid Sketching (Red Routes) – Responsive Design – Low-Fidelity Wireframing – High-Fidelity Mockups – Creating Workflows – Building Interactive Prototypes – Design Tools and Software – Interaction Patterns – Conducting Usability Testing – Evaluative User Research Methods – Synthesizing Test Findings – Prototype Iteration.

**UNIT –V**

**RESEARCH, IDEATION AND INFORMATION ARCHITECTURE:** Problem Identification and Writing Problem Statements – Selecting Appropriate Research Methods – Creating Personas – Solution Ideation – Creating User Stories – Scenario Development – Flow Diagrams – Flow Mapping – Information Architecture – Structuring Content for Usability.

**TEXT BOOKS**


1. **Joel Marsh**, *UX for Beginners: A Crash Course in 100 Short Lessons*, O'Reilly Media, 2022.
2. **Jon Yablonski**, *Laws of UX: Using Psychology to Design Better Products & Services*, O'Reilly Media, 2021.


**REFERENCE BOOKS**


1. **Jenifer Tidwell, Charles Brewer, Aynne Valencia**, *Designing Interfaces*, 3rd Edition, O'Reilly Media, 2020.
2. **Steve Schoger, Adam Wathan**, *Refactoring UI*, 2018.
3. **Steve Krug**, *Don't Make Me Think, Revisited: A Common Sense Approach to Web & Mobile Usability*, 3rd Edition, New Riders, 2015.


**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Design and build user interfaces for web and mobile applications using UI design principles. | **K1-K6** |
| **CO2** | Evaluate and analyze the UX design of products or applications based on usability and user-centered design principles. | |
| **CO3** | Apply UX research methods and demonstrate UX skills in product development. | |
| **CO4** | Implement sketching and ideation techniques for interface design. | |
| **CO5** | Develop wireframes and interactive prototypes incorporating usability testing and iterative refinement. | |

K1-Remember, K2-Understand, K3- Apply, K4-Analyze, K5-Evaluate, K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | M | H | H | M | H | L | L | M | M | L |
| **CO2** | M | H | M | H | M | M | M | L | M | L |
| **CO3** | M | H | H | H | M | M | M | L | M | L |
| **CO4** | L | M | H | M | M | L | L | M | M | L |
| **CO5** | M | H | H | H | M | M | M | L | M | L |

H-High; M-Medium; L-Low

**Subject Code: 26UPCSC2E06** **Credits: 04**

## SOFTWARE TESTING AND AUTOMATION

### COURSE OBJECTIVES

- To understand fundamental concepts, principles, and importance of software testing.
- To learn various testing types and techniques used in software projects.
- To design effective test plans and test cases.
- To perform structured test execution and defect management.
- To understand test automation, Agile testing, and modern testing challenges.

### UNIT I: Software Testing Fundamentals and Types

The Importance of Software Testing – Software Testing Types and Techniques – Functional Testing – Unit Testing – Integration Testing – System Testing – User Acceptance Testing – Nonfunctional Testing –Static Testing

### UNIT II: Software Development Life Cycle and Test Planning

Software Development Life Cycle : Planning Phase – Requirements Gathering Phase – Design Phase – Development Phase – Deployment Phase – Maintenance Phase – The Role of Testing in the SDLC – Test Planning : Defining Testing Objectives – Determining the Scope of Testing – Selecting the Testing Approach – Identifying Testing Resources- Developing the Test Schedule – Defining Test Cases – Identifying Test Data – Defect Management Process – Stop Testing Criteria – Reviewing and Approving the Test Plan – Benefits of Test Planning – Test Plan Document – Test Planning Tools and Techniques

### UNIT III: Test Design Techniques

Black-Box Testing – Equivalence Partitioning – Boundary Value Analysis – Decision Table Testing – State Transition Testing – Use-Case Testing – Pairwise Testing – Error Guessing – Exploratory Testing – Random Testing – Ad Hoc Testing – White-Box Testing – Statement Coverage – Branch Coverage – Path Coverage – Condition Coverage – Decision Coverage – Multiple Condition Coverage – Modified Condition/Decision Coverage – Loop Testing – Data Flow Testing – Static Testing- **Test Execution:**
Test Execution Process – Test Environment Setup – Defect Reporting and Retesting – Regression Testing – Test Case Status Reporting – Test Case Completion – Techniques and Tools Used in Test Execution – Quality Metrics

### UNIT IV: Test Automation, and Agile Testing

Test Automation – Benefits of Test Automation – Record and Playback Tools – Scripting Tools – Hybrid Tools – Frameworks – Automated Testing Tools – Automated Test Scripts – Testing in

Agile Environment – Agile Testing Principles – Agile Testing Quadrants – Test-Driven Development – Behavior-Driven Development – Acceptance Test-Driven Development – Continuous Integration and Continuous Delivery – Test Automation in Agile – Agile Testing Best Practices

**UNIT V: Challenges and Solutions**

Challenges and Solutions in Software Testing – Lack of Clear Requirements – Impact of Lack of Clear Requirements on Testing – Mitigating the Impact of Lack of Clear Requirements – Time Constraints – Impact of Time Constraints on Software Testing – Strategies for Managing Time Constraints in Testing – Lack of Skilled Resources – Impact of Lack of Skilled Resources on Software Testing – Strategies for Managing Lack of Skilled Resources in Testing – Automation Challenges – Common Automation Challenges – Strategies for Addressing Automation Challenges – Communication and Collaboration – Change Management – Testing Across Platforms – Future of Software Testing – Risk-Based Testing

**TEXT BOOK**

1. Panagiotis Leloudas, *Introduction to Software Testing: A Practical Guide to Testing, Design, Automation, and Execution*, Apress, 2023.

**REFERENCES**

1. Glenford J. Myers, Corey Sandler, Tom Badgett, *The Art of Software Testing*, 3rd Edition, Wiley.
2. Paul C. Jorgensen, *Software Testing: A Craftsman's Approach*, 4th Edition, CRC Press.
3. Ron Patton, *Software Testing*, Sams Publishing.

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Explain the fundamental concepts, principles, and types of software testing across SDLC models. | **K1-K6** |
| **CO2** | Design comprehensive test plans and apply appropriate black-box and white-box test design techniques. | |
| **CO3** | Execute test cases, manage defects systematically, and evaluate software quality using metrics. | |
| **CO4** | Analyze nonfunctional requirements and perform performance, security, and reliability testing. | |
| **CO5** | Develop and implement automated test scripts and apply testing practices in Agile and CI/CD environments. | |

K1-Remember, K2-Understand, K3- Apply, K4-Analyze, K5-Evaluate, K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | M | H | H | M | H | L | L | M | M | L |
| **CO2** | M | H | M | H | M | M | M | L | M | L |
| **CO3** | M | H | H | H | M | M | M | L | M | L |
| **CO4** | L | M | H | M | M | L | L | M | M | L |
| **CO5** | M | H | H | H | M | M | M | L | M | L |

H-High; M-Medium; L-Low

## ERTICAL III: Cloud Computing and Data Centre Technologies

| | |
|---|---|
| 26UPCSC2E07 | Cloud Computing |
| 26UPCSC2E08 | Virtualization |
| 26UPCSC2E09 | Cloud Security |

**Subject Code: 26UPCSC2E07** **Credits: 04**

### CLOUD COMPUTING

**COURSE OBJECTIVES**

- To understand the fundamental concepts and evolution of cloud computing
- To analyze cloud service and deployment models
- To study virtualization, containerization, and cloud-native architectures
- To evaluate cloud pricing, security, and governance mechanisms
- To examine transition strategies and real-world public cloud implementations

**UNIT I: Introduction and Historical Perspective**

A Definition of Cloud Computing – Virtualization – Application virtualization – Server virtualization – Containerization – Cloud Services – Service-level agreement (SLA) – Service-level objectives (SLOs) – Service Models: Levels of Abstraction – Infrastructure-as-a-Service (IaaS) – Platform-as-a-Service (PaaS) – Software-as-a-Service (SaaS) – Business Process-as-a-Service (BPaaS) – Information-as-a-Service (INaaS) – Cloud Deployment Models – Public cloud – Private cloud – Community cloud – Hybrid cloud – Five Characteristics of Cloud Computing – Broad network access – On-demand self-service – Resource pooling – Rapid elasticity – Measured service – Internetworking – Protocol wars – TCP/IP protocol – Internet layers – Virtualization – Virtual machines – Hypervisor – VMware – Open-source virtualization – Xen – Containers – Cloud Computing evolution – SaaS emergence – AWS development – Public cloud providers

**UNIT II: Types of Cloud Computing**

Abstraction Levels – Infrastructure-as-a-Service (IaaS) – Platform-as-a-Service (PaaS) – Software-as-a-Service (SaaS) – Information-as-a-Service (INaaS) – Business Process-as-a-Service (BPaaS) – Deployment Models – Public clouds – Private clouds – Community clouds – Hybrid clouds – Types of Cloud – Personal cloud – Cloud of Things – Cloud Cells – Cloud Cell Patterns – Cloud Relationships – Encapsulation – Aggregation – Cloud-native concepts – Containers – Container orchestration – Kubernetes – Microservices foundations – DevOps – Continuous integration – Continuous delivery – Scalability – Resilience – Observability

**UNIT III: Microservices and Cloud Paradigm**

Microservices architecture – Service decomposition – API communication – Service discovery – Load balancing – Fault tolerance – Circuit breaker pattern – API gateway – Data management in microservices – Event-driven architecture – Cloud as paradigm shift – CapEx vs OpEx – Business transformation – IT agility – Scalability benefits – Cost optimization – Risks and challenges – Vendor lock-in – Organizational change

**UNIT IV: Pricing, Data, and Security**

Utility pricing – Subscription pricing – Pay-as-you-go – Reserved pricing – Spot pricing – Cost optimization strategies – Billing models – Cost management – Data in cloud – Data storage models – Structured data – Unstructured data – Data lifecycle – Data governance – Data consistency – Data replication – Big data in cloud – Security in cloud – Threat models – Identity and access management – Encryption – Network security – Compliance – Risk management – Security best practices

**UNIT V: Cloud Migration and Applications**

Migration strategies – Lift and shift – Refactoring – Replatforming – Cloud adoption frameworks – Change management – Risk mitigation- Amazon Web Services (AWS) – Microsoft Azure – Google Cloud Platform – Service comparisons – Use cases

**TEXT BOOKS**

1. Nayan B. Ruparelia, *Cloud Computing*, Revised and Updated Edition, MIT Press, 2023

**REFERENCES**

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

2. James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.

3. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Explain the fundamental concepts, characteristics, and economic models of cloud computing. | **K1-K6** |
| **CO2** | Compare and evaluate cloud service models and deployment models for different organizational needs. | |
| **CO3** | Design cloud-native architectures using virtualization, containers, and micro services principles. | |
| **CO4** | Analyze pricing strategies, data governance, and security mechanisms in cloud environments. | |
| **CO5** | Evaluate cloud migration strategies, public cloud platforms, and future cloud technologies. | |

K1-Remember, K2-Understand, K3- Apply, K4-Analyze, K5-Evaluate, K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | L | L | M | L | L | L | L | L |
| **CO2** | M | H | M | M | M | M | L | L | L | L |
| **CO3** | M | H | H | H | H | M | L | L | M | L |
| **CO4** | M | H | M | H | M | H | M | M | L | L |
| **CO5** | M | H | H | M | M | M | M | M | M | M |

H-High; M-Medium; L-Low

**Subject Code: 26UPCSC1E08** **Credits: 04**

## VIRTUALIZATION

### COURSE OBJECTIVES

- To understand the fundamentals and significance of virtualization
- To study hypervisors, virtual machines, and virtual infrastructure components
- To gain hands-on knowledge in creating and configuring virtual machines
- To analyze performance tuning of CPU, memory, storage, and networking in virtual environments
- To explore virtualization availability, protection, and its role in cloud computing

### UNIT I: Virtualization Fundamentals and Concepts

Understanding Virtualization – Describing Virtualization – Microsoft Windows Drives Server Growth – Explaining Moore's Law – Understanding the Importance of Virtualization – Examining Today's Trends – Virtualization and Cloud Computing – Hyperconverged Infrastructure – Understanding Virtualization Software Operation – Virtualizing Servers – Virtualizing Desktops – Virtualizing Applications- Describing a Hypervisor – Exploring the History of Hypervisors – Understanding Type 1 Hypervisors – Understanding Type 2 Hypervisors – Understanding the Role of a Hypervisor – Holodecks and Traffic Cops – Resource Allocation – Comparing Today's Hypervisors – VMware ESX – Citrix Hypervisor (Xen) – Microsoft Hyper-V – Other Solutions

### UNIT II: Virtual Machines

Describing a Virtual Machine – Examining CPUs in a Virtual Machine – Examining Memory in a Virtual Machine – Examining Network Resources in a Virtual Machine – Examining Storage in a Virtual Machine – Understanding How a Virtual Machine Works – Working with Virtual Machines – Understanding Virtual Machine Clones – Understanding Templates – Understanding Snapshots – Understanding OVF – Understanding Containers- Performing P2V Conversions – Investigating the Physical-to-Virtual Process – Hot and Cold Cloning – Loading Your Environment – Loading VMware Workstation Player – Exploring VMware Workstation Player – Loading VirtualBox – Building a New Virtual Machine

### UNIT III: Installing Virtual Machines

Thinking About VM Configuration – Creating a First VM – Loading Windows into a Virtual Machine – Installing Windows 11 – Installing VMware Tools – Understanding Configuration Options – Optimizing a New Virtual Machine – Loading Linux into a Virtual Machine – Exploring Oracle VM VirtualBox – Installing Linux into a Virtual Machine – Installing

VirtualBox Guest Additions – Understanding Configuration Options – Optimizing a New Linux Virtual Machine

**UNIT IV: Resource Management in Virtual Machines**

Understanding CPU Virtualization – Configuring VM CPU Options – Tuning Practices for VM CPUs – Choosing Multiple vCPUs vs. a Single vCPU – Hyperthreading – Working with Intel and AMD Servers – Understanding Memory Virtualization – Configuring VM Memory Options – Tuning Practices for VM Memory – Calculating Memory Overhead – Memory Optimizations – Understanding Storage Virtualization – Configuring VM Storage Options – Tuning VM Storage – Understanding Network Virtualization – Configuring VM Network Options – Tuning Practices for Virtual Networks

**UNIT V: Advanced Virtualization and Applications**

Cloning a Virtual Machine – Working with Templates – Saving a Virtual Machine State – Creating a Snapshot – Merging Snapshots – Using Virtual Machine Tools – Understanding Virtual Devices – Configuring a CD/DVD Drive – Configuring a Floppy Disk Drive – Configuring a Sound Card – Configuring USB Devices – Configuring Graphic Displays – Configuring Other Devices – Increasing Availability – Protecting a Virtual Machine – Protecting Multiple Virtual Machines – Protecting Data Centers – Examining Virtual Infrastructure Performance Capabilities – Deploying Applications in a Virtual Environment – Understanding Virtual Appliances and vApps – Open Stack and Containers – Cloud and the Future of Virtualization

**TEXT BOOK**

1. Matthew Portnoy, *Virtualization Essentials*, Wiley Publications, Third Edition, 2023

**REFERENCES**

1. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
2. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress, 2005.
3. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Explain the principles and architecture of virtualization technologies. | **K1-K6** |
| **CO2** | Compare hypervisor types and configure virtual machines effectively. | |
| **CO3** | Deploy and manage virtual machines using industry-standard tools. | |
| **CO4** | Optimize CPU, memory, storage, and network resources in virtual environments. | |
| **CO5** | Evaluate virtualization availability, protection mechanisms, and its integration with cloud computing. | |

K1-Remember, K2-Understand, K3- Apply, K4-Analyze, K5-Evaluate, K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | L | L | M | L | L | L | L | L |
| **CO2** | M | H | M | M | H | L | L | L | L | L |
| **CO3** | M | H | H | M | H | M | L | L | M | L |
| **CO4** | M | H | H | H | H | M | M | M | L | L |
| **CO5** | M | H | M | M | M | H | M | M | M | M |

H-High; M- Medium; L -Low

**Subject Code: 26UPCSC2E09** **Credits: 04**

## CLOUD SECURITY

### COURSE OBJECTIVES

- To understand the fundamentals of cloud computing and associated security challenges.
- To analyze security and privacy risks in cloud environments.
- To study cloud security architecture, cryptography, and data protection techniques.
- To explore identity management, access control, and cloud security assessment methods.
- To examine advanced cloud security concepts including blockchain and confidential computing.

### UNIT I: Introduction to Cloud Computing and Security

Cloud Computing Overview – Service Models – Advantages of Cloud Computing – Disadvantages on Cloud Computing – Types of Cloud Computing – Key Security Challenges in Cloud Computing – Risk Assessment for Cloud Environments – Threat Modeling – Cloud Security Controls

### UNIT II: Security and Privacy Risks in Cloud computing

Data breaches and data loss in cloud environments – Data breach – Data loss – Compliance and regulatory issues – Shared Responsibility Model – Legal considerations in cloud computing – Ethical considerations in cloud computing – Case studies on security and privacy breaches

### UNIT III: Cloud Security Architecture and Data Protection

Cloud Security Architecture – Secure Network Design – Cloud Security Models – Data Storage and Processing Security – Securing Cloud-Based Applications – API – API Security – Cryptography – Key Management – Data Protection – Encryption – Decryption – Data backup – Disaster recovery

### UNIT IV: Identity Management and Cloud Security Assessment

Authentication – Access Control – Identity and access management (IAM) – IAM technologies and tools – Single Sign-On (SSO) – Federation – Monitoring and Auditing – Security Assessment – Risk Management – Cloud security auditing – Cloud incident response – Cloud forensic

### UNIT V: Cloud Security and Confidential Computing

Cloud security – Cloud app administrator identity – App deployment identity – Cloud admin identity – Blockchain approach – Blockchain's approach to preventing app compromises – Economy of security – Cloud security conclusions – Security vs. availability ANDs and ORs – Azure – Future appears serverless – Azure Security Services – Conclusions – Exercises – Different Clouds and Confidential Compute Promise – Introduction – Structure – Objectives –

Cloud admin compromise should not be fatal – Promise of confidential computing – Bootstrapping Enclave proofs – Clean room setup – Identity provider for users, apps, and Enclaves – Compute and storage – Compute and storage architecture security considerations – Blockchain architectures – Features of Azure – Types of Enclaves – Different philosophies – Achieving public blockchain confidentiality – Homomorphic encryption – Tumblers – Other techniques – Blockchain architectures

**TEXT BOOKS**


1. Mateu, T. (Ed.), Privacy and Security in Cloud Computing: Methods and Techniques, Intelliz Press, 2024
2. Rouskov, Y. R., Cloud Application Security Essentials with Azure: Azure application security, confidential computing, app identity, authentication, and authorization, BPB Publications, 2025.


**REFERENCES**


1. Thomas Erl, Robert Cope, Amin Naserpour Cloud Computing Design Patterns
2. Praveen Ayyappa Economics of Cloud Computing, LAP Lambert Academic Publishing
3. RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi, Mastering Cloud Computing Foundations and Applications Programming
4. Enamul Haque, *Cloud Service Management and Governance – Smart Service Management in Cloud Era*, Enel Publications, 2020.
5. Thomas Erl, Ricardo Puttini, Zaigham Mohammad, Cloud Computing: Concepts, Technology & Architecture by 2013


**COURSE OUTCOMES**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Explain cloud computing concepts, service models, and security ch | **K1-K6** |
| **CO2** | Identify and analyze security and privacy risks in cloud computing | |
| **CO3** | Apply cloud security architecture, cryptography, and data protection techniques. | |
| **CO4** | Demonstrate identity management, access control, and cloud security assessment practices | |
| **CO5** | Evaluate advanced cloud security approaches such as blockchain and confidential computing. | |

K1-Remember, K2-Understand, K3- Apply, K4-Analyze, K5-Evaluate, K6- Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | L | L | M | L | L | L | L | L |
| **CO2** | M | H | M | H | M | L | L | L | M | L |
| **CO3** | M | H | H | H | M | M | L | L | M | L |
| **CO4** | M | H | M | H | M | H | M | M | L | L |
| **CO5** | M | H | H | M | M | H | M | M | M | M |

H-High; M-Medium; L -Low

## VERTICAL IV: Cyber Security and Data Privacy

| | |
|---|---|
| 26UPCSC2E10 | Network Security and Ethical Hacking |
| 26UPCSC2E11 | Digital and Mobile Forensics |
| 26UPCSC2E12 | Modern Cryptography and Blockchain Technologies |

**Subject Code: 26UPCSC2E10** **Credits: 04**

### NETWORK SECURITY AND ETHICAL HACKING

**COURSE OBJECTIVES**

- To understand networking fundamentals and traffic interception techniques.
- To study cryptographic foundations and secure communication protocols.
- To analyze social engineering and reconnaissance methodologies.
- To explore vulnerability discovery and exploitation techniques.
- To examine malware, password attacks, and web application vulnerabilities.

**UNIT- I**

**NETWORK FUNDAMENTALS:** Virtual Lab Setup – VirtualBox – pfSense firewall configuration – Internal LAN setup – Kali Linux – Metasploitable – Ubuntu lab configuration.Internet architecture – Packets – MAC addresses – IP addressing – CIDR notation – Routers and LAN – ARP protocol – ARP tables – ARP spoofing – Detecting ARP attacks – Traffic capture using Wireshark – Internet protocol stack – Packet inspection – TCP handshake – Reverse shell – Port scanning – Botnet fundamentals – SYN scan and detection.

**UNIT -II**

**CRYPTOGRAPHY AND SECURE COMMUNICATION:** Encryption – One-time pad – Pseudorandom generators – Insecure Block Ciphers Modes- Secure Block Ciphers Modes – File encryption and decryption – Email encryption.Public-key cryptography – Rivest–Shamir–Adleman Theory - The RSA Math– Optimal Asymmetric Encryption Padding (OAEP).Transport Layer Security (TLS) – Certificates and Certificate Authorities – Message authentication – Diffie-Hellman key exchange – Elliptic Curve Diffie-Hellman – Key derivation – TLS socket programming – SSL stripping – HSTS bypass

**UNIT- III**

**SOCIAL ENGINEERING AND RECONNAISSANCE:** Social engineering attacks – Phishing – Email spoofing – SMTP communication – DNS lookup – Fake websites – Deepfake fundamentals – Voice cloning basics. Open Source Intelligence (OSINT) – Link analysis – Maltego – Leaked credential databases – SIM jacking. Network scanning – nmap – Masscan – Shodan – Vulnerability databases – Vulnerability scanners – IPv6 considerations – NAT limitations – Writing simple OSINT and scanning tools.

**UNIT- IV**

**VULNERABILITY DISCOVERY AND MALWARE:** Case study: Heartbleed vulnerability – Writing exploits – Fuzzing fundamentals – Writing a basic fuzzer – Symbolic execution – Dynamic symbolic Password hashing – MD5 structure – Cracking password hashes – Salting – Building salted hash crackers – John the Ripper – Hashcat – Hydra – Brute force techniques – NoSQL injection – Burp Suite basics.Cross-Site Scripting (XSS) – Stored and Reflected XSS – OWASP Zed Attack Proxy – Browser Exploitation Framework (BeEF) – Cookie theft – Website exploitation case studies.execution – Angr framework overview. Trojans – Malware architecture – Implant development – Hiding malware in legitimate files – Encoding techniques – Windows, Linux and Android trojan concepts. Linux kernel modules – Rootkits – System call hooking – Hiding files and processes – Keylogger fundamentals.

**UNIT -V**

**PASSWORD ATTACKS AND WEB EXPLOITATION:** SQL Injection – Extracting database information – Writing SQL injection tools – SQLMap – HTTP request manipulation.

**TEXT BOOK**

1. Daniel G. Graham, *Ethical Hacking: A Hands-on Introduction to Breaking In*, No Starch Press, 2021.

**REFERENCE BOOKS**

1. Michael T. Simpson et al., *Hands-On Ethical Hacking and Network Defense*, Cengage.
2. William Stallings, *Cryptography and Network Security*, Pearson.
3. Jon Erickson, *Hacking: The Art of Exploitation*, No Starch Press.

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1 | Explain networking fundamentals, traffic interception techniques, and ARP-based attacks. | K1-K6 |
| CO2 | Apply cryptographic principles and secure communication mechanisms such as TLS and Diffie-Hellman. | |
| CO3 | Analyze social engineering and reconnaissance techniques to identify security weaknesses. | |
| CO4 | Design and evaluate exploitation techniques including fuzzing, malware, and rootkits in controlled environments. | |
| CO5 | Implement web application and password attack techniques such as SQL injection and XSS for vulnerability assessment. | |

K1–Remember, K2–Understand, K3–Apply, K4–Analyze, K5–Evaluate, K6–Create

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | M | M | H | L | L | M | M | L |
| **CO2** | H | H | M | M | H | M | L | M | M | L |
| **CO3** | M | H | H | M | M | M | M | L | M | L |
| **CO4** | M | H | H | H | M | M | M | M | M | L |
| **CO5** | H | H | H | H | H | M | M | M | M | M |

H-High; M-Medium; L-Low

**Subject Code: 26UPCSC2E11** **Credits:04**

## DIGITAL AND MOBILE FORENSICS

**COURSE OBJECTIVES**

- To understand the principles and methodology of digital forensic investigation
- To establish and configure a forensic laboratory environment
- To perform evidence acquisition and forensic analysis across operating systems
- To investigate mobile, browser, memory, and cloud artifacts
- To prepare legally admissible forensic reports

**UNIT -I**

**FUNDAMENTALS OF DIGITAL FORENSICS:** Defining digital forensics – Digital forensics goals – Defining cybercrime – Sources of cybercrime – Computers in cybercrimes – Digital forensics categories – Computer forensics – Mobile forensics – Network forensics – Database forensics — Law enforcement – Civil ligation – Intelligence and counterintelligence – Digital forensics investigation types – Forensics readiness – Type of digital evidence – Locations of electronic evidence – Chain of custody – Examination process – Seizure – Acquisition -**Essential Technical Concepts-**Decimal (Base-10) – Binary – Hexadecimal (Base-16) – Hexadecimal (Base-64) – Character encoding schema – File carving – File structure – Digital file metadata – Timestamps decoder – Hash analysis – Calculate file hash – System memory – Types of computer memory storage – Primary storage — SSD – DCO and HPA – Considerations for data recovery – File system – NTFS – FAT – Environment for computing – Cloud computing – Windows versions – Internet protocol (IP) address – Getting an IP address

**UNIT II: Storage and Forensic Lab Setup**

Hard disk and file systems – File systems – Hard disk – Hard disk forensics – Analyzing the registry files -Digital Forensic Lab – Physical requirements – Environment controls – Digital forensic equipment – Forensic hardware – Office electrical equipment – Networked devices – Forensic workstation – Commercial digital forensic workstations – Forensic software applications – Commercial forensics tools – Open-source forensic tools – Linux distributions – Virtualization – Lab information management system (LIMS) – Lab policies and procedures – Documentation – Lab accreditation – Conclusion

**UNIT III: Evidence Acquisition and Analysis**

Raw format – Advanced forensic format – EnCase: Expert witness transfers – Other file formats – Validation of forensic imaging files – Live memory acquisition – Virtual memory: Swap space – Challenges acquiring RAM – Administration privilege – Live RAM capturer –

Magnet RAM capture – FTK imager – Acquiring nonvolatile memory – Hard disk acquisition – Acquiring physical resources – Logical acquisition – Sparse acquisition – Capturing hard drives using FTK imager – Network acquisition – Limitations of a forensic tool - Arsenal Image Mounter – OSFMount – Autopsy – Analyzing RAM forensic image – Memoryze – Redline – Volatility framework

**UNIT IV: System and Browser Forensics**

Timeline analysis tools – File recovery – Undeleting files – Recycle bin forensics – Data carving – Associated user account action – Windows registry analysis – Windows registry architecture – Acquiring windows registry – Registry examination – Windows registry program keys – USB device forensics – Most recently used list – Network analysis – Windows shutdown time – UserAssist forensics – Printer registry information – File format identification – Windows thumbnail forensics – Windows 10 forensics – Notification area database – Cortana forensics -Web browser forensics – Google chrome browser forensics – Top sites and shortcuts – Login data – Web data – Bookmarks – Bookmarks.bak – Cache folder – Mozilla Firefox Browser Forensics – Microsoft Edge browser forensics – Other Web browser investigation tools

**UNIT V: E-mail Forensics and Anti-Forensics**

E-mails around us – E-mail communication steps – E-mail protocols – Examine e-mail headers – Reveal header information – View Gmail headers – View Outlook mail header – View Mozilla Thunderbird headers – View Outlook mail client header – Analyzing e-mail headers – Determine the sender's geolocation and time zone Anti-forensics techniques – Digital Steganography – Text Steganography – Image Steganography – Audio-video Steganography – Network Steganography – Metadata manipulation – Encryption techniques – Disk encryption using open-source tools – Anonymity techniques – Digital forensic reports

**TEXT BOOKS**

1. Akashdeep Bhardwaj, Keshav Kaushik, Practical Digital Forensics: Forensic Lab Setup, Evidence Analysis, and Structured Investigation Across Windows, Mobile, and Cloud, BPB Publications, 2023

**REFERENCE BOOKS**

1. Rohit Tamma, Practical Mobile Forensics: Forensically investigate and analyze iOS, Android, and Windows 10 devices, 4th Edition , 2020
2. Gerard Johansen, Digital Forensics and Incident Response: Incident response techniques and procedures to respond to modern cyber threats, 2020
3. DeepanshuKhanna Digital Forensics and Incident Response: A practical guide to using

Kali Linux for cyber investigations (English Edition) , 2024

**COURSE OUTCOMES (COs)**

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

| | | |
|---|---|---|
| CO1 | Explain digital forensic investigation processes and legal frameworks | K1-K6 |
| CO2 | Perform forensic acquisition and analysis on Windows and Linux systems | |
| CO3 | Analyze mobile and browser artifacts for digital evidence extraction | |
| CO4 | Investigate volatile memory, network, and cloud-based evidence | |
| CO5 | Prepare structured forensic reports and present digital evidence professionally | |

**MAPPING WITH PROGRAMME OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | M | M | H | M | H | L | M |
| **CO2** | H | H | H | H | H | M | M | M | L | M |
| **CO3** | H | H | H | H | H | M | M | M | L | M |
| **CO4** | H | H | H | H | H | H | M | H | M | M |
| **CO5** | M | M | H | M | M | H | M | H | H | H |

H-High; M-Medium; L -Low

**Subject Code: 26UPCSC2E12** **Credits: 04**

## MODERN CRYPTOGRAPHY AND BLOCKCHAIN TECHNOLOGIES

### COURSE OBJECTIVES

- To understand the theoretical foundations of modern cryptography.
- To study encryption techniques for data at rest and in transit.
- To explore emerging cryptographic domains including cloud, AI, and post-quantum cryptography.
- To understand the principles and architecture of blockchain systems.
- To examine smart contracts and decentralized applications.

**UNIT –I**

**FUNDAMENTALS OF CRYPTOGRAPHY:** Fundamentals of Cryptography – History of Cryptography – Historical Development of Cryptography – Need for Cryptography – Introduction to Cryptography – Definitions – Classical versus Modern Cryptography – Encoding, Hashing, and Encryption – Security Concepts – Types of Modern Cryptography – Steganography – Additional Techniques – Confusion and Diffusion – Refresher on Mathematics – Primer on Ciphers - Primer on Symmetric Cryptography - Symmetric Key Algorithms

**UNIT –II**

DATA ENCRYPTION AND WEB SECURITY: Primer on Data Security- Data-at-Rest Encryption- Primer on Web Security - Web Security Protocols- Implementing VPNs Using IPS - Securing Web-Based Applications - Public Key Infrastructure

**UNIT- III**

**CLOUD, AI AND POST-QUANTUM CRYPTOGRAPHY:** Primer on Cloud Cryptography-Encryption Key Management - Cryptography as a Service by Major Cloud Service Providers - Cryptography as a Service byMajor Cloud Service Providers - AI for Cryptography-Cryptography for AI - Best Practices and Ethical Use of AI - Primer on Quantum Computing-Quantum Computing and

Cryptography

**UNIT –IV**

**BLOCKCHAIN FOUNDATIONS:** Origins of Blockchain Technology – Distributed Systems – Centralized vs Decentralized Architecture – Bitcoin Predecessors – Bitcoin Experiment – Bringing Bitcoin to Life – Cryptocurrency Fundamentals

**UNIT- V**

**BLOCKCHAIN EVOLUTION AND SMART CONTRACTS:** Forks and Altchains – Bitcoin Improvement Proposals – Understanding Forks- Bitcoin Cash Fork- Altcoins- 2.0 Chains- Privacy focused cryptocurrency – Ripple and Stellar - Improving Bitcoin's Limited Functionality- b. Ethereum: Taking Master coin to the Next Level

**TEXTBOOKS**

1. **Sandip Dholakia**, *Modern Cryptography: The Practical Guide*, Rheinwerk Publishing, **First Edition, 2024**.
2. **Lorne Lantz and Daniel Cawrey**, *Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications*, O'Reilly Media, **First Edition, 2021**.

**REFERENCE BOOKS**

1. Kumar Saurabh and AshutoshSaxena , Blockchain Technology, Wiley Publication, 2020
2. Asharaf S.,SivadasNeelima, Franklin John,Blockchain Technology: Algorithms and Applications,Wiley Publication,2023
3. Jean-Philippe Aumasson, Serious Cryptography: A Practical Introduction to Modern Encryption, no starch press, 2024

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1 | Explain the fundamental principles, mathematical foundations, and classical-to-modern evolution of cryptography. | K1-K6 |
| CO2 | Apply encryption techniques for securing data at rest and data in transit across computing environments. | |
| CO3 | Analyze advanced cryptographic domains including cloud cryptography, AI-integrated cryptography, and post-quantum cryptographic models. | |
| CO4 | Examine blockchain architecture, consensus mechanisms, and cryptocurrency fundamentals. | |
| CO5 | Design and evaluate smart contract–based decentralized applications within blockchain ecosystems. | |

(K1–Remember, K2–Understand, K3–Apply, K4–Analyze, K5–Evaluate, K6–Create)

**MAPPING WITH PROGRAMME OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | M | M | M | L | L | M | M | L |
| **CO2** | H | H | M | M | H | M | L | M | M | L |
| **CO3** | M | H | H | M | M | M | M | M | M | L |
| **CO4** | H | H | H | H | H | M | M | M | M | M |
| **CO5** | H | H | H | H | H | M | M | M | H | M |

H-High; M-Medium; L-Low

## NON MAJOR ELECTIVE –II

**Subject Code: 26UPCSC1N01** **Credit: 02**

## ADVANCED MICROSOFT OFFICE LAB

## LIST OF EXPERIMENTS

**MS-Word:**

1. Design an admission/enquiry from using shapes, textbooks, colors, tables with formatting options.
2. Design a text book with cover page, content page and text using indenting options, rulers, page layout, header/footer and hyperlinks.
3. Design News paper advertisement with images and texts.
4. Design mark statement copy using tables, images and watermarks.
5. Design conference/ seminar in variation with logos, formatting options, margins and borders.
6. Write a Research article with Chart, Tables, Symbols, Equations and References.

**MS-Excel:**

7. Design an application for student Exam Result using Data validation, Aggregate functions and Conditional formatting.
8. PrepareCost-BenefitAnalysisforanorganizationusingStatisticaltools.
9. Develop an application to predict population of a city using analysis Macros.

**MS-Access:**

10. Design an Employee payroll system with Forms and Reports using Macros.
11. Develop relational integrity databases.
12. Develop an application which automatically updates a table using Triggers.
13. Design an inventory database and generate conditional report.

**MS-PowerPoint:**

14. Prepare a presentation with embedding multimedia objects.
15. Prepare presentation with slide layout, animations, font effects, hyperlinks.

**MS-Publisher:**

16. Prepare an academic calendar for an institution.

**REFERENCE BOOKS:**


1. Lisa A. Bucki, “MSOffice 2013 Bible”,Wiley Publications, 2013.
2. Richard Mansfield, “Mastering VBA for Microsoft office 2016”, Wiley Publications, 2016.
3. Wayne L.Winston, “Microsoft Excel Data Analysis and Business Modeling”, PHI, 2017.
4. Manisha Nigam, “Data Analysis with Excel”, BPB Publications, 2019.
5. Michael Alexander and Dick Kusleika, “Excel Power Programming with VBA”, Wiley Publications, 2016.
6. Michael Alexander and Dick Kuskeika, “Access the Comprehensive tutorial guide”, Wiley Publications, 2016.

## NON MAJOR ELECTIVE–II

**Subject Code: 26UPCSC1N02** **Credit: 02**

## BIOPYTHON PROGRAMMING LAB

## LIST OF EXPERIMENTS

1. Program to implement Functions.
2. Program to perform Basic Operations on Sequence objects.
3. Program to perform Operations on Sequence an notation objects.
4. Program to perform Operations on Sequence Input/Output.
5. Program to perform Operations on Multiple Sequence Alignment objects.
6. Program to perform Operations on BLAST.
7. Program to perform Sequence motif analysis.
8. Program to perform Cluster analysis.
9. Program to perform Supervised learning methods.
10. Program to perform Genome Data visualization.

**REFERENCE BOOK**


1. Via,A., Rother, K.,& Tramontano,A. (2014). Managing your biological data with Python. Chapman and Hall/CRC.
2. Rocha, M.,& Ferreira,P.G.(2018)Bioinformatics Algorithms: Design and Implementation in Python. Academic Press.
3. Chun,W.(2001).Core python programming (Vol.1).Prentice Hall Professional.

# Value Added Course

**COURSE: 26UPCSCVA01 MS-Office (Excel) Credits: 4**

**Course Objectives:**

This course should enable the students:

- Give students an in-depth understanding of how the office tool is essential in business, education and society
- To understand the basics and advanced features of Excel spread program
- To improve the Data interpretation and analysis skills of the learner
- Learner get familiar in working of Statistical functions to analyze the data

1. Create an excel sheet and perform the following operation

   i) Creating and running a macro. ii) Assigning button to a defined macro. iii) Editing a macro.

2. Create a table and apply the various formatting properties and generate the char for the table

3. Create a table and apply the various mathematical functions.

4. Prepare Excel worksheet with chart for Employee salary with the following information

   (i) Name of People with their age (at least 10)

   (ii) Number of years they have worked with salary per month

   (iii) Show the HRA, MA, TA and Hard allowances

Calculate the total, average, maximum, minimum salary of employees and give the chart for salary

5. Create Excel worksheet for Wedding cost estimation with the following information

   (i) Name of guest along with who invited them (Bride / Groom) (at least 10)

   (ii) Guests may be divided in to adult and children

   (iii) Cost of the reception for adult Rs 650, children 60% of adult cost and 183% of GST

Calculate the total number of guests, number of adult and children and total reception cost. Show the graph for adult and children.

6. Prepare Excel table for Balance check book with the following information Ck# (Check book number), date, item description (at least 10 transactions), Debit and

Credit. Calculate the balance using the formula Balance= Credit - Debit

7. Prepare Excel worksheet table f o r Cost-Benefit analysis of stadium for 10 years with the following information

Year, Costs, Benefits, Total benefits, Discount factor, Present Value

Calculate the total benefits (Total benefits = Benefits - Cost), discount factor (discount factor = 1/(1+0.1) year, Present value

(Present value= total benefits* discount factor).

8. Develop a spread program for the following case scenario

One day at a family dinner, your dad and your uncle got into a debate about which basketball team is better. Your dad is a loyal fan of the State University while your uncle graduated from the U n i v e r s i t y of State, a big rival of the S t a t e University. Your great aunt chimed in that the University of Next- State's basketball team is the best.

Compare the performance of the basketball teams and y o u w i l l bring in your analysis to the next family dinner.

9. Develop a spread program for the following case scenario

National Park Services (NPS) is a federal agency of the United States Government responsible for managing all U.S. National parks, many American national monuments, an d many other conservation and historical properties. Information about visitation at units of the NPS is publicly available and may be downloaded at https:// irma.nps.gov/Stats/ You work for a company that specializes in guided tours of national parks across the United States. As an assistant to the Director of Marketing, you were asked to analyze some visit data at selected national parks. Your boss is specifically interested in the number of visitors as well as the trend of recreational visits over the years. The information will be used to develop marketing strategies, promotional packages, as well as advertising campaigns for the next five years.

10. Develop a spread pro gram for the f o l l o w i n g case scenario

Headquartered in Memphis, TN, Gre nad ier Super Store (GSS) specializes in offi ce supplies and furniture. The com pany's custom ers range from individual consumers and small businesses (retail), to corpora te organizations (wholesale) located in the United States and Canada.

You are an intern working for the Canada division of GSS. Your supervisor has given you an Excel file containing Order data from 2009-2012 and he would like you to analyze Orders/Customers/Sales data using PivotTables and Pivot Charts.

**References**


1. https://www.excel-easy.com/data-analysis.html
2. https://excelwithbusiness. com/blog/15-excel-data-analysis-functions-need/
3. https://www.studyanalytics.in/data analysis using excel


**Course outcomes:**

On the succe ssf ul completion of the course, students will be able to:

1. Understand the basics of MS-Excel and its functions concepts
2. Gain knowledge to apply the appropriate Excel functions in the real data
3. Understand the functionality of the analysis tool pack to analyze the data
4. Learner get familiar with the analysis functions of statistics

**Employability skills**

The add on course in MS-Excel helps the learner to understand and identify the usage of MS-Excel in business, education and society using statistical functions. The above learning skill helps the learner to get more employability in the data analysis environment

**Career scope:**

- Data Analyst
- Data engineer
- Business analyst
- Business intelligence

Course Duration : 30 Hours


Course Duration : 30 Hours


No Course Fees

## VALUE ADDED COURSE

**COURSE: 26UPCSCVA02** **R Programming** **Credits: 4**

**Course Objective**:

This course should enable the students:

To be able to learn how to program in R and how to use R for effective data analysis. Familiar with programming in R, reading data into R, accessing R packages, writing R functions, debugging, profiling R code, and organizing and commenting R code.

**Implement the following concepts using R:**

1. R data types-and objects,
2. Reading and writing data
3. Control structures
4. Functions
5. Dates and times
6. Loop functions
7. Vector and Matrix Operations
8. List and Data-Frame Operations
9. Data Import and export Operations
10. Data Exploration and Visualization Operations

**References**

1. Larry Pace, "Beginning R: An Introduction to Statistical Programming, Apress, Second

Edition, 2015

2. Richard Cotton, "Learning R: A Step-by-Step Function Guide to Data Analysis, OReilly,

2013

**Web References**:

1. https://www.w3resource.com/ r-programming-exercises

**Course Outcomes:**

The students should enable to:

1. Gain knowledge to identify appropriate R Programming language constructs to write basic programs for the given problem.

2. Identify and implement the right data representation formats and data structure based on the requirements of the problem.

3. Understand the functionality of R package and to implement the same for the problem solving.

**Employability Skill:**

This Add-on course will help learners, especially Statistical, Mathematical & Computer science students improve their employment quotient and job qualifications in the marketplace.

**Career Scope:**

- Data Analysts
- R Programmer
- R Researcher in leading research institutions
- Data Scientists

- Course Duration : 30 Hours
- No Course Fees

## Value Added Course

**COURSE: 26UPCSCVA03** **Bio Python** **Credits: 4**

**Course Objective:**

This course should enable the students:

- To be able to introduce programming basics and design using Python Programming Language
- To understand in-depth biological data and information processing techniques using Bio Python.

**Implement the following concepts using Python:**

1. Basics of Python
2. Advanced Data Structure
3. Control Flow
4. Functions and modules
5. Files
6. Retrieve Sequence from FASTA and Genebank files
7. Split a Sequence File into a set of smaller files.
8. Sequence file formats conversion
9. Manipulations of sequence files
10. Visualization and analyze of Sequence data.

**References**


1. Dusty Philips, "Python 3 Object Oriented Programming", PACKT Publishing, 2nd Edition, 2015.
2. Sebastian Bassi, Python for Bioinformatics, Second Edition, Chapman & Hall and CRC Press, 2009
3. Jeff Chang, Brad Chapman, Iddo Friedberg, Thomas Hamelryck, Michiel de Hoon, Peter Cock, Tiago Antao, Eric Talevich, Bartek Wilczy´nski, Biopython Tutorial and Cookbook, 2019 (http://biopython.org/DIST/docs/tutorial/Tutorial.pdf


**Web References:**

1. https://www.w3resource.com/python-exercises/class-exercises/
2. https://www.rithmschool.com/courses/python-fundamentals-part-2/python-object- oriented programming-exercise

**Course Outcomes:**

The students should enable to:

1. Gain knowledge to identify appropriate Python language constructs to write basic programs for the given problem.

2. Identify and implement the right data representation formats and data structure based on the requirements of the problem.
3. Understand the functionality of Bio Python package and to implement the same for the problem solving.

**Employability Skill:**

This Add-on course will help learners especially Life-Science students improve their employment quotient and job qualifications in the marketplace.

**Career Scope:**

1. Bioinformatics Analysts
2. Bioinformatics Programmer
3. Bioinformatics Researcher in leading research institutions
4. Data Scientists

- Course Duration : 30 Hours

- Course Fees: Rs. 500/-

## Value Added Course

**COURSE: 26UPCSCVA04 Large Language Models (LLMs) Credits: 4**

**Course Objectives**

- Understand the basic concepts and functions of Large Language Models (LLMs).
- Apply LLMs (e.g., ChatGPT, Gemini) for summarization, analysis, and content generation.
- Develop effective prompts to extract relevant information from LLMs.
- Analyze sentiment, bias, and public opinion using LLM tools.
- Demonstrate ethical considerations in using AI tools in research.

## Lab Exercises

. Introduction to LLMs & Applications

. Working with ChatGPT / Gemini

. Prompt Engineering Basics

. Text Summarization & Paraphrasing

. Sentiment & Opinion Analysis

. Translation & Code-Switching

. LLMs as Data Assistants

. Generate Questionnaire

. Visual Dashboard Plan

0. Ethical Use of AI in Social Sciences

1. Mini-Project & Presentation

**Course Outcomes (COs)**

By the end of this course, learners will be able to:

| CO No. | Course Outcome Description | Bloom's Level |
|---|---|---|
| CO1 | Recall the fundamental concepts of LLMs and their evolution and its applications. | **K1** – Knowledge<br>**K2** – Comprehension |
| CO2 | Apply LLMs to summarize, paraphrase, and classify social content. | **K3** – Application |
| CO3 | Analyze texts for sentiment, bias, or opinion using prompt engineering. | **K4** – Analysis |
| CO4 | Evaluate the ethical use of AI tools in research and media. | **K5** – Evaluation |
| CO5 | Design and present a mini-project applying LLMs to a social science issue. | **K6** – Creation |

## Value Added Course

**COURSE: 26UPCSCVA05** **Credits: 4**

### Basics of Computer Hardware & Introduction to Networking

**Course Objectives:**

The main objectives of this course are:

1. To understand core hardware components
2. To demonstrate Hardware Assembly and Troubleshooting
3. To grasp Networking Fundamentals
4. To set up and configure Network Devices
5. To apply safety and maintenance practices

**Expected Course Outcomes:**

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

| | | |
|---|---|---|
| CO1 | Understand the functions and roles of essential computer hardware components such as the CPU, RAM, motherboard, storage devices, and input/output peripherals. | K1-K6 |
| CO2 | Develop hands-on skills in assembling a computer system, identifying hardware issues, and applying basic trouble shooting techniques. | |
| CO3 | Understand basic networking concepts including types of networks, network topologies, IP addressing, and essential protocols like TCP/IP. | |
| CO4 | Learn to configure basic networking devices such as routers, switches, and modems, and establish simple local area networks (LANs). | |
| CO5 | Known for hardware handling, ESD safety, and routine maintenance to ensure system reliability and longevity. | |

| S.No | Module Name | Outcome | Theory (Hrs) | Practical (Hrs) | Total (Hrs) |
|---|---|---|---|---|---|
| 1 | Basic Computer Fundamentals and Basics of Power System in a Computer | Identify different parts of a computer system | 01 | 01 | 02 |
| 2 | Introduction to SMPS & UPS | Install Test and Troubleshoot Switch Mode Power Supply & UPS | 01 | 01 | 02 |
| 3 | Introduction to Basic Input Output System | Demonstrate configurations and changes in BIOS or CMOS Setup and POST | 01 | 01 | 02 |
| 4 | Introduction to Operating System | Install an OS in a new Computer System and configure the machine | 01 | 02 | 03 |
| 5 | Computer Management | Manage the resources of a Computer System according to users need | 01 | 01 | 02 |
| 6 | Disk Partitioning | Create partition of the HDD, SSD of a Computer System | 01 | 01 | 02 |
| 7 | Details about Central Processing Unit & Main board | Install a CPU on motherboard and under lying technology used | 01 | 01 | 02 |
| 8 | Primary and Secondary Memory | Install RAM, SSD, HDD and explain primary memory and secondary memory in a computer system | 01 | 01 | 02 |
| 9 | Computer Accessories | Install and connect accessories like optical drive, keyboard, mouse, monitor, Printer and troubleshoot | 01 | 02 | 03 |
| 10 | Introduction to Networking | Basic of Essential Network Components | 01 | 01 | 02 |
| 11 | Connecting Devices | Identify different types of Cables, RJ 45 Connectors, Punching / Crimping Tools and I/O Sockets | 01 | 02 | 03 |

| | | | | | |
|---|---|---|---|---|---|
| 12 | Network Communication Devices | Explain Working Principle of Communication and utility of Network | 01 | 01 | 02 |
| 13 | Knowledge of Sharing of Resources | Connect computers in a networking system and able to share, files, printers or other Resources in a system | 01 | 01 | 02 |
| 14 | Knowledge of Internet and Internet Network Configuration | Configure the modem and setup a secured connection via Internet. | 01 | 01 | 01 |
| **Total (Hours)** | | **30** | | | |

**References Books:**


1. Mike Meyers, "CompTIA A+ Certification All-in-One Exam Guide", 11th Edition, McGraw- Hill Education, 2021. (ISBN: 978-1260462189).
2. Mike Meyers, "Networking + Guide to Managing and Troubleshooting Networks", 7th Edition, McGraw-Hill Education, 2019. (ISBN: 978-1260458083).
3. Mike Meyers, "PC Hardware and Maintenance", 4th Edition, McGraw-Hill Education, 2016. (ISBN: 978-0071848232)
4. Charles Severance, "Introduction to Networking: How the Internet Works", 1st Edition, CreateSpace Independent Publishing Platform, 2014. (ISBN: 978-0993449200)
5. V. Rajaraman, "Hardware and Computer Organization", 5th Edition, Prentice Hall, 2018. (ISBN: 978-9332573483)

**Module No.1:** Basic Computer Fundamentals & Basics of Power System in a Computer.

**Outcome:** Identify different parts of a computer system.

**Theory Content:**

- Computer Fundamentals History and Generations of Computer. (Gen1to5)
- Architecture of the Computer.
- Description of different parts of a Computer.
- Idea about Operating system, System Software and Application Software.

**Practical Content:**

- Identification of different Components of a computer and demonstration and uses of them.
- Different Tools / equipment used for assembling/disassembling a PC.
- Demonstrations of the power flow inside a computer through slides/PPT.
- Identification of the power source, coloured wires of interest etc.

**ModuleNo.2:** Introduction to SMPS & UPS.

**Outcome:** Install Test and Troubleshoot Switch Mode Power Supply & UPS.

- SMPS Features and Functions.
- Types of SMPS.
- Power distribution in SMPS.
- Components and Circuits inside the SMPS Unit.
- Types of Uninterrupted Power Supply (UPS) Offline and Online.

**Practical Content:**

- A running SMPS demonstration.
- Installation of a SMPS on a cabinet.
- Isolated Power testing by sorting.
- Live UPS Demonstration.

**ModuleNo.3:** Introduction to Basic Input Output System.

**Outcome:** Demonstrate configurations and changes in BIOS or CMOS Setup and POST.

**Theory Content:**

- Introduction to BIOS/CMOS Setup, POST. (Power on Self-Test)
- Demonstration of BIOS/CMOS Configuration. (Date, Time, Enable/Disable Devices)
- Dual BIOS Feature BIOS/CMOS Setup, Booting Sequence/Boot Order.

**Practical Content:**

- Demonstration of BIOS/CMOS setup, POST in a Computer step by step.
- Demonstration of different types of configurations and effect of changes in an existing BIOS feature for system.
- Implementation of Dual Booting setup preferably in windows.

**ModuleNo.4:** Introduction to Operating System.

**Outcome:** Install an OS in a new Computer System and configure the machine.

**Theory Content:**

- Definition and types of Operating Systems. Functions & Features of OS.
- MS-Dos (Prelims), Windows8.1, 10, 11, RedHat7 Linux Server, Ubuntu, MACOS, Android etc.
- Process of Booting the Operating System.
- Installation of Operating Systems such as Windows 8.1, 10, 11 Activation and Automatic Updating procedures.

**Practical Content:**

- Installation of different types of Operating Systems.
- Demonstration on Windows Using: Safe Mode, Safe Mode Boot options, Last Known Good Configuration, etc.
- Demonstrating Windows Diagnostic Tools, System Restore, Creating Restore point.
- Windows Recovery using System Factory Defaults/Recovery tools.
- Installation of driver routines for the system.

**ModuleNo.5:** Computer Management.

**Outcome:** Manage the resources of a Computer System in Windows according to users need.

**Theory Content:**

- Computer Management, Disk Management, Defragmentation.
- Services and Applications, Local Users and Groups.
- Advanced System Settings, Device Manager, Task Manager, Windows Registry.

**Practical Content:**

- Demonstrating computer management in Windows using Disk manager, Shrink, Extend and Creating Logical Drive etc.
- Creating users, groups etc.
- Installing & uninstalling program, devices driver from control panel, uses of task manager, termination of a process etc.

**ModuleNo.6:** Disk Partitioning.

**Outcome:** Create partition of the HDD, SSD of a Computer System in Windows according to users need.

**Theory Content:**

- Partitioning of Hard Drive/SSD-Primary, Extended, Logical partitions using Partition Tools in Windows.

**Practical Content:**

- Demonstration of Partitioning of Hard Drive/ SSD - Primary, Extended and Logical partitions using Partition Tools in Windows through Disk Manager.

**ModuleNo.7:** Details about Central Processing Unit & Main board

**Outcome:** Install a CPU on mother board & underlying technology used.

**Theory Content:**

- Definition of CPU, Architecture, Speed, Types of CPU (XT and AT technologies) 32/64Bit.
- Types processor technologies like Clock speed, Bus speed, Cache memory.
- Threading technologies, Core technologies, IRQ & DMA Technologies.

- Brands (Intel/AMD), CPU Series–like Pentium, PI, PII, PIII, PIV etc.
- What is "I" Technology, Core series (i3, i5, i7).
- I/O Ports (PS/2, Serial, Parallel, USB, VGA, HDMI, Audio, Ethernet, etc.)

**Practical Content:**

- Demonstration of different generation CPU (Intel /AMD), showing clock speed, Bus Speed & Other features.
- Demonstration of technological difference between different generation's CPU through Slides, Lecture, picture etc.
- Hand on practice to install CPU on the slot provided on the compatible main board.
- Installation of external cards viz. graphics, sound, Ethernet and etc., on the main board.

**ModuleNo.8:** Primary and Secondary Memory.

**Outcome:** Install RAM, SSD, HDD and explain Primary Memory and Secondary Memory in a Computer system.

**Theory Content:**

- Introduction to RAM, ROM, Cache Memory, Buffer Memory, Virtual Memory. Speed, Timeline (EDO, NON-EDO, SD, RD, DDR, DDR2, DDR3, DDR4), Hybrid Memory.
- Comparing and Installing RAM, Memory Module Form Factor, etc.
- Introduction to HDD & SSD, Types, Functioning of HDD, Functioning of SSD, Dual Usage.
- Tracks, Sectors, Cylinders, Cluster MBR, FAT Area, DIR Area, Zero Track.
- IDE Jumper settings (Primary/Secondary), (Master/Slave/Cable Select).
- Installing and Configuring a New HDD/SSD.

**Practical Content:**

- Demonstration of different generation's RAM compatible with the system.
- Hand on practice to install RAM on the slot provided on the compatible main board.
- Demonstration of different types of HDD/SSD, showing speed, characteristics & other features.
- Hand on practice to install HDD/ SSD or both in a System.
- Hands on practice to make a HDD/SSD as Primary/Secondary Master/Slave using IDE Jumper Settings or cable select.
- Fresh installation a HDD/SSD, Partition, Installation of OS, Application S/W.

**ModuleNo.9:** Computer Accessories

**Outcome:** Install & connect accessories like optical drive, keyboard, mouse, monitor, Printer and troubleshoot

## Theory Content:

### Optical Drive

- Types of Optical Drives-ROM/Writer,
- Types of Media-(CD/DVD), Layers of CD and DVD, Difference between CD and DVD.
- Storage Technology-Reading, Writing &Re-Writing data, Drive Interfaces - (IDE/SATA).
- Burning CD/DVD's using multiple Burning Tools, i.e., Nero, NTI, etc.
- Creating, Managing and Burning ISO Images using tools like: Magic ISO, Power ISO etc.

### Keyboard & Mouse

- Types of Keyboards.
- Working Principles of Keyboard (Make/Brake Scan Code, Key Matrix).
- Keyboard Interfaces (DIN Type, PS/2,USB, wireless).
- Types of Mouses (Ball Mouse, Optical Mouse, Trackball).
- Principles of Mouse(X,Y Axis in Ball Mouse &DSP, Sensor in Optical Mouse). Mouse Interfaces( Serial, PS/2,USB,wireless)

### Monitor

- Types of Monitors(CRT/LCD/LED) and Working Principles of each type.
- Demonstration and Practical on Monitor Installation, Menu Configuration, Adjusting Monitor Settings, Monitor Power Supply types, Possible Problems and Troubleshooting.

### Printer

- Types of Printers (Dot Matrix, Inkjet, Laser, Thermal, All-in-One Printers, etc.) Interface Cables, Ports & Connectors.
- Working Principles of each type, network Printer.
- Installing a Printer and Configuring Drivers.
- Possible Printer Problems and Troubleshooting Techniques.
- Types of Scanners (Handheld, Flatbed, Sheet fed, Portable Scanners).

- Interface Cables, Ports and Connectors.
- Installation of Scanner, Device Driver Installation.
- Scanner Settings, Scanning Documents, Photos in different Formats like JPG, PDF, etc.

**Practical Content:**

**Optical Drive**

- Hand on practice to learn on burning through requisite application Software.
- Connecting drives with the system with different interfaces.
- Hand on practice on Burning CD and DVD to create ISO image of software.

**Keyboard & Mouse**

- Demonstration of different types of Keyboards.
- Hands on practice with different types of mouses.

**Monitor**

- Hands on practice with different types of monitor.
- Monitor Problems and Troubleshooting.

**Printer**

- Demonstration of different types of Printers (Dot Matrix, Inkjet, Laser, Thermal, All- in-One, network Printers etc.)
- Installing a Printer and Configuring Drivers.
- Printer Problems and Troubleshooting Techniques.
- Demonstration of different types of Scanners (Handheld, Flatbed, Sheet fed, Portable Scanners).
- Installing a Scanner and Configuring Drivers.
- Scanner Problems and Printer Troubleshooting Techniques.

**ModuleNo.10:** Introduction to Networking.

**Outcome:** Basic of Essential Network Components.

**Theory Content:**

- Essential Network Components for Data Transfer (Two Systems Required, Communication Media, Transmission Media, Connecting Devices and Protocol)

**Practical Content:**

- Demonstration of different types of Communication Media, Transmission Media and Connecting Devices.
- Hands on practice with Essential Network Components.