



Learn Beyond

**KPR Institute of  
Engineering and  
Technology**

(Autonomous, Affiliated to Anna University)

# **CURRICULUM AND SYLLABI REGULATIONS – 2025 (REVISED)**

**Department of  
Artificial Intelligence and Data Science**

**CONTROLLED COPY**



## **I. Vision and Mission of the Institute**

### **Vision**

To become a premier institute of academic excellence by imparting technical, intellectual and professional skills to students for meeting the diverse needs of industry, society, the nation and the world at large

### **Mission**

- Commitment to offer value-based education and enhancement of practical skills
- Continuous assessment of teaching and learning processes through scholarly activities
- Enriching research and innovation activities in collaboration with industry and institutes of repute
- Ensuring the academic processes to uphold culture, ethics and social responsibilities

## **II. Vision and Mission of the Department**

### **Vision**

To be a department with global recognition through innovative teaching process, product development and research excellence in Artificial Intelligence and Data Science

### **Mission**

The mission of the department is to

- Provide the highest quality of teaching and learning opportunities to the students with a well-researched and carefully crafted curriculum
- Enable the students to develop projects and products in latest technologies related to data science and artificial intelligence with the help of industrial collaboration
- Develop a top notch research culture by empowering students and faculty in fundamentals and applications of data science and artificial intelligence
- Educate the students to apply their skills in solving social challenges in an ethical manner

## **III. Program Educational Objectives (PEOs)**

The Program Educational Objectives (PEOs) of the ARTIFICIAL INTELLIGENCE AND DATA SCIENCE (AD) represent major accomplishments that the graduates are expected to achieve after three to five years of graduation.

**PEO1:** Acquire the expertise in artificial intelligence and data science essential for real-time problems

**PEO2:** Have the abilities to establish teams, exhibit leadership traits, and uphold moral principles that are crucial for operating ethically and professionally

**PEO3:** Develop the necessary competencies to become entrepreneurs, data scientists, and business owners in the field of artificial intelligence and data science

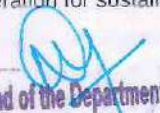
**PEO4:** Continue to learn technological advancements through higher studies and research

## **IV. Program Outcomes (POs)**

Graduates of the ARTIFICIAL INTELLIGENCE AND DATA SCIENCE will be able to

**PO1:** Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems

**PO2:** Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development (WK1 to WK4)

  
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- PO3:** Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required (WK5)
- PO4:** Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions (WK8)
- PO5:** Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems (WK2 and WK6)
- PO6:** The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment (WK1, WK5, and WK7)
- PO7:** Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws (WK9)
- PO8:** Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams
- PO9:** Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10:** Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments
- PO11:** Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change (WK8)

#### Knowledge and Attitude Profile (WK)

- WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences
- WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline
- WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
- WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
- WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area
- WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
- WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development
- WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues
- WK9:** Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes

**V. Program Specific Outcomes (PSOs)**

Graduates of the ARTIFICIAL INTELLIGENCE AND DATA SCIENCE will be able to

**PSO1:** Integrate the foundations of mathematical, analytical, programming and domain knowledge to build AI enabled systems for solving real world problems

**PSO2:** Acquire skills to model the Data Science assisted systems and to analyse the data to solve business related problem

**VI. PEO / PO Mapping**

Following three levels of correlation should be used:

- 1: Low
- 2: Medium
- 3: High

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| PEO 1      | 3   | 3   | 3   | 3   | 3   | 2   | 2   | 1   | 1   | -    | 3    | 2    | 3    |
| PEO 2      | 2   | 2   | 2   | 1   | 2   | 3   | 3   | 3   | 3   | 3    | 3    | 2    | 3    |
| PEO 3      | 3   | 3   | 3   | 2   | 2   | 3   | 2   | 3   | 3   | 3    | 3    | 2    | 3    |
| PEO 4      | 2   | 2   | 2   | 2   | 1   | 2   | 2   | 2   | 2   | 1    | 3    | 2    | 3    |

**VII. Mapping of Course Outcomes (COs) with Program Outcomes (POs)**

| Sem | Course Title                                | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|-----|---------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| I   | Professional Communication - I              | -   | -   | -   | -   | -   | -   | -   | ✓   | ✓   | -    | ✓    | -    | -    |
|     | Multivariable Calculus and Applications     | ✓   | ✓   | -   | -   | -   | -   | -   | -   | -   | -    | ✓    | -    | -    |
|     | Physics for Data Storage and Computing      | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -   | -    | -    | ✓    | -    |
|     | Engineering Chemistry                       | ✓   | ✓   | ✓   | -   | ✓   | -   | -   | ✓   | ✓   | -    | ✓    | -    | -    |
|     | C Programming                               | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Essentials of Computing                     | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | C Programming Laboratory                    | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | -    | ✓    | -    |
|     | Induction Program                           |     |     |     |     |     |     |     |     |     |      | ✓    | ✓    | -    |
|     | Universal Human Values                      | -   | -   | -   | -   | -   | ✓   | ✓   | ✓   | -   | -    | ✓    | -    | -    |
|     | தமிழர் மரபு / Heritage of Tamils            | -   | -   | -   | -   | -   | -   | ✓   | ✓   | -   | ✓    | -    | -    | -    |
|     | Design Thinking                             | ✓   | ✓   | ✓   | -   | -   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |
| II  | Professional Skill Development - I          | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |
|     | Professional Communication - II             | -   | -   | -   | -   | -   | -   | ✓   | ✓   | -   | ✓    | -    | -    | -    |
|     | Linear Algebra and Number Theory            | ✓   | ✓   | -   | -   | ✓   | -   | -   | -   | ✓   | -    | ✓    | ✓    | -    |
|     | Engineering Physics                         | ✓   | ✓   | ✓   | -   | ✓   | -   | -   | ✓   | ✓   | -    | -    | -    | -    |
|     | Python Programming                          | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Data Science                                | ✓   | ✓   | ✓   | ✓   | -   | -   | ✓   | -   | -   | -    | -    | ✓    | -    |
|     | Linux and Shell Scripting                   | ✓   | ✓   | ✓   | -   | ✓   | -   | -   | ✓   | -   | -    | -    | -    | ✓    |
|     | Makerspace                                  | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |
|     | Python Programming Laboratory               | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Environmental Governance and Sustainability | ✓   | ✓   | -   | -   | -   | ✓   | ✓   | -   | ✓   | -    | ✓    | -    | -    |

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| Sem | Course Title                                               | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|-----|------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|     | தமிழரும் தொழில்நுட்பமும் / Tamils and Technology           | -   | -   | -   | -   | -   | -   | ✓   | ✓   | -   | ✓    | -    | -    | -    |
|     | Professional Skill Development - II                        | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |
| III | Probability and Statistical Modeling for Computing Systems | ✓   | ✓   | -   | -   | ✓   | -   | -   | -   | -   | -    | -    | ✓    | -    |
|     | Digital Principles and Computer Organization               | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Artificial Intelligence                                    | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | -    | ✓    | ✓    |
|     | Data Structures and Algorithms                             | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -    | -    | ✓    | -    |
|     | Data Exploration and Visualization                         | ✓   | ✓   | ✓   | ✓   | ✓   | -   | ✓   | -   | ✓   | ✓    | ✓    | ✓    | ✓    |
|     | Object Oriented Programming Using Java                     | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Artificial Intelligence Laboratory                         | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -    | -    | -    | ✓    |
|     | Object Oriented Programming Using Java Laboratory          | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Essence of Indian Traditional Knowledge                    | -   | ✓   | -   | ✓   | -   | -   | ✓   | -   | -   | -    | -    | -    | -    |
|     | Professional Skill Development - III                       | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |
| IV  | Discrete Mathematics                                       | ✓   | ✓   | -   | -   | -   | -   | -   | -   | -   | -    | -    | ✓    | -    |
|     | Machine Learning Essentials                                | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -    | ✓    | -    | ✓    |
|     | Database Management Systems                                | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Image Processing and Visual Analytics                      | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Operating Systems                                          | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | -   | -   | -    | ✓    | ✓    | -    |
|     | Database Management Systems Laboratory                     | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -   | ✓   | ✓    | ✓    | ✓    | -    |
|     | Machine Learning Laboratory                                | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | -   | -   | -    | ✓    | -    | ✓    |
|     | Indian Constitution                                        | -   | -   | -   | -   | -   | ✓   | ✓   | ✓   | -   | -    | -    | -    | -    |
|     | Professional Skill Development - IV                        | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓    | ✓    | -    | -    |

  
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## ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Regulations 2025

For the students admitted from 2025 onwards

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR I - VIII SEMESTERS

## SEMESTER I

| No                                                                             | Course Code | Title                                   | Category | Type          | L | T | P | J | C  |
|--------------------------------------------------------------------------------|-------------|-----------------------------------------|----------|---------------|---|---|---|---|----|
| 1                                                                              | U25REN101   | Professional Communication - I          | HSMC     | TwL           | 2 | - | 2 | - | 3  |
| 2                                                                              | U25RMA101   | Multivariable Calculus and Applications | BSC      | T             | 3 | 1 | - | - | 4  |
| 3                                                                              | U25RPH02    | Physics for Data Storage and Computing  | BSC      | T             | 2 | - | - | - | 2  |
| 4                                                                              | U25RCY01    | Engineering Chemistry                   | BSC      | TwL           | 2 | - | 2 | - | 3  |
| 5                                                                              | U25RCSG01   | C Programming                           | ESC      | T             | 3 | - | - | - | 3  |
| 6                                                                              | U25RCSG02   | Essentials of Computing                 | PCC      | T             | 2 | - | - | - | 2  |
| 7                                                                              | U25RCSG03   | C Programming Laboratory                | ESC      | L             | - | - | 2 | - | 1  |
| Total                                                                          |             |                                         |          |               |   |   |   |   | 18 |
| MANDATORY CREDIT COURSES (MCC - Non CGPA) / MANDATORY NON-CREDIT COURSES (MNC) |             |                                         |          |               |   |   |   |   |    |
| 8                                                                              | U25RMNC01   | Induction Program                       | MNC      | MNC           | - | - | - | - | -  |
| 9                                                                              | U25RMCC01   | Universal Human Values                  | MCC      | MCC           | 3 | - | - | - | 3  |
| 10                                                                             | U25RMCC02   | தமிழர் மரபு / Heritage of Tamils        | MCC      | Tamil Courses | 1 | - | - | - | 1  |
| 11                                                                             | U25RMCC03   | Design Thinking                         | MCC      | MCC           | 1 | - | 2 | - | 2  |
| 12                                                                             | U25RMCC06   | Professional Skill Development - I      | MCC      | MCC           | - | - | - | - | 1  |
| Total                                                                          |             |                                         |          |               |   |   |   |   | 7  |

## SEMESTER II

| No                                                                             | Course Code | Title                                            | Category | Type          | L | T | P | J | C  |
|--------------------------------------------------------------------------------|-------------|--------------------------------------------------|----------|---------------|---|---|---|---|----|
| 1                                                                              | U25REN201   | Professional Communication - II                  | HSMC     | TwL           | 2 | - | 2 | - | 3  |
| 2                                                                              | U25RMA201   | Linear Algebra and Number Theory                 | BSC      | TwL           | 3 | - | 2 | - | 4  |
| 3                                                                              | U25RPH01    | Engineering Physics                              | BSC      | TwL           | 2 | - | 2 | - | 3  |
| 4                                                                              | U25RCSG04   | Python Programming                               | ESC      | T             | 3 | - | - | - | 3  |
| 5                                                                              | U25RAD201   | Data Science                                     | PCC      | TwL           | 3 | - | 2 | - | 4  |
| 6                                                                              | U25RCSG05   | Linux and Shell Scripting                        | PCC      | TwL           | 1 | - | 2 | - | 2  |
| 7                                                                              | U25RGE01    | Makerspace                                       | ESC      | L             | - | - | 4 | - | 2  |
| 8                                                                              | U25RCSG06   | Python Programming Laboratory                    | ESC      | L             | - | - | 2 | - | 1  |
| Total                                                                          |             |                                                  |          |               |   |   |   |   | 22 |
| MANDATORY CREDIT COURSES (MCC - Non CGPA) / MANDATORY NON-CREDIT COURSES (MNC) |             |                                                  |          |               |   |   |   |   |    |
| 9                                                                              | U25RMCC04   | Environmental Governance and Sustainability      | MCC      | MCC           | 2 | - | - | - | 2  |
| 10                                                                             | U25RMCC05   | தமிழரும் தொழில்நுட்பமும் / Tamils and Technology | MCC      | Tamil Courses | 1 | - | - | - | 1  |

| No    | Course Code | Title                               | Category | Type | L | T | P | J | C |
|-------|-------------|-------------------------------------|----------|------|---|---|---|---|---|
| 11    | U25RMCC07   | Professional Skill Development - II | MCC      | MCC  | - | - | - | - | 1 |
| Total |             |                                     |          |      |   |   |   |   | 4 |

## SEMESTER III

| No                                                                             | Course Code | Title                                                      | Category | Type | L | T | P | J | C  |
|--------------------------------------------------------------------------------|-------------|------------------------------------------------------------|----------|------|---|---|---|---|----|
| 1                                                                              | U25MA301    | Probability and Statistical Modeling for Computing Systems | BSC      | TwL  | 2 | - | 2 | - | 3  |
| 2                                                                              | U25ADG01    | Digital Principles and Computer Organization               | ESC      | T    | 3 | - | - | - | 3  |
| 3                                                                              | U25AD301    | Artificial Intelligence                                    | PCC      | T    | 3 | - | - | - | 3  |
| 4                                                                              | U25ADG02    | Data Structures and Algorithms                             | PCC      | TwL  | 3 | - | 2 | - | 4  |
| 5                                                                              | U25ADG03    | Data Exploration and Visualization                         | PCC      | TwL  | 2 | - | 2 | - | 3  |
| 6                                                                              | U25CSG11    | Object Oriented Programming Using Java                     | PCC      | T    | 3 | - | - | - | 3  |
| 7                                                                              | U25AD302    | Artificial Intelligence Laboratory                         | PCC      | L    | - | - | 4 | - | 2  |
| 8                                                                              | U25CSG13    | Object Oriented Programming Using Java Laboratory          | PCC      | L    | - | - | 2 | - | 1  |
| Total                                                                          |             |                                                            |          |      |   |   |   |   | 22 |
| MANDATORY CREDIT COURSES (MCC - Non CGPA) / MANDATORY NON-CREDIT COURSES (MNC) |             |                                                            |          |      |   |   |   |   |    |
| 9                                                                              | U25MNC02    | Essence of Indian Traditional Knowledge                    | MNC      | MNC  | 1 | - | - | - | -  |
| 10                                                                             | U25RMCC08   | Professional Skill Development - III                       | MCC      | MCC  | - | - | - | - | 1  |
| Total                                                                          |             |                                                            |          |      |   |   |   |   | 1  |

## SEMESTER IV

| No                                                                             | Course Code | Title                                  | Category | Type | L | T | P | J | C  |
|--------------------------------------------------------------------------------|-------------|----------------------------------------|----------|------|---|---|---|---|----|
| 1                                                                              | U25MA401    | Discrete Mathematics                   | BSC      | T    | 3 | - | - | - | 3  |
| 2                                                                              | U25AMG02    | Machine Learning Essentials            | PCC      | T    | 3 | - | - | - | 3  |
| 3                                                                              | U25CSG16    | Database Management Systems            | PCC      | T    | 3 | - | - | - | 3  |
| 4                                                                              | U25AD401    | Image Processing and Visual Analytics  | PCC      | TwL  | 2 | - | 2 | - | 3  |
| 5                                                                              | U25CSG17    | Operating Systems                      | PCC      | TwL  | 2 | - | 2 | - | 3  |
| 6                                                                              | U25CSG18    | Database Management Systems Laboratory | PCC      | LwP  | - | - | 2 | 2 | 2  |
| 7                                                                              | U25AMG03    | Machine Learning Laboratory            | PCC      | LwP  | - | - | 2 | 2 | 2  |
| 8                                                                              | -           | Open Elective I                        | OEC      | T    | 3 | - | - | - | 3  |
| Total                                                                          |             |                                        |          |      |   |   |   |   | 22 |
| MANDATORY CREDIT COURSES (MCC - Non CGPA) / MANDATORY NON-CREDIT COURSES (MNC) |             |                                        |          |      |   |   |   |   |    |
| 9                                                                              | U25MNC03    | Indian Constitution                    | MNC      | MNC  | 1 | - | - | - | -  |
| 10                                                                             | U25RMCC09   | Professional Skill Development - IV    | MCC      | MCC  | - | - | - | - | 1  |
| Total                                                                          |             |                                        |          |      |   |   |   |   | 1  |

T - Theory, L - Laboratory, TwL - Theory with Laboratory, TwP - Theory with Project

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## SEMESTER I

| U25REN101 | Professional Communication - I<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: HSMC |   |   |   |   |
|-----------|------------------------------------------------------------------------------------------------------|----------------|---|---|---|---|
|           |                                                                                                      | L              | T | P | J | C |
|           |                                                                                                      | 2              | 0 | 2 | 0 | 3 |

## COURSE OBJECTIVES:

- To develop professional communication skills for academic, technical and workplace environments
- To enhance the listening skills and facilitate effective pronunciation
- To enable students to communicate confidently in individual and team-based situations

## COURSE OUTCOMES:

|                                                                                                   |            |
|---------------------------------------------------------------------------------------------------|------------|
| CO 1: Use appropriate vocabulary and grammatical structures in professional communication         | Understand |
| CO 2: Communicate confidently in academic, social and workplace situations                        | Apply      |
| CO 3: Develop reading and writing skills for technical and professional purposes                  | Apply      |
| CO 4: Infer and present information using appropriate communication strategies                    | Analyze    |
| CO 5: Demonstrate effective listening, presentation, and teamwork skills in professional contexts | Apply      |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 2       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 3       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 4       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 5       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |

## SYLLABUS:

## UNIT I: FOUNDATIONS OF PROFESSIONAL COMMUNICATION

6 + 6

Verbal, Non-verbal and Digital Communication - Word chain - Professional Etiquette - Self-Introduction and Elevator Pitch - Growth Mindset and Workplace Communication - Cross-cultural Communication - Professional Terminology - AI-assisted Communication Tools

## UNIT II: PROFESSIONAL READING AND WRITING

6 + 6

Reading Technical Articles - Error correction - Manuals and SOPs - Infographics and Data - Email Etiquette - Email Writing - AI-assisted Writing Tools - Ethical Use of AI - Verbal Analogy

## UNIT III: LISTENING AND INTERPERSONAL COMMUNICATION

6 + 6

Listening Barriers - Note-taking Techniques - Listening for Problem Solving - Team Communication - Conflict Resolution - Workplace Discussions - Idioms and Phrases



**UNIT IV: DIGITAL COMMUNICATION AND PRESENTATION SKILLS**

6 + 6

Storytelling Techniques - Discourse markers, linkers and cohesive devices - Data Presentation - Presentation Anxiety Management - Digital Presentation Platforms - Branding - Commonly Confused Words

**UNIT V: EMPLOYABILITY AND PROFESSIONALISM**

6 + 6

Prefixes, Suffixes and Root Words - LinkedIn Profile - Interview Skills - Group Discussion Strategies - Art of Persuasion - Entrepreneurial Communication - AI in Future Workplace

**LIST OF EXPERIMENTS**

1. Self-Introduction
2. Group Presentation
3. Listening to TED Talks
4. Listening to Documentaries
5. Digital Profiling

**CONTACT PERIODS:**

**Lecture:** 30 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Ashraf Rizvi, Effective Technical Communication, 3rd Edition, McGraw-Hill Education, 2023
2. Meenakshi Raman & Sangeeta Sharma, Technical Communication: Principles and Practice, 4th Edition, Oxford University Press, 2022
3. Sanjay Kumar & Pushp Lata, Communication Skills, 3rd Edition, Oxford University Press, New Delhi, 2018

**REFERENCES:**

1. Stephen E. Lucas, The Art of Public Speaking, 14th Edition, McGraw Hill Education, New York, 2023
2. Dale Carnegie, The Quick and Easy Way to Effective Speaking, Updated Edition, Simon & Schuster, New York, 2019
3. Matt Abrahams, Think Faster, Talk Smarter: How to Speak Successfully When You're Put on the Spot, Simon & Schuster, New York, 2024

  
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## SEMESTER I

| U25RMA101 | Multivariable Calculus and Applications<br>(Common to all programmes) | Category: BSC |   |   |   |   |
|-----------|-----------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                       | L             | T | P | J | C |
|           |                                                                       | 3             | 1 | 0 | 0 | 4 |

## COURSE OBJECTIVES:

- To provide a comprehensive knowledge of multivariable calculus, including, partial derivatives integral calculus, and vector calculus
- For constructing more convenient for students to apply their calculus knowledge to their various fields of study
- To develop skills in solving first and second order linear differential equations for engineering applications

## COURSE OUTCOMES:

- CO 1: Explain the concepts of multivariable differential calculus, estimate the extreme values and Taylor's Understand formula of two variable functions
- CO 2: Apply integral calculus to evaluate double integrals over various regions and compute area and volume using double integration Apply
- CO 3: Apply vector calculus to compute directional derivative, divergence, curl, Green's, Stokes' and Gauss divergence theorems Apply
- CO 4: Solve first order ordinary differential equations, model physical phenomena, determine appropriate methods for solving them, and interpret the results Apply
- CO 5: Formulate second-order differential equations, solve the equations, and interpret the solutions for physical models Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 2       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 3       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 4       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |
| CO 5       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | -    |

## SYLLABUS:

## UNIT I: DIFFERENTIAL CALCULUS

9 + 3

Functions of two variables – Partial derivatives – Total derivatives – Taylor's formula for functions of two variables – Extreme Values

## UNIT II: INTEGRAL CALCULUS

9 + 3

UNIT II Double integrals – Over rectangles – Over general regions – Fubini's theorem (statement only), Area and Volume by double integration – Reversing the order of integration



9 + 3

**UNIT III: VECTOR CALCULUS**

Differentiation in vector field – Gradient of a scalar field – Directional derivative – Divergence of a vector field – Curl of a vector field – Integration in vector field – Line integrals – Work– circulation and flux – Path independence – Conservative fields – Green's – Gauss divergence and Stoke's theorems

9 + 3

**UNIT IV: FIRST ORDER LINEAR ORDINARY DIFFERENTIAL EQUATIONS**

Basic concepts of ordinary differential equations – Separable and exact differential equations – Integrating factors and first-order linear differential equations – Mathematical modelling of real-world problems

9 + 3

**UNIT V: SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS**

Homogeneous linear equations of second order – linearity principle – second order homogeneous equations with constant coefficients – Euler–Cauchy equation – Non-homogeneous linear second order-solution by variation of parameters

**CONTACT PERIODS:**

|                            |                             |                             |                           |                          |
|----------------------------|-----------------------------|-----------------------------|---------------------------|--------------------------|
| <b>Lecture:</b> 45 Periods | <b>Tutorial:</b> 15 Periods | <b>Practical:</b> - Periods | <b>Project:</b> - Periods | <b>Total:</b> 60 Periods |
|----------------------------|-----------------------------|-----------------------------|---------------------------|--------------------------|

**TEXTBOOKS:**

1. Thomas G. B. and Finney R. L., "Calculus and Analytic Geometry", Pearson Education, New Delhi, 2012
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Pvt Ltd, New Delhi, 2012

**REFERENCES:**

1. Wylie C. R. and Barrett L. C., "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2013
2. Peter V.O Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2010
3. Michael D. G, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013
4. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017



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## SEMESTER I

| U25RPH02 | Physics for Data Storage and Computing<br>(Common to AD, AM, CB, CS, IT, SC) | Category: BSC |   |   |   |   |
|----------|------------------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                              | L             | T | P | J | C |
|          |                                                                              | 2             | 0 | 0 | 0 | 2 |

## COURSE OBJECTIVES:

- To understand the concepts of optical and optoelectronic materials and device applications
- To examine the principles and applications of magnetic and nano devices
- To understand the principles of quantum mechanics for computing and electronic circuits and to analyze next generation quantum electronics

## COURSE OUTCOMES:

- CO 1: Explain the properties and applications of optical materials, optical devices, and optical data storage systems Understand
- CO 2: Describe the behavior of magnetic materials and the working of magnetic storage devices and sensors Understand
- CO 3: Apply the principles of quantum confinement, tunneling, and single electron phenomena in nanodevices Apply
- CO 4: Explain the concepts of quantum computing, qubits, and Bloch sphere representation Understand
- CO 5: Apply the operation of quantum gates, quantum circuits, and quantum devices in quantum computing systems Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| CO 2       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| CO 3       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| CO 4       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| CO 5       | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    |

## SYLLABUS:

## UNIT I: OPTICAL MATERIALS AND DEVICES

6

Classification of optical materials – Carrier generations and recombination process – Absorption, emission and scattering of light in solids – Photodiode – Solar cell – OLED – Optical data storage techniques – Blue ray disc

## UNIT II: MAGNETIC MATERIALS AND DATA STORAGE

6

Origin of magnetic materials – Classification of magnetic materials – Ferromagnetic theory – Hysteresis – Magnetic memory devices – Magnetic tape – GMR Sensor – Magnetic bubble memories – Magstripe

## UNIT III: NANODEVICES

6

Introduction – Quantum confinement – Quantum structures: quantum wells, wires and dots – Band gap of nanomaterials – Tunneling – Single electron phenomena: Coulomb blockade – Single electron transistor – Resonant tunneling diode – Quantum cellular automata



#### UNIT IV: QUANTUM COMPUTING

6

Introduction to Quantum Computing – Moore's law and its limitations – Differences between Classical and Quantum computing – Concept of qubit and its properties – Representation of qubit by Bloch sphere – Single and Two qubits

#### UNIT V: QUANTUM CIRCUITS

6

Quantum devices – Qubit Gates, Single Qubit Gates: Quantum NOT Gate – Pauli – X, Y and Z Gates – Hadamard Gate – Phase Gate (or S Gate), T Gate – Multiple Qubit Gates (qualitative) – Quantum Chips

#### CONTACT PERIODS:

|                            |                            |                             |                           |                          |
|----------------------------|----------------------------|-----------------------------|---------------------------|--------------------------|
| <b>Lecture:</b> 30 Periods | <b>Tutorial:</b> - Periods | <b>Practical:</b> - Periods | <b>Project:</b> - Periods | <b>Total:</b> 30 Periods |
|----------------------------|----------------------------|-----------------------------|---------------------------|--------------------------|

#### TEXTBOOKS:

1. S O Pillai, "Solid State Physics", New Age International Private Limited, 8th Edition, 2018
2. Vishal Sahani "Quantum Computing", McGraw Hill Education, 2007

#### REFERENCES:

1. M.N. Avadhanulu, P.G. Kshirsagar, and T.V.S. Arun Murthy, "A Textbook of Engineering Physics", 11th edition, S. Chand Publishing, New Delhi, 2022
2. Quantum Computing – A Beginner's Introduction, Parag K Lala, Indian Edition, Mc GrawHill, Reprint 2020
3. [https://onlinecourses.nptel.ac.in/noc21\\_cs103/preview](https://onlinecourses.nptel.ac.in/noc21_cs103/preview)



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## SEMESTER I &amp; II

| U25RCY01 | Engineering Chemistry<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: BSC |   |   |   |   |
|----------|---------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                                             | L             | T | P | J | C |
|          |                                                                                             | 2             | 0 | 2 | 0 | 3 |

## COURSE OBJECTIVES:

- To introduce the fundamentals, properties, industrial applications of polymeric materials and advanced energy storage devices
- To impart knowledge about corrosion prevention, surface treatment methods and nanomaterials
- To provide a basic understanding of semiconductor materials, microelectronics, quantum, computational chemistry and their applications

## COURSE OUTCOMES:

- CO 1: Apply the concepts of polymer materials and their properties in solving industrial and technological challenges Apply
- CO 2: Interpret the performance of batteries, solar cells, and supercapacitors for their effective energy storage applications Apply
- CO 3: Utilize suitable corrosion prevention methods, surface treatment techniques and nanomaterials for industrial requirements Apply
- CO 4: Apply suitable semiconductor materials, microfabrication processes and display technologies for specific applications Apply
- CO 5: Utilize quantum chemistry principles and AI-assisted techniques to model, visualize, and predict material properties Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | 1    | -    | -    |
| CO 2       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | 1    | -    | -    |
| CO 3       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | 1    | -    | -    |
| CO 4       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | 1    | -    | -    |
| CO 5       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | 1    | -    | -    |

## SYLLABUS:

## UNIT I: POLYMERIC MATERIALS

6 + 6

Polymers – Introduction – Compounding – Compression, Injection – Smart Polymers – Temperature responsive (PNIPAM), pH responsive (PAA), Light responsive (Azobenzene), 3D Printable (PLA), flexible and wearable polymers (PDMS – E-skin, RFID) – Conductive Polymers (PEDOT) – Synthesis, working and applications – Biopolymers – Classification, PEG, Alginate Hydrogel – Synthesis and applications



**UNIT II: ENERGY CONVERSION AND STORAGE**

6 + 6

Batteries – Classification,  $\text{LiFePO}_4$  – Construction, working and applications – Fuel Cells – Proton Exchange Membrane( PEM), Solid Oxide Fuel Cells (SOFC) – Green Hydrogen – Classification, production method, electrolysis – Organic photovoltaics – P3HT and PCBM – Working and applications – Solar Cells – Dye-Sensitized Solar Cells (DSSC), Supercapacitors – Electrostatic Double Layer– Working and application

**UNIT III: CORROSION AND NANO SCIENCE**

6 + 6

Types of corrosion – Factors influencing corrosion – Cathodic protection, Coatings – Galvanization, Epoxy, Polyurethane, Enamel, Superhydrophobic coatings – Process and applications. Surface treatments – Carburizing, Nitriding, Cyaniding – Process and applications. Nanomaterials – Introduction, 0D (Quantum dots), 1D (nanowire, nanorods and carbon nanotubes) 2D nanomaterials ( $\text{MoS}_2$ ), Size effects and quantum confinement, Synthesis – Laser ablation and Chemical Vapour Deposition (CVD), Various applications of nanomaterials

**UNIT IV: SEMICONDUCTOR AND DISPLAY TECHNOLOGY**

6 + 6

Semiconductors – Perfluoropentacene, GaN – Characteristics and applications, Neuromorphic Materials – Phase-Change Memory and Memristors – Working and applications – Liquid Crystal Displays, OLED, QLED – Working and applications – Wafer Manufacturing – Purification – Czochralski and Float Zone methods – Photolithography and microfabrication

**UNIT V: QUANTUM AND COMPUTATIONAL CHEMISTRY**

6 + 6

Quantum Chemistry – Basics, quantum numbers, shapes of atomic orbitals, Molecular Orbital Theory – ( $\text{H}_2$ ,  $\text{O}_2$ ,  $\text{N}_2$ ), Schrödinger equation (Derivation) – Qubits and Quantum Memory, Computational Chemistry – Molecular modeling – Basic Computational Methods – Software tools – iGemdock, Chem draw, Molview, Jmol – Introduction to AI and its role in the field of Chemistry

**LIST OF EXPERIMENTS**

1. Estimate the viscosity of a given polymer solution using an Ostwald viscometer and determine molecular weight of the given polymer
2. Synthesis of a polymer (Bakelite / polyaniline (PANI) and assess the physical properties of the polymer
3. Potentiometric determination and comparative study of EMF in different solutions
4. Determine maximum wavelength of absorption of a given solution to verify Beer's Law and to find unknown concentration of the given sample by Spectrophotometry / Colorimetry
5. Determination of corrosion rate of Iron and its prevention by electroplating / electroless plating
6. Synthesis of  $\text{ZnO}$  /  $\text{TiO}_2$  / Ag nanoparticles and study of their photocatalytic degradation of Methylene Blue dye
7. Recovery of Copper from waste Printed Circuit Boards (PCBs) and quantitative determination of copper content
8. Measurement of electrical conductivity of solutions using a conductometric Sensor
9. Perform molecular docking using freely available online software to investigate the binding affinity a ligand with the protein
10. Construct the 2D structure of a given compound and generate its 3D molecular model using computational tools for visualization and structural analysis

**CONTACT PERIODS:**

Lecture: 30 Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 60 Periods

**TEXTBOOKS:**

1. Wiley India Pvt. Ltd., "Engineering Chemistry", 2nd edition, Wiley India Pvt. Ltd., New Delhi, 2013
2. S.S. Dara and S.S. Umare, "A Textbook of Engineering Chemistry", 12th edition, Chand Publishing, New Delhi, 2024

3. R.V. Gadag and A. Nityananda Shetty, "Engineering Chemistry", 3rd edition, I.K. International Publishing House, New Delhi, 2014

**REFERENCES:**

1. Fred W Billmeyer, "Textbook of Polymer Science", 4th edition, John Wiley & Sons, New York, 1999
2. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons, "Biomaterials Science: An Introduction to Materials in Medicine", 4th edition, Academic Press, London, 2020
3. Kirby W Beard, Linden's "Handbook of Batteries", 5th edition, McGraw Hill, New York, 2019
4. John Larminie and Andrew Dicks, "Fuel Cell Systems Explained", 3rd edition, John Wiley & Sons, Chichester, 2012
5. Fontana M. G., "Corrosion Engineering", 3rd edition, McGraw-Hill Book Company, New York, 1986
6. V. Raghavan, "Materials Science and Engineering: A First Course", 6th edition, Prentice Hall of India, New Delhi, 2015
7. M.F. Ashby and D.R.H. Jones, "Engineering Materials" 2: An Introduction to Microstructures, Processing and Design, 4th edition, Elsevier, UK, 2012
8. Ira N Levine, "Quantum Chemistry", 7th edition, Pearson, Boston, 2013



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## SEMESTER I

| U25RCSG01 | C Programming<br>(Common to all programmes) | Category: ESC |   |   |   |   |
|-----------|---------------------------------------------|---------------|---|---|---|---|
|           |                                             | L             | T | P | J | C |
|           |                                             | 3             | 0 | 0 | 0 | 3 |

## COURSE OBJECTIVES:

- To enable students to understand the fundamentals of problem-solving and C programming, including algorithms, flowcharts, pseudocode, and the structure of a C program
- To develop programming skills using input/output operations, control structures, arrays, strings, functions, pointers, and dynamic memory allocation
- To introduce user-defined data types such as structures and unions for handling complex data effectively
- To familiarize students with file handling concepts and develop C-based solutions for real-world applications

## COURSE OUTCOMES:

- CO 1:** Explain fundamental programming concepts, problem-solving techniques, and the basic structure of C Understand programs
- CO 2:** Develop C programs using input/output functions, operators, decision-making, and iterative control structures Apply
- CO 3:** Implement arrays and string handling concepts to solve data processing and real-world applications Apply
- CO 4:** Develop modular and efficient programs using functions, recursion, pointers, and dynamic memory allocation techniques Apply
- CO 5:** Apply user-defined data types and file handling operations to manage and process data effectively Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |
| CO 5       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | 2    | 2    | -    |

## SYLLABUS:

## UNIT I: PROBLEM SOLVING APPROACHES AND C PROGRAMMING BASICS

10

Problem Solving Techniques: Problem Statement and Analysis – Problem Modelling – Identifying Input and Output Requirements – Algorithms – Flowcharts – Pseudocode for Solving Basic Scientific and Business Problems. Introduction to C: Characteristics of C – Structure of a C Program – Compiling and Executing C Program – Pre-processor Directives – Tokens – Character Set – Keywords – Identifiers – Constants – Variables – Operators – Data Types – Typecasting – Input/Output Statements in C

**UNIT II: DECISION CONTROL AND LOOPING STATEMENTS**

8

Conditional Statements: if Statement – if-else Statement – Nested if Statements – else-if Ladder – switch Statement. Looping Statements: while Loop – do-while Loop – for Loop – Nested Loops. Jump Statements: break Statement – continue Statement – goto Statement

**UNIT III: ARRAYS AND STRINGS**

9

Arrays: Declaration and Initialization – Accessing and Manipulating Array Elements – One-Dimensional Arrays – Two-Dimensional Arrays – Applications of Arrays. Strings: Declaration and Initialization of Strings – String Handling Functions – String Arrays

**UNIT IV: FUNCTIONS AND POINTERS**

9

Functions: Definition – Function Call – Function Prototype – Return Statement – Types of Functions – Recursive Functions – Command Line Arguments. Pointers: Declaration and Initialization – Pointer Arithmetic – Passing Arguments by Value and by Reference – Pointer to Pointer – Pointers and Arrays. Dynamic Memory Allocation: malloc(), calloc(), realloc(), free()

**UNIT V: USER-DEFINED DATA TYPES AND FILE MANAGEMENT**

9

Structures: Declaration and Initialization – Accessing Structure Members – Arrays of Structures – Nested Structures – Pointer to Structures. Unions – Storage Classes. Files: File Access Methods – File Modes – File Operations – File Pointers – Binary File Operations

**CONTACT PERIODS:**

Lecture: 45 Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 45 Periods

**TEXTBOOKS:**

1. Reema Thareja, "Computer Fundamentals and Programming in C", 3rd Edition, Oxford University Press, 2023
2. Brian W. Kernighan and Dennis Ritchie, "The C Programming Language", 2nd Edition, Pearson, 2015

**REFERENCES:**

1. Paolo Ferragina and Fabrizio Luccio, "Computational Thinking First Algorithms", Then Code", 1st Edition, Springer International Publishing, 2018
2. Paul Deitel and Harvey Deitel, "C How to Program", 7th Edition, Pearson Publication
3. Juneja, B. L and Anita Seth, "Programming in C", 1st Edition, Cengage Learning India Pvt. Ltd., 2011
4. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", 1st Edition, Oxford University Press, 2009

  
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## SEMESTER I

| U25RCSG02 | Essentials of Computing<br>(Common to AD, AM, CB, CS, IT, SC) | Category: PCC |   |   |   |   |
|-----------|---------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                               | L             | T | P | J | C |
|           |                                                               | 2             | 0 | 0 | 0 | 2 |

## COURSE OBJECTIVES:

- To introduce the fundamentals of computing systems, computer organization, digital information representation, and operating systems
- To develop computational thinking and problem-solving skills using decomposition, abstraction, algorithms, flowcharts, and pseudocode
- To familiarize students with programming fundamentals, software development processes, programming environments, and language translation tools
- To provide an understanding of emerging computing technologies and their applications in solving real-world problems

## COURSE OUTCOMES:

- CO 1:** Describe the fundamentals of computing systems, computer organization, memory, processors, operating systems, and emerging computing technologies **Understand**
- CO 2:** Apply computational thinking and problem-solving techniques using decomposition, abstraction, algorithms, flowcharts, pseudocode, variables, and operators **Apply**
- CO 3:** Explain programming environments, software development processes, language translation tools, and visual programming concepts **Understand**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 2       | 2   | 3   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 3       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |

## SYLLABUS:

## UNIT I: COMPUTING FUNDAMENTALS

10

Introduction to Computing: Characteristics and Applications of Computers – Classification of Computers – Evolution of Computers – Basic Organization of a Computer – CPU, Memory and Storage Devices – Input and Output Devices – Operating Systems and their Functions. Computer Architecture and Emerging Technologies: Computer Memory and Processors – Basic Processor Architecture – Pipelining and Parallel Processing – Types of Processors – Emerging Trends in Computing: Artificial Intelligence, Quantum Computing and Quantum Communication

## UNIT II: COMPUTATIONAL THINKING AND DIGITAL REPRESENTATION

10

Computational Thinking: Decomposition – Pattern Recognition – Abstraction – Algorithmic Thinking – Real-World Applications of Computational Thinking. Digital Representation of Information: Data Representation in Computers – ASCII and Unicode – Number Systems: Binary, Decimal and Hexadecimal – Binary Arithmetic Basics – Sequential and Parallel Processing Concepts – Computational Thinking Case Studies

**UNIT III: PROGRAMMING ENVIRONMENTS AND SOFTWARE DEVELOPMENT**

10

Programming Languages and Software: Generations of Programming Languages – Classification of Programming Languages – Computer Software: System Software and Application Software – Open-Source and Proprietary Software. Language Translators and Development Tools: Compiler – Interpreter – Assembler – Linker – Loader – Overview of Software Development Process, Tools and Techniques. Visual Programming: Introduction to Visual Programming using Scratch/Turtle Environment – Developing Simple Programs using Blocks and Graphics

**CONTACT PERIODS:**

Lecture: 30 Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 30 Periods

**TEXTBOOKS:**

1. Reema Thareja, "Fundamentals of Computers", Oxford University Press, 2020
2. David D. Riley and Kenny A. Hunt, "Computational Thinking for the Modern Problem Solver", 1st Edition, CRC Press, 2014
3. J. Glenn Brookshear and Dennis Brylow, "Computer Science: An Overview", 12th Edition, Pearson, 2015

**REFERENCES:**

1. V. Rajaraman and Neeharika Adabala, "Fundamentals of Computers", PHI Learning, 2014
2. Majed Marji, "Learn to Program with Scratch: A Visual Introduction to Programming with Games, Art, Science and Math", 1st Edition, No Starch Press, 2014
3. G. Venkatesh and M. Mukund, "Computational Thinking", 1st Edition, Notion Press, 2021
4. Chris Bernhardt, "Quantum Computing for Everyone", 1st Edition, MIT Press, 2019

  
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## SEMESTER I

| U25RCSG03 | C Programming Laboratory<br>(Common to all programmes) | Category: ESC |   |   |   |   |
|-----------|--------------------------------------------------------|---------------|---|---|---|---|
|           |                                                        | L             | T | P | J | C |
|           |                                                        | 0             | 0 | 2 | 0 | 1 |

## COURSE OBJECTIVES:

- To provide hands-on experience in problem solving and structured programming using the C programming language
- To develop programming skills using control structures, arrays, strings, functions, pointers, and dynamic memory management techniques
- To enable students to design and implement applications using user-defined data types and file handling concepts for real-world problems

## COURSE OUTCOMES:

- CO 1: Demonstrate problem-solving techniques, algorithms, flowcharts, and basic C programming constructs in program development Apply
- CO 2: Develop C programs using input/output operations, decision-making statements, and iterative constructs Apply
- CO 3: Demonstrate the use of arrays and strings for data processing and manipulation Apply
- CO 4: Develop modular applications using functions, recursion, pointers, and dynamic memory management techniques Apply
- CO 5: Develop applications using structures, unions, storage classes, and file handling operations for data management Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 2       | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 3       | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 4       | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 5       | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |

## LIST OF EXPERIMENTS

1. Design and implementation of algorithms, flowcharts, and pseudo code for basic problem-solving applications
2. Development of C programs demonstrating data types, operators, and formatted input/output operations
3. Implementation of decision-making applications using conditional statements and switch-case constructs
4. Development of iterative applications using looping and loop control statements
5. Design and implementation of console-based applications for real-world mathematical and logical problem solving
6. Implementation of one-dimensional array operations for searching, sorting, and statistical analysis
7. Development of matrix manipulation applications using two-dimensional arrays
8. Design and implementation of string processing applications using standard string handling functions
9. Development of modular applications using user-defined functions and recursive techniques
10. Implementation of applications demonstrating parameter passing mechanisms using call by value and call by reference
11. Development of applications using pointers, pointer arithmetic, and array-pointer relationships

12. Implementation of dynamic memory management applications using malloc(), calloc(), realloc(), and free()
13. Design and implementation of applications using structures, nested structures, unions, and storage classes
14. Development of file processing applications using text and binary file operations in C
15. Implementation of command-line and console-based applications integrating functions, pointers, structures, and file management concepts for real-world use cases

**CONTACT PERIODS:**

Lecture: - Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 30 Periods

**REFERENCES:**

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson Education, 2015
2. Reema Thareja, "Computer Fundamentals and Programming in C", 3rd Edition, Oxford University Press, 2023
3. Yashavant Kanetkar, "Let Us C", 17th Edition, BPB Publications, 2023
4. Byron Gottfried, "Programming with C", 4th Edition, Schaum's Outline Series, McGraw Hill Education

  
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## SEMESTER I

| U25RMNC01 | Induction Program<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: MNC |   |   |   |   |
|-----------|-----------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                         | L             | T | P | J | C |
|           |                                                                                         | 3 Weeks       |   |   |   |   |
|           |                                                                                         |               |   |   |   | 0 |

## GUIDELINES:

Students come with diverse thoughts, backgrounds and preparations. It is important to assist them adjust in the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Keeping the above thought in mind AICTE proposes a 3-week induction program for the UG students entering the institution before the commencement of normal classes which will start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, set a healthy daily routine, create bonding in the batch as well as between faculty, develop awareness, sensitivity and understanding of the self, society at large, and nature. The following are the activities under the induction program in which the student should be fully and actively engaged throughout the entire duration of the program.

**Physical Activity:** To inculcate team spirit, competitiveness, group cohesion and bonding as well as physical & mental health, physical activities like team sports, yoga, physical exercises should be conducted daily during early morning & evening. Activities like gardening may also be encouraged.

**Creative Arts:** Every student should choose one skill related to arts /visual arts/ performing arts like painting, sculpture, pottery, music, dance etc. to develop a sense of aesthetics and also to enhance creativity. The student should pursue it daily for the duration of the program.

**Universal Human Values:** Universal Human Values module will help the student to explore oneself and experience the joy of learning, stand up to peer pressure, take decisions with courage, create awareness about the relationship with colleagues and supporting staff in the hostel and department, etc.

**Literary:** Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

**Proficiency Modules:** To establish the command over skills like English, a computer familiarity etc. these modules can be taught earlier so that when norm

## CONTACT PERIODS:

Lecture: - Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 0 Periods

  
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## SEMESTER I

| U25RMCC01 | Universal Human Values<br>(Common to all programmes) | Category: MCC |   |   |   |   |
|-----------|------------------------------------------------------|---------------|---|---|---|---|
|           |                                                      | L             | T | P | J | C |
|           |                                                      | 3             | 0 | 0 | 0 | 3 |

## COURSE OBJECTIVES:

- To understand the significance of universal human values and their role in complementing technical, intellectual, and professional skills for holistic development.
- To apply a holistic perspective in addressing personal, societal, professional, and environmental challenges through ethical and value-based approaches.
- To demonstrate responsible citizenship, professional ethics, mutual respect, and sustainable practices that contribute positively to society, industry, and the environment.

## COURSE OUTCOMES:

- CO 1: Explain the significance of Universal Human Values and self-exploration in developing a holistic Understand perspective, enabling students to harmonize technical competence with ethical responsibility and value-based living.
- CO 2: Differentiate the needs of the Self and the Body, and apply self-exploration to develop healthy habits, Understand value-based decision-making, and holistic well-being.
- CO 3: Explain the concepts of natural acceptance, competence, and respect, and apply them to foster Understand harmonious relationships, resolve social conflicts, promote value education for children, and develop holistic perspectives for societal development.
- CO 4: Demonstrate an understanding of the interconnectedness of existence and integrate holistic perspectives Apply into academic, professional, and societal contexts.
- CO 5: Apply human values and professional knowledge to promote sustainable development, family harmony, Apply societal well-being, and responsible participation in nature.

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | -   | -   | -   | -   | 3   | 3   | -   | -   | -    | 3    | -    | -    |
| CO 2       | -   | -   | -   | -   | -   | 3   | 3   | 3   | -   | -    | 3    | -    | -    |
| CO 3       | -   | -   | -   | -   | -   | 3   | 3   | -   | -   | -    | 3    | -    | -    |
| CO 4       | -   | -   | -   | -   | -   | 3   | 3   | -   | -   | -    | 3    | -    | -    |
| CO 5       | -   | -   | -   | -   | -   | 3   | 3   | 3   | -   | -    | 3    | -    | -    |

## SYLLABUS:

## UNIT I: INTRODUCTION TO VALUE EDUCATION

9

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) – Understanding Value Education – Self-exploration as the Process for Value Education – Continuous Happiness and Prosperity – the Basic Human Aspirations – Happiness and Prosperity: Current Scenario – Method to Fulfil the Basic Human Aspirations. Self-Exploration Activity Topics: Sharing about Oneself – Exploring Human Consciousness

**UNIT II: HARMONY IN THE HUMAN BEING**

9

Understanding Human being as the Co-existence of the Self and the Body – Distinguishing between the Needs of the Self and the Body – The Body as an Instrument of the Self – Understanding Harmony in the Self – Harmony of the Self with the Body – Programme to ensure self-regulation and Health. Self-Exploration Activity Topics: Exploring the difference of Needs of Self and Body – Exploring Sources of Imagination in the Self – Exploring Harmony of Self with the Body

**UNIT III: HARMONY IN THE FAMILY AND SOCIETY**

9

Harmony in the Family – the Basic Unit of Human Interaction – 'Trust': the Foundational Value in Relationship – 'Respect': as the Right Evaluation – Other Feelings, Justice in Human-to-Human Relationship – Understanding Harmony in the Society – Vision for the Universal Human Order. Self-Exploration Activity Topics: Exploring the Feeling of Trust – Exploring the Feeling of Respect – Exploring Systems to fulfil Human Goal

**UNIT IV: HARMONY IN THE NATURE/EXISTENCE**

9

Understanding Harmony in the Nature – Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders – Realizing Existence as Co-existence at All Levels – The Holistic Perception of Harmony in Existence. Self-Exploration Activity Topics: Exploring the Four Orders of Nature – Exploring Co-existence in Existence

**UNIT V: HARMONY ON PROFESSIONAL ETHICS : HOLISTIC UNDERSTANDING**

9

Natural Acceptance of Human Values – Definitiveness of (Ethical) Human Conduct – A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order – Competence in Professional Ethics – Holistic Technologies, Production Systems and Management Models: Typical Case Studies – Strategies for Transition towards Value-based Life and Profession. Self-Exploration Activity Topics: Exploring Natural Acceptance – Exploring Ethical Human Conduct – Exploring Humanistic Models in Education – Exploring Steps of Transition towards Universal Human Order

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. R R Gaur, R. Asthana, G P Bagaria, "A Foundation course in Human Values and Professional Ethics", 3rd Edition, Excel Books, New Delhi, 2024. ISBN 978-93-87034- 47-1
2. Prof. K. V. Subba Raju, "Success Secrets for Engineering Students", Smart Student Publications, 3rd Edition, 2013.
3. R R Gaur, R Asthana, G P Bagaria, "Teachers Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

**REFERENCES:**

1. Ivan Illich, "Energy & Equity", The Trinity Press, Worcester, and HarperCollins, USA, 1974.
2. E. F. Schumacher, "Small is Beautiful: a study of economics as if people mattered.", Blond & Briggs, Britain, 1973.
3. A Nagraj, "Jeevan Vidya ek Parichay", Divya Path Sansthan, Amarkantak, 1998.

  
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## SEMESTER I

| U25RMCC02 | தமிழர் மரபு / Heritage of Tamils<br>(Common to all programmes) | Category: MCC |   |   |   |   |
|-----------|----------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                | L             | T | P | J | C |
|           |                                                                | 1             | 0 | 0 | 0 | 1 |

## COURSE OBJECTIVES:

- Learn the extensive literature of classical Tamil
- Review the fine arts heritage of Tamil culture
- Realize the contribution of Tamils in Indian freedom struggle

## COURSE OUTCOMES:

|                                                                                                                  |            |
|------------------------------------------------------------------------------------------------------------------|------------|
| CO 1: Understand the extensive literature of Tamil and its classical nature                                      | Understand |
| CO 2: Understand the heritage of sculpture, painting and musical instruments of ancient people                   | Understand |
| CO 3: Review on folk and martial arts of Tamil people                                                            | Understand |
| CO 4: Realization of Thina concepts, trade and victory of Chozha dynasty                                         | Understand |
| CO 5: Understand the contribution of Tamils in Indian freedom struggle, Self-esteem movement and siddha medicine | Understand |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | 2    | -    | -    | -    |
| CO 2       | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | 2    | -    | -    | -    |
| CO 3       | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | 2    | -    | -    | -    |
| CO 4       | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | 2    | -    | -    | -    |
| CO 5       | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | 2    | -    | -    | -    |

## SYLLABUS:

## UNIT I: LANGUAGE AND LITERATURE

3

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyan and Bharathidhasan

## UNIT II: HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE

3

Hero stone to modern sculpture – Bronze icons – Tribes and their handicrafts – Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yash and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils

## UNIT III: FOLK AND MARTIAL ARTS

3

Tattooing, basket weaving, Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils

**UNIT IV: THINAI CONCEPT OF TAMILS**

3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas

**UNIT V: CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**

3

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books

**CONTACT PERIODS:**

**Lecture:** 15 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 15 Periods

**TEXTBOOKS:**

1. Jayanthi Ravikrishna K, Heritage of Tamils, Sri Krishna publications, First Edition, 2023
2. S. Priyadharshini, Heritage of Tamils, V. K. Publications

**REFERENCES:**

1. தமிழக வரலாறும் மக்களும் பண்பாடும் - கே. கே. பிள்ளை, உலகத் தமிழாராய்ச்சி நிறுவனம் (International Institute of Tamil Studies), C.P.T கேம்பஸ், சென்னை.
2. கணினித் தமிழ் - முனைவர். இல. சுந்தரம், விகடன் பிரசுரம், அண்ணொ சொல, .சன்0ன, திசம்பர் 2016
3. கீழடி - 0வ0க நதிக்க0ரயில் சங்ககொல நகர நொகரிகம், .தொல்லியல் துறை .வளையீடு, தமிழ்நொடு அரசு, .சன்0ன, ஆறொம் பதிப்பு 2020
4. Social Life of Tamils, Dr. K. K. Pillay, A joint publication of TNTB & ESC and RMRL (in print) University of Madras, Chennai, Second Edition 1975
5. The Contributions of the Tamils to Indian Culture, Dr.M.Valarmathi, International Institute of Tamil Studies, C.I.T Campus, Tharamani, Chennai, First Edition 1995



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## SEMESTER I &amp; II

| U25RMCC03 | Design Thinking<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: MCC |   |   |   |   |
|-----------|---------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                       | L             | T | P | J | C |
|           |                                                                                       | 1             | 0 | 2 | 0 | 2 |

## COURSE OBJECTIVES:

- To Understand the basics of Design Thinking, its principles, processes, and tools used
- To empathize with stakeholders and frame problems using structured tools and techniques
- To generate ideas and present solutions effectively using design tools

## COURSE OUTCOMES:

|                                                                                     |            |
|-------------------------------------------------------------------------------------|------------|
| CO 1: Explain purpose and features of design thinking process                       | Understand |
| CO 2: Use required tools to empathize with the stockholders to identify the problem | Apply      |
| CO 3: Comment the identified problem elaborately and clearly                        | Apply      |
| CO 4: Develop a conceptual solution for a societal problem                          | Apply      |
| CO 5: Present the identified solution to all the stakeholders                       | Apply      |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | 1   | 1   | -   | 1   | 1    | 2    | -    | -    |
| CO 2       | 2   | 1   | -   | -   | -   | 1   | 1   | -   | 1   | 1    | 2    | -    | -    |
| CO 3       | 2   | 1   | 1   | -   | -   | 1   | 1   | 3   | 1   | 1    | 2    | -    | -    |
| CO 4       | 3   | 3   | 2   | -   | -   | 1   | 1   | 3   | 1   | 1    | 2    | -    | -    |
| CO 5       | 3   | 2   | -   | -   | -   | 1   | 1   | 3   | 3   | 1    | 2    | -    | -    |

## SYLLABUS:

## UNIT I: FUNDAMENTALS OF DESIGN THINKING

5 + 10

Introduction to Design Thinking: Definition, relevance, and applications – Design The Thinking – Personal Visualization, The Wheel of Life, and Balancing Priorities – Understanding and appreciating the concept of 'Design' – The 3 Laws of Design Thinking

## UNIT II: THE EMPATHIZE AND DEFINE STAGE

5 + 10

Understanding Stakeholders – Role of Empathy in Design Thinking – Tools: Persona, Journey Mapping, Stakeholder Mapping, CATWOE, Cartographic Perspective (L0), and Empathy Map – Case Study. Problem Framing and Reframing – Role of a Design Thinker – Tools: Five Whys, Anti-Pattern, Problem Paraphrasing, Introduction to LORD Skillset – Case Study

## UNIT III: THE DIVERGENCE AND CONVERGENCE AND COMMUNICATION STAGE

5 + 10

Ideation through Divergent and Convergent Thinking – Tools: Brainstorming, 100gm – 1000gm, Presenting Design Outcomes – Tools: 4Cs Framework – Case Study

#### LIST OF EXPERIMENTS

1. Design a solution for a societal problem that can be in line with sustainable development, thrust areas, industrial problems etc. under various themes like Health & Wellness: MedTech, Biotech, and HealthTech Agriculture & Rural: Agriculture, FoodTech, and Rural Development Green Energy: Renewable/Sustainable Energy and Clean and Green Technology Advanced Tech: Blockchain and Cyber Security, Robotics and Drones, and Space Technology Smart Infrastructure: Smart Automation, Smart Education, Smart Vehicles, Transportation and Logistics Daily Utility & Leisure: Fitness and Sports, Tourism, Disaster Management, Games, and Toys Sustainability & Smart Cities: waste-to-wealth, disaster management, or digital twin models for resource management

#### CONTACT PERIODS:

**Lecture:** 15 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 45 Periods

#### TEXTBOOKS:

1. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", 1st edition, New York, HarperCollins Publishers Ltd, New York, 2018
2. Idris Mootee, "Design Thinking for Strategic Innovation", 1st edition, John Wiley & Sons Inc, 2013

#### REFERENCES:

1. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009
2. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
3. Liedtka, Andrew King, Kevin Bennett, Book – "Solving Problems with Design Thinking – Ten Stories of What Works", Columbia Business School Publishing, 2013
4. Maurício Vianna, Ysmar Vianna, Isabel K. Adler, Brenda Lucena, Beatriz Russo, "Design thinking: Business Innovation", MJV Press, 2011
5. Burgelman, Christensen, and Wheelwright, "Strategic Management of Technology and Innovation", 5th Edition, McGraw Hill Publications, 2017

  
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## SEMESTER I

|           |                                                                  |               |   |   |   |   |
|-----------|------------------------------------------------------------------|---------------|---|---|---|---|
| U25RMCC06 | Professional Skill Development - I<br>(Common to all programmes) | Category: MCC |   |   |   |   |
|           |                                                                  | L             | T | P | J | C |
|           |                                                                  | 15 Hours      |   |   |   | 1 |

## COURSE OUTCOMES:

- CO 1:** Demonstrate technical skill competency through attainment of industry-relevant certifications, participation in competitions, internships, and project-based learning activities Apply
- CO 2:** Apply research, innovation, and problem-solving skills to develop impactful solutions through projects, publications, patents, and higher education preparation Apply
- CO 3:** Exhibit leadership, ethical responsibility, community engagement, and professional digital presence to enhance career readiness and lifelong learning Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 2   | 1   | 3   | 1   | -   | -   | 2   | 2    | -    | -    | -    |
| CO 2       | 3   | 2   | 2   | 1   | 2   | 2   | -   | -   | 1   | 1    | -    | -    | -    |
| CO 3       | 3   | 2   | 2   | 1   | -   | 2   | 2   | 3   | 3   | 3    | 2    | -    | -    |

## GUIDELINES:

- Certifications and Skill Credentials - Free awareness certs, NPTEL/Coursera, Associate-level, Professional-level, Expert-level
- Competitions, Hackathons, and Technical Challenges - Online, institution, state, national, international competitions and hackathons, Kaggle medals
- GATE Preparation and Performance - Study plan, mock tests, registration, appearing, score percentile
- Academic, Industry, and Innovation Projects - Mini-projects, intermediate projects, industry-grade deployed projects, funded or published projects
- Internships and Industrial Training - Virtual, on-site short, core role, CoE on-campus, PPO, PPO converted to offer
- Research Publications, Patents, Intellectual Property - Reading journals, survey papers, conference papers, Scopus/WoS, Q1/Q2 journals, patents from provisional to granted
- Leadership, Community, Digital Presence - Club membership, event roles, office bearer, president, outreach, LinkedIn, GitHub, portfolio, Google Scholar

## CONTACT PERIODS:

Lecture: - Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 0 Periods

  
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## SEMESTER II

| U25REN201 | Professional Communication - II<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: HSMC |   |   |   |   |
|-----------|-------------------------------------------------------------------------------------------------------|----------------|---|---|---|---|
|           |                                                                                                       | L              | T | P | J | C |
|           |                                                                                                       | 2              | 0 | 2 | 0 | 3 |

## COURSE OBJECTIVES:

- To strengthen advanced communication and interpersonal skills required for academic and professional success
- To integrate AI-enabled communication tools for content creation, presentations and professional documentation
- To prepare students for modern workplace communication in global and digital environments

## COURSE OUTCOMES:

|       |                                                                                                      |            |
|-------|------------------------------------------------------------------------------------------------------|------------|
| CO 1: | Apply advanced verbal, written and digital communication strategies in professional contexts         | Apply      |
| CO 2: | Analyze technical information and produce effective workplace documents                              | Analyze    |
| CO 3: | Demonstrate negotiation, leadership and collaborative communication skills                           | Understand |
| CO 4: | Deliver impactful technical presentations and communicate innovative ideas effectively               | Apply      |
| CO 5: | Utilize AI-assisted communication tools ethically for professional growth and workplace productivity | Apply      |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 2       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 3       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 4       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |
| CO 5       | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -    | 1    | -    | -    |

## SYLLABUS:

## UNIT I: TECHNICAL WRITING AND DOCUMENTATION

6 + 6

Technical Reports - Proposal Writing - Meeting Agenda and Minutes - Technical Instructions and Process Description - AI-assisted Technical Documentation - Technical Vocabulary

## UNIT II: COGNITIVE PROFESSIONALISM

6 + 6

Critical Thinking Strategies - Problem-solving Communication - Case Study - Brainstorming Techniques - Collaborative Decision Making - One-word Substitutions

## UNIT III: CAREER PLANNING

6 + 6

Self-Assessment Techniques - SWOT Analysis - Goal Setting - AI-assisted Documentation - Digital Content Writing - Collocations

**UNIT IV: CORPORATE COMMUNICATION AND NETWORKING**

6 + 6

Public Speaking - Welcome Address - Vote of Thanks - Anchoring and Event Hosting - Audience Engagement - Cloze tests - Discourse markers - linkers and cohesive devices

**UNIT V: CRITICAL THINKING AND COLLABORATIVE PROBLEM SOLVING**

6 + 6

Problem-solving Techniques - Mind Mapping - Negotiation Skills - Book Review / Film Review - Podcast and Media Analysis - Critical Reading - Group Discussion

**LIST OF EXPERIMENTS**

1. Public Speaking
2. Group Discussion
3. Case Study
4. Blog Writing
5. Mind Mapping

**CONTACT PERIODS:**

Lecture: 30 Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 60 Periods

**TEXTBOOKS:**

1. Ashraf Rizvi, Effective Technical Communication, 3rd Edition, McGraw Hill Education, 2023
2. Meenakshi Raman & Sangeeta Sharma, Technical Communication: Principles and Practice, 4th Edition, Oxford University Press, 2023
3. Sanjay Kumar & Pushp Lata, Communication Skills, 3rd Edition, Oxford University Press, New Delhi, 2018

**REFERENCES:**

1. Stephen E. Lucas, The Art of Public Speaking, 14th Edition, McGraw Hill Education, New York, 2023
2. Dale Carnegie, The Quick and Easy Way to Effective Speaking, Updated Edition, Simon & Schuster, New York, 2019
3. Matt Abrahams, Think Faster, Talk Smarter: How to Speak Successfully When You're Put on the Spot, Simon & Schuster, New York, 2024



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## SEMESTER II

| U25RMA201 | Linear Algebra and Number Theory<br>(Common to AD, AM, CB, CS, IT, SC) | Category: BSC |   |   |   |   |
|-----------|------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                        | L             | T | P | J | C |
|           |                                                                        | 3             | 0 | 2 | 0 | 4 |

## COURSE OBJECTIVES:

- To introduce the foundational concepts of linear algebra and number theory pertinent to algorithmic applications
- To develop the ability to model and solve computational problems using mathematical structures
- To impart in-depth theoretical concepts in practical scenarios through computational tools

## COURSE OUTCOMES:

|                                                                                                                                   |       |
|-----------------------------------------------------------------------------------------------------------------------------------|-------|
| CO 1: Apply Gaussian elimination, Gauss–Jordan elimination, and LU decomposition methods to solve the systems of linear equations | Apply |
| CO 2: Apply the concepts of vector spaces, subspaces, basis, and dimension in computational contexts                              | Apply |
| CO 3: Determine eigenvalues, eigenvectors, and diagonalization of matrices for engineering applications                           | Apply |
| CO 4: Apply number theoretic concepts such as divisibility, congruence, and modular arithmetic in computational problems          | Apply |
| CO 5: Implement cryptographic algorithms using modular arithmetic and RSA principles                                              | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | -   | -   | 2   | -   | -   | -   | 1   | -    | 1    | 2    | -    |
| CO 2       | 3   | 2   | -   | -   | 2   | -   | -   | -   | 1   | -    | 1    | 2    | -    |
| CO 3       | 3   | 2   | -   | -   | 2   | -   | -   | -   | 1   | -    | 1    | 2    | -    |
| CO 4       | 3   | 2   | -   | -   | 2   | -   | -   | -   | 1   | -    | 1    | 2    | -    |
| CO 5       | 3   | 2   | -   | -   | 2   | -   | -   | -   | 1   | -    | 1    | 2    | -    |

## SYLLABUS:

## UNIT I: SYSTEMS OF LINEAR EQUATIONS

9 + 6

Systems of linear equations – Gaussian elimination – Gauss – Jordan elimination method – LU decomposition method – Consistency of linear systems and rank of a matrix

## UNIT II: VECTOR SPACES

9 + 6

Definition and examples of vector spaces – subspaces – Linear independence – Basis and dimension of vector spaces – Linear transformations and matrix representation

## UNIT III: EIGENVALUES AND EIGENVECTORS

9 + 6

Eigenvalues and eigenvectors – Characteristic equation– Diagonalization of matrices – Cayley–Hamilton theorem – Applications of eigenvalues and eigenvectors

## UNIT IV: ELEMENTARY NUMBER THEORY

9 + 6

Divisibility and prime numbers – Greatest common divisors – Euclidean algorithm and its applications – Congruence and modular arithmetic – Euler's Totient Function – Chinese Remainder theorem – Fermat's Little theorem

**UNIT V: NUMBER THEORY IN CRYPTOGRAPHY**

9 + 6

Modular exponentiation – Modular inverse computations – Introduction to cryptography – RSA algorithm basics – Diffie-Hellman Key Exchange and Digital Signatures – Applications in secure communication

**LIST OF EXPERIMENTS**

1. Systems of Linear Equations – Solve systems of linear equations using Gauss–Jordan method – Implement LU decomposition method
2. Vector Space Computations – Determine linear independence and basis of vectors – Compute dimension and rank of matrices
3. Eigenvalues and Diagonalization (6) – Compute eigenvalues and eigenvectors of matrices – Perform matrix diagonalization
4. Number Theory Computations – Implement Euclidean algorithm for finding GCD – Solve congruence problems using the Chinese Remainder theorem
5. Cryptographic Applications – Implement modular exponentiation and modular inverse computations – Simulate RSA encryption and decryption

**CONTACT PERIODS:**

Lecture: 45 Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 75 Periods

**TEXTBOOKS:**

1. Howard Anton, Chris Rorres, Anton Haul "Elementary Linear Algebra", Wiley India, New Delhi, 2019
2. Kenneth H. Rosen, Elementary Number Theory and Its Applications, 6th Edition, Pearson Education, 2011

**REFERENCES:**

1. David C. Lay, "Linear Algebra and Its Applications", 5th Edition, Pearson Education, 2015
2. Gilbert Strang, "Introduction to Linear Algebra", 6th Edition, Wellesley-Cambridge Press, 2023
3. Jeffrey Hoffstein, Jill Pipher and Joseph H. Silverman, "An Introduction to Mathematical Cryptography", Springer, 2014
4. David M. Burton, "Elementary Number Theory", 7th Edition, McGraw Hill, 2010



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## SEMESTER I &amp; II

| U25RPH01 | Engineering Physics<br>(Common to all programmes) | Category: BSC |   |   |   |   |
|----------|---------------------------------------------------|---------------|---|---|---|---|
|          |                                                   | L             | T | P | J | C |
|          |                                                   | 2             | 0 | 2 | 0 | 3 |

## COURSE OBJECTIVES:

- To understand the fundamental mechanical and thermal properties of solids and fluids for real-world engineering applications
- To explore advanced concepts in ultrasonic waves and their applications in imaging, testing, and sensing technologies
- To gain insights into semiconductor physics and photonics for their role in modern electronic and optical systems

## COURSE OUTCOMES:

|       |                                                                                                                             |       |
|-------|-----------------------------------------------------------------------------------------------------------------------------|-------|
| CO 1: | Apply the stress-strain behavior concepts in engineering materials and structures                                           | Apply |
| CO 2: | Apply principles of heat transfer and fluid mechanics to evaluate thermal systems and engineering applications              | Apply |
| CO 3: | Demonstrate the operation of ultrasonic wave generation and detection techniques for industrial and biomedical applications | Apply |
| CO 4: | Analyze the electrical properties and carrier transport mechanisms in semiconductors and semiconductor devices              | Apply |
| CO 5: | Demonstrate the principles of lasers and optical fibers in communication, sensing, and biomedical applications              | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | -    | -    | -    |
| CO 2       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | -    | -    | -    |
| CO 3       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | -    | -    | -    |
| CO 4       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | -    | -    | -    |
| CO 5       | 3   | 2   | 1   | -   | 1   | -   | -   | 1   | 1   | -    | -    | -    | -    |

## SYLLABUS:

## UNIT I: MECHANICAL PROPERTIES OF SOLIDS

6 + 6

Modulus of Elasticity – Stress-strain diagram – Poisson's ratio – Elastic and plastic deformation – Stress-strain behaviour in metals, polymers and ceramics – Bending Moment – Cantilever – Applications (GIRDERS, MEMS)

## UNIT II: FUNDAMENTALS OF HEAT TRANSFER AND FLUIDS

6 + 6

Heat transfer – Thermal expansion – Heat conductivity – Lee's Disc method – Surface tension – Viscosity – Coefficient of viscosity using Poiseuille's flow experiment – Solar water heater – Microwave oven – Heat exchangers – Radiators – Cooling towers

**UNIT III: ULTRASONICS AND ITS APPLICATIONS****6 + 6**

Properties of Ultrasonic waves – Production of ultrasonic waves – Piezoelectric Oscillator – Magnetostriction Oscillator – Velocity measurement of Ultrasonic waves – SONAR – Non-Destructive Testing – Ultrasound imaging – Ultrasonic scanning methods

**UNIT IV: SEMICONDUCTOR PHYSICS****6 + 6**

Properties – Direct and Indirect bandgap-semiconductor – Intrinsic and extrinsic Semiconductors – Carrier concentration in n-type semiconductor – P-type semiconductor – Carrier Transport in Semiconductor – Hall effect – Ohmic contacts – Schottky diode

**UNIT V: PHOTONICS****6 + 6**

Interaction of Radiation with Matter – Laser Characteristics – Population Inversion – CO<sub>2</sub> laser – Semiconductor Diode Laser – Laser applications – Total Internal Reflection – Structure and working principle of Optical fibre – Fiber optic Endoscopy – Fiber optic sensors

**LIST OF EXPERIMENTS**

1. Determine the moduli of elasticity of the given beams and evaluate them for different structural applications. (High/Medium/Low modulus)
2. Evaluate the shear moduli of the different materials and rank them for suitable applications with reference to their strength
3. Select the most effective thermal insulation material from mica, cardboard, and glass for optimal heat protection
4. Determine the Viscosity of Liquids Using Poiseuille's Method and Identify the Fastest-Flowing Liquid
5. Measure the speed of ultrasound in liquids and calculate their compressibility for different hydraulic purposes
6. Categorize the specified semiconducting materials according to their energy bandgap values
7. Determine a semiconducting material's Hall coefficient and identify its type
8. Determination of wavelength of given laser and the particle size of the given samples using diffraction method
9. Use an optical fiber to measure its light-gathering capacity and calculate the propagation angle
10. Calculate the surface tension of different liquids and examine how surfactants affect it
11. Determination of wavelength of various spectral lines by using spectrometer and grating
12. Determination of velocity of light passing through glass medium using spectrometer

**CONTACT PERIODS:**

Lecture: 30 Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 60 Periods

**TEXTBOOKS:**

1. M.N. Avadhanulu, P.G. Kshirsagar, and T.V.S. Arun Murthy, "A Textbook of Engineering Physics", 11th edition, S. Chand Publishing, New Delhi, 2022
2. R.K. Gaur and S.L. Gupta, "Engineering Physics", 8th edition, Dhanpat Rai Publications, New Delhi, 2017

**REFERENCES:**

1. Harald Ibach and Hans Luth, "Solid State Physics: An Introduction", 4th edition, Springer Publications, 2020
2. Charles Kittel, revised by David Pines (Editor) "Introduction to Solid State Physics", 9th edition, Wiley & Sons, US, 2020
3. H.K. Malik and A.K. Singh "Engineering Physics" Publisher: McGraw Hill Education India, 2022
4. [https://onlinecourses.nptel.ac.in/noc20\\_cy17/preview](https://onlinecourses.nptel.ac.in/noc20_cy17/preview)

## SEMESTER II

| U25RCSG04 | Python Programming<br>(Common to all programmes) | Category: ESC |   |   |   |   |
|-----------|--------------------------------------------------|---------------|---|---|---|---|
|           |                                                  | L             | T | P | J | C |
|           |                                                  | 3             | 0 | 0 | 0 | 3 |

## COURSE OBJECTIVES:

- To introduce the fundamental concepts of Python programming, including syntax, data types, operators, and input/output operations
- To develop problem-solving skills through the use of control structures, functions, recursion, and modular programming techniques
- To provide proficiency in Python collections, file handling, exception handling, and program organization using modules and packages
- To familiarize students with basic object-oriented programming concepts and the use of Python libraries for data analysis applications

## COURSE OUTCOMES:

- CO 1: Explain Python programming fundamentals, including data types, operators, input/output operations, and debugging techniques **Understand**
- CO 2: Develop Python programs using decision-making statements, iterative constructs, functions, recursion, and variable scope concepts **Apply**
- CO 3: Implement string processing and Python collections such as lists, tuples, sets, and dictionaries to solve computational problems **Apply**
- CO 4: Develop modular Python programs using file handling, exception handling, modules, and packages **Apply**
- CO 5: Develop simple object-oriented programs and apply NumPy and Pandas libraries for basic data analysis applications **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |
| CO 5       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |

## SYLLABUS:

## UNIT I: PYTHON FUNDAMENTALS

9

Introduction to Python – Features and Applications of Python – Installing Python – Python Interpreter – Script and Interactive Modes – Identifiers and Keywords – Variables – Data Types – Type Conversion – Operators and Expressions – Input and Output Operations – Comments and Documentation – Error Types – Testing and Debugging Basics

**UNIT II: CONTROL STRUCTURES AND FUNCTIONS**

9

Conditional Statements – Nested Conditional Statements – Iterative Statements: while Loop and for Loop – Loop Control Statements – Functions – Function Definition and Invocation – Function Arguments and Return Values – Scope of Variables – Recursive Functions – Applications of Functions in Problem Solving

**UNIT III: STRINGS AND PYTHON COLLECTIONS**

9

Strings and String Operations – Lists and List Operations – List Comprehensions – Tuples and Tuple Operations – Sets and Set Operations – Dictionaries and Dictionary Operations – Packing and Unpacking

**UNIT IV: FILE HANDLING, MODULES AND EXCEPTION HANDLING**

9

Modules and Packages – Importing Modules – Built-in Functions – File Handling – Opening and Closing Files – Reading and Writing Files – File Methods – Exception Handling – try, except, else and finally Blocks – User Defined Exceptions

**UNIT V: OBJECT-ORIENTED PROGRAMMING AND DATA ANALYSIS**

9

Classes and Objects – Creating Classes and Objects – Constructors – Instance Variables and Methods – Introduction to NumPy – Creating Arrays – Array Operations – Indexing and Slicing – Introduction to Pandas – Series and DataFrames – Reading and Displaying Data – Simple Data Analysis Applications.

**CONTACT PERIODS:**

Lecture: 45 Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 45 Periods

**TEXTBOOKS:**

1. Reema Thareja, "Python programming: Using problem solving approach", 1st Edition, Oxford Press, 2017
2. William McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition, Shroff/O'Reilly Publication, 2017

**REFERENCES:**

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
2. Ashok Namdev Kamthane and Amit Ashok Kamthane, "Programming and Problem Solving with Python", 2nd Edition, McGrawHill Education, 2018
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", 1st Edition, Pearson India Education Services Pvt. Ltd., 2016

  
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## SEMESTER II

| U25RAD201 | Data Science | Category: PCC |   |   |   |   |
|-----------|--------------|---------------|---|---|---|---|
|           |              | L             | T | P | J | C |
|           |              | 3             | 0 | 2 | 0 | 4 |

## COURSE OBJECTIVES:

- To introduce the fundamental concepts and lifecycle of data science
- To develop basic skills in statistical analysis, correlation, and regression for data interpretation
- To create awareness of ethical, fair, and responsible use of data in real-world applications

## COURSE OUTCOMES:

|                                                                              |            |
|------------------------------------------------------------------------------|------------|
| CO 1: Illustrate the data science process for real-world problems            | Understand |
| CO 2: Compute statistical techniques to describe data                        | Apply      |
| CO 3: Compute relationships among variables using correlation and regression | Apply      |
| CO 4: Utilize data science tools to handle real-time data                    | Apply      |
| CO 5: Explain the ethical considerations in data science                     | Understand |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 5       | 2   | 1   | -   | -   | -   | -   | 3   | -   | -   | -    | -    | -    | 2    |

## SYLLABUS:

UNIT I: INTRODUCTION TO DATA SCIENCE 9 + 6

Data Science – Need for data science – Benefits and uses – Facets of data – Data Science Life Cycle – KDD process overview – Data cleaning – Data transforming – Exploratory data analysis – Real-world data science project workflow

UNIT II: DATA DESCRIPTION AND STATISTICS 9 + 6

Types of Data – Frequency distributions – Graphs – Outliers – Measures of Central Tendency: Mean – Median – Mode – Measures of Dispersion: Range – Variance – Standard Deviation – IQR – Normal distributions: Calculation of z-score – Finding proportions – Finding scores and data transformation basics

UNIT III: CORRELATION AND REGRESSION 9 + 6

Correlation: Concept – Scatter plots – Correlation coefficient ( $r$ ) – Computation of Pearson's correlation – Simple Linear Regression: Concept – Formula of line of best fit – Least square method – Concept of regression towards the mean – Multiple linear regression

UNIT IV: DATA SCIENCE TOOLS 9 + 6

Machine Learning: Types – Application in Data Science (e.g., prediction, classification) – Python tools – Concept of modelling process – Case study: Spam detection – Customer churn prediction

**UNIT V: DATA ETHICS AND APPLICATIONS**

9 + 6

Responsible data use – Examples of unethical data practices – Bias and fairness in decision-making systems – Case studies on real-world consequences of data misuse – Careers and future scope in Data Science

**LIST OF EXPERIMENTS**

1. Study of the Python programming environment and implementation of basic data handling operations. Import a real-world dataset, explore its structure, identify missing values, remove duplicate records, and create a cleaned dataset suitable for analysis.
2. Perform data preprocessing and transformation techniques including normalization, standardization, and encoding. Generate summary statistics and visualize the dataset using charts and plots to understand data characteristics.
3. Compute descriptive statistical measures such as mean, median, mode, range, variance, and standard deviation for a given dataset and interpret the results for data analysis.
4. Construct frequency distributions and graphical representations including histograms, box plots, and bar charts. Identify and analyze outliers using suitable statistical methods.
5. Analyze relationships between variables using scatter plots and correlation measures. Calculate and interpret correlation coefficients for different datasets.
6. Implement simple linear regression for predictive analysis. Develop a regression model, visualize the regression line, and evaluate model performance using appropriate error metrics.
7. Develop a basic classification model using a standard dataset. Train and test the model using suitable machine learning techniques and evaluate its performance through accuracy measures and confusion matrices.
8. Conduct a mini case study on data ethics and responsible data usage. Analyze issues related to data privacy, bias, fairness, and security in a real-world data science application and prepare a brief report.

**CONTACT PERIODS:**

Lecture: 45 Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 75 Periods

**TEXTBOOKS:**

1. David Cielien, Arno D. B. Meysman and Mohamed Ali, "Introducing Data Science: Big Data, Machine Learning, and More Using Python Tools", 1st Edition, Manning Publications, 2016
2. Peter Bruce, Andrew Bruce and Peter Gedeck, "Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python", 2nd Edition, O'Reilly Media, 2020
3. Kristen Martin, "Ethics of Data and Analytics: Concepts and Cases", 1st Edition, CRC Press, Routledge, 2022

**REFERENCES:**

1. Robert S. Witte and John S. Witte, "Statistics", 11th Edition, Wiley Publications, 2017
2. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly Media, 2014
3. Foster Provost and Tom Fawcett, "Data Science for Business", O'Reilly Media, 2013

  
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## SEMESTER II

| U25RCSG05 | Linux and Shell Scripting<br>(Common to AD, AM, CB, CS, IT, SC) | Category: PCC |   |   |   |   |
|-----------|-----------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                 | L             | T | P | J | C |
|           |                                                                 | 1             | 0 | 2 | 0 | 2 |

## COURSE OBJECTIVES:

- To introduce Linux operating system and command-line interface
- To familiarize students with basic file handling and shell commands
- To enable students to write and execute shell scripts for automation

## COURSE OUTCOMES:

CO 1: Understand and execute basic Linux commands

Understand

CO 2: Manage files, directories, and permissions in Linux

Apply

CO 3: Write and debug shell scripts to automate system tasks

Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | -   | -   | 3   | -   | -   | -   | 1   | -    | -    | -    | -    |
| CO 2       | 3   | 3   | 2   | -   | 3   | -   | -   | -   | 2   | -    | -    | -    | -    |
| CO 3       | 3   | 3   | 2   | -   | 3   | -   | -   | -   | 2   | -    | -    | -    | -    |

## SYLLABUS:

## UNIT I: INTRODUCTION TO LINUX ENVIRONMENT AND FILE MANAGEMENT

5 + 10

Introduction to Linux environment – Linux login process, terminal usage, Linux file system structure – Basic Linux commands such as ls, pwd, cd, clear, whoami, date and cal – File and directory handling concepts including creation, deletion and management of files – Directories using commands like mkdir, rmdir, touch, cat, cp, mv, rm, head, tail, more and less – File permissions and ownership concepts including read, write and execute permissions, chmod, chown, umask commands, symbolic and numeric modes of permission management

## UNIT II: LINUX UTILITIES AND SYSTEM ADMINISTRATION COMMANDS

5 + 10

File searching – Filtering utilities in Linux including find, locate, grep, sort, uniq, cut, wc, diff and cmp commands – Process management and system monitoring concepts using ps, top, kill, nice, df, du, uptime, free, uname and who commands – Archiving and compression utilities including creation, extraction and management of archive files using tar, gzip, gunzip, zip, unzip and xz commands

## UNIT III: SHELL SCRIPTING AND AUTOMATION

5 + 10

Introduction to shell scripting, writing and executing simple shell scripts, use of comments, variables, read and echo commands, arithmetic operations using expr and let – Decision-making statements in shell scripting including if, if-else, if-elif-else, test conditions, integer, string and file comparisons – Looping constructs such as for, while and until loops with break and continue statements – Advanced shell scripting concepts including user-defined functions, function declaration, calling, passing arguments, scope of variables, command line arguments using \$1, \$2, \$@ and \$# and automation of tasks such as backup and log monitoring

## LIST OF EXPERIMENTS

1. Basic Linux Commands & File Management Introduction to Linux Environment - Login process, terminal, file system structure, basic commands: ls, pwd, cd, clear, whoami, date, cal
2. File and Directory Handling Commands: mkdir, rmdir, touch, cat, cp, mv, rm, head, tail, more, less
3. File Permissions and Ownership : Use of chmod, chown, umask, symbolic and numeric modes of permissions
4. Working with Linux Utilities File Searching and Filtering Use of find, locate, grep, sort, uniq, cut, wc, diff, cmp
5. Process Management and System Monitoring Commands: ps, top, kill, nice, df, du, uptime, free, uname, who
6. Archiving and Compression Utilities: Using tar, gzip, gunzip, zip, unzip, xz
7. Shell Scripting Basics Writing Simple Shell Scripts : Hello world, script execution, comments, variables, read, echo, expr, let
8. Conditional Statements in Shell Use of if, if-else, if-elif-else, test conditions, integer/string/file comparisons
9. Looping Constructs in Shell : for, while, until loops; loop control commands: break, continue
10. Advanced Shell Scripting: User-defined Functions in Shell Scripts: Declaring, calling functions, passing arguments, scope of variables
11. Command Line Arguments and Script Automation : Use of \$1, \$2, \$@, \$#, automating tasks like backup, log monitoring

**CONTACT PERIODS:**

**Lecture:** 15 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. Richard Blum and Christine Bresnahan, "Linux Command Line and Shell Scripting Bible", 4th Edition, Wiley, 2020
2. Richard Blum and Christine Bresnahan, "Linux Command Line and Shell Scripting Bible", 4th Edition, Wiley, 2020

**REFERENCES:**

1. B.M. Harwani, "Unix and Shell Programming", 1st Edition, Oxford University Press, 2013
2. Michael Kerrisk, "The Linux Programming Interface", 1st Edition, No Starch Press, 2010

  
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## SEMESTER I &amp; II

| U25RGE01 | Makerspace<br>(Common to all programmes) | Category: ESC |   |   |   |   |
|----------|------------------------------------------|---------------|---|---|---|---|
|          |                                          | L             | T | P | J | C |
|          |                                          | 0             | 0 | 4 | 0 | 2 |

## COURSE OBJECTIVES:

- Apply fundamental fabrication, electrical, electronics, programming, and digital manufacturing techniques for engineering applications
- Develop practical skills in prototyping, automation, robotics, and emerging technologies through experiential learning activities
- Design and construct interdisciplinary engineering prototypes by integrating concepts from multiple engineering domains

## COURSE OUTCOMES:

|       |                                                                                                              |        |
|-------|--------------------------------------------------------------------------------------------------------------|--------|
| CO 1: | Fabricate simple components using basic mechanical engineering tools and additive manufacturing              | Apply  |
| CO 2: | Carry out electrical wiring installations applying safety measures in domestic applications                  | Apply  |
| CO 3: | Interface electronic devices to develop functional engineering solutions                                     | Apply  |
| CO 4: | Illustrate the role of automation and artificial intelligence in engineering applications                    | Apply  |
| CO 5: | Develop interdisciplinary engineering prototype addressing specific problems through teamwork and innovation | Create |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | -   | -   | 3   | -   | -   | 3   | 2   | -    | 2    | -    | -    |
| CO 2       | 3   | 2   | -   | -   | 3   | -   | -   | 3   | 2   | -    | 2    | -    | -    |
| CO 3       | 3   | 2   | -   | -   | 3   | -   | -   | 3   | 2   | -    | 2    | -    | -    |
| CO 4       | 2   | -   | -   | -   | 3   | -   | -   | -   | -   | -    | 2    | -    | -    |
| CO 5       | 3   | 3   | 2   | 1   | 3   | 2   | 2   | 3   | 3   | 2    | 2    | -    | -    |

## LIST OF EXPERIMENTS

## MODULE 1: FABRICATION AND MAKING SKILLS (10 Hours)

1. Welding procedure, selection & safety Measures - Hands-on session for preparing base material and joining of steel materials using arc welding
2. Study on basic pipe connections with different joining components.
3. Demo on laser cutting of acrylic boards and wire arc welding

## MODULE 2: DIGITAL DESIGN AND RAPID PROTOTYPING (10 Hours)

4. 3D Modelling of simple components using software's
5. Fabrication of simple components / parts using 3D printers
6. Demonstration of assembly modelling of components

## MODULE 3: AUTOMATION AND ROBOTICS (8 Hours)

7. Demonstration on mechatronics components/systems

8. Demonstration on basic robotics system
9. Demonstration on automobiles, performance measures
10. Demonstration on programmable logic control circuit

**MODULE 4: ELECTRICAL PRACTICES (10 Hours)**

11. Study on basic electrical installation tools, equipment and safety measures
12. Basic electrical wiring and connections such as soldering, fuses, earthing, miniature circuit breakers and switch wiring
13. Hands-on session of electrical connections for lightings, fans, calling bells etc
14. Hands-on session of electrical connections for motors and uninterruptible power supply

**MODULE 5: ELECTRONICS AND EMBEDDED SYSTEMS (8 Hours)**

15. Electronic components, equipment and safety measures
16. Interfacing of sensors and actuator with microcontrollers (Arduino)
17. Integration of electronic circuits with IoT system
18. Interfacing of components with printed circuit board

**MODULE 6: ARTIFICIAL INTELLIGENCE (4 Hours)**

19. Demonstration on artificial intelligence technologies
20. Demonstration on AR/VR technologies

**MODULE 7: INTERDISCIPLINARY PROTOTYPE CHALLENGE (10 Hours)**

21. Students work in teams to develop and demonstrate an interdisciplinary product/prototype for the problem identified

**CONTACT PERIODS:**

|                    |                     |                       |                    |                   |
|--------------------|---------------------|-----------------------|--------------------|-------------------|
| Lecture: - Periods | Tutorial: - Periods | Practical: 60 Periods | Project: - Periods | Total: 60 Periods |
|--------------------|---------------------|-----------------------|--------------------|-------------------|

**TEXTBOOKS:**

1. Mikell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes and Systems", 7th Edition, Wiley, 2020
2. Simon Monk, "Programming Arduino: Getting Started with Sketches", 3rd Edition, McGraw-Hill Education, 2022
3. Richard H. Barnett, "Introduction to Mechatronics and Measurement Systems", 6th Edition, McGraw-Hill Education, 2023
4. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2016

**REFERENCES:**

1. Arduino Documentation – <https://www.arduino.cc>
2. Tinkercad Learning Portal – <https://www.tinkercad.com>
3. FreeCAD Documentation – <https://www.freecad.org>
4. Ultimaker Cura Resources – <https://ultimaker.com/software/ultimaker-cura>
5. ESP32 Documentation – <https://docs.espressif.com>



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## SEMESTER II

| U25RCSG06 | Python Programming Laboratory<br>(Common to all programmes) | Category: ESC |   |   |   |   |
|-----------|-------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                             | L             | T | P | J | C |
|           |                                                             | 0             | 0 | 2 | 0 | 1 |

## COURSE OBJECTIVES:

- To understand the fundamental concepts of Python programming and problem-solving using Python language constructs
- To apply control structures, functions, strings, and Python collections for developing efficient applications
- To develop modular applications using file handling, exception handling, modules, and packages.
- To implement basic object-oriented programming concepts and utilize Python libraries for data analysis applications

## COURSE OUTCOMES:

|                                                                                                                           |       |
|---------------------------------------------------------------------------------------------------------------------------|-------|
| CO 1: Implement Python programs using basic language constructs, data types, operators, and input/output operations       | Apply |
| CO 2: Develop Python programs using decision-making statements, looping constructs, functions, and recursion              | Apply |
| CO 3: Implement applications using strings, lists, tuples, sets, and dictionaries for data processing and problem solving | Apply |
| CO 4: Develop modular applications using file handling, exception handling, modules, and packages                         | Apply |
| CO 5: Design applications using basic object-oriented programming concepts and Python libraries such as NumPy and Pandas  | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 5       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |

## LIST OF EXPERIMENTS

1. Development of Python programs demonstrating variables, data types, operators, and input/output operations
2. Implementation of applications using conditional statements and nested conditional constructs
3. Development of iterative applications using for loops, while loops, and loop control statements
4. Design and implementation of console-based applications for mathematical and logical problem solving
5. Development of applications using user-defined functions and recursive functions
6. Implementation of string processing applications using Python string operations and methods
7. Development of applications using lists, tuples, sets, and dictionaries
8. Implementation of applications using list comprehensions and collection-based problem solving
9. Development of modular applications using built-in and user-defined modules
10. Implementation of file handling applications for reading, writing, and appending data
11. Development of robust applications using exception handling and user-defined exceptions

12. Design and implementation of applications using classes, objects, constructors, and instance methods
13. Development of applications demonstrating inheritance and method overriding
14. Implementation of numerical computing applications using NumPy arrays and array operations
15. Development of simple data analysis applications using Pandas Series and DataFrames

**CONTACT PERIODS:**

Lecture: - Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 30 Periods

**REFERENCES:**

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd Edition, O'Reilly Media, 2016
2. Ashok Namdev Kamthane and Amit Ashok Kamthane, Programming and Problem Solving with Python, 2nd Edition, McGraw Hill Education, 2018



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## SEMESTER I &amp; II

| U25RMCC04 | Environmental Governance and Sustainability<br>(Common to AD, AM, BM, CB, CE, CH, CS, EC, EE, EV, IT, ME, MI, SC) | Category: MCC |   |   |   |   |
|-----------|-------------------------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                                                   | L             | T | P | J | C |
|           |                                                                                                                   | 2             | 0 | 0 | 0 | 2 |

## COURSE OBJECTIVES:

- To provide basic concepts of ecosystem, biodiversity, atmospheric and hydrological processes
- To inculcate knowledge on the lithosphere, waste management practices, environmental laws and disaster management strategies
- To apply the principles of sustainable living and green technologies in alignment with the UN Sustainable Development Goals

## COURSE OUTCOMES:

- CO 1: Explain the role of biodiversity conservation and wildlife protection in addressing environmental issues Understand
- CO 2: Apply pollution control methods, environmental laws, and water management practices for environmental protection Apply
- CO 3: Implement sustainable waste management practices for efficient resource utilization Apply
- CO 4: Explain the role of disaster management, governance, and IT tools in environmental and health sustainability Understand
- CO 5: Employ sustainable practices and national environmental initiatives for sustainable development Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | 3   | 2   | -   | 1   | -    | 1    | -    | -    |
| CO 2       | 2   | 1   | -   | -   | -   | 3   | 2   | -   | 1   | -    | 1    | -    | -    |
| CO 3       | 2   | 1   | -   | -   | -   | 3   | 2   | -   | 1   | -    | 1    | -    | -    |
| CO 4       | 2   | 1   | -   | -   | -   | 3   | 2   | -   | 1   | -    | 1    | -    | -    |
| CO 5       | 3   | 1   | -   | -   | -   | 3   | 2   | -   | 1   | -    | 1    | -    | -    |

## SYLLABUS:

## UNIT I: ENVIRONMENT AND BIODIVERSITY

6

Scope of Environmental Science – Ecology – Ecosystem – Classification, structure, productivity – Energy flow and nutrient cycles – Nitrogen cycle – Ecological succession – Biodiversity – Types and values of biodiversity – Biodiversity at Global, National and Local Levels – Bio-geographical Classification of India – India as a Mega-diversity Nation – Red Data Book – Hotspots of Indian Biodiversity – Endangered and endemic species – Conservation of biodiversity

Self - Learning & Case Studies – Species conservation projects in India – Species Reintroduction – National Biodiversity Action Plan 2015 – Role of International Union for Conservation of Nature (IUCN)

**UNIT II: ATMOSPHERE AND HYDROSPHERE**

6

Atmosphere – Structure and composition – Earth's Albedo – Carbon cycle and oxygen cycle – Air Quality Standards – Air Pollution – Sources, effects and control measures – Indian Environmental Laws – Air Act 1981. Hydrosphere – Hydrosphere – Hydrological Cycle, Water Quality Parameters, Water Pollution – Sources, effects, and control measures - Water conservation – Rainwater harvesting, Dams, and watershed Management – Wastewater treatment, Ocean acidification, Blue economy, Water Act, 1974 and Environment Protection Act, 1986

Self - Learning & Case Studies – Clean Development Mechanism (CDM) – Greenhouse Gas Protocol – ISO 14064 – Jal Shakti Abhiyan – Implementation of CNG in NCT of Delhi – Taj Trapezium Case – Narmada River – Sardar Sarovar Project

**UNIT III: LITHOSPHERE AND SOLID WASTE MANAGEMENT**

6

Lithosphere – Structure of the lithosphere – Continental drift – Forest resources – Deforestation – Causes and effects – Agriculture – Effects of modern agriculture – Soil Pollution – Causes, effects and control measures. Solid Waste Management – Solid Waste – Sources, classification, and effects, Waste reduction strategies – Circular Economy and 5R Principles, Solid waste treatment, Disposal techniques, Refuse-Derived Fuel and Waste-to-Energy technologies, Biomedical, E-Waste and Hazardous waste management, Resource recovery – Environmental Standards and Waste Management Regulations (ISO 14001 and Waste Rules)

Self - Learning & Case Studies – Solid Waste Management rules, 2024 – Plastic Waste Management Rules (PWMR) – Degradation of Soil in Rajasthan – Indore's Waste Management System

**UNIT IV: GLOBAL ISSUES, HUMAN WELFARE AND ROLE OF TECHNOLOGY**

6

EIA- Concepts, stages – Land clearing projects – Environmental and Social Impacts, Resettlement and Rehabilitation – Concepts and challenges – Disaster management – Floods, Landslides, Disaster management cycle and mitigation – Environmental Governance, Global Governance and Fundamental Human Rights – Importance. Human Population – Population growth, explosion and its challenges – Trends and variation among nations – Role of IT – Remote sensing, GIS and Google earth engine – Disease tracking and prediction using big data and AI (e.g., COVID-19 apps)

Self - Learning & Case Studies – Mission Amrit Sarovar – Beti Bachao Beti Padhao mission – Kerala Flood (2018) – Sterlite Copper Plant Case – Thoothukudi

**UNIT V: SUSTAINABLE DEVELOPMENT AND GREEN PRACTICES**

6

Sustainable Development – Concept, significance of sustainability – UN Sustainable Development Goals (UN SDGs) – Sustainability assessment – Carbon footprint, accounting, Carbon Neutrality – Net Zero Emissions – Carrying Capacity of the Earth – Carbon Sequestration and Carbon Capture – Blue Carbon and Green Carbon. Green Practices – Sustainable Agriculture – Green Energy – Biofuels, Green Hydrogen, Solar, wind and biomass Energy – Sustainable Transport – Electric Vehicles (EVs)

Self - Learning & Case Studies – National Solar Mission, Green India Mission – Ambikapur, Chhattisgarh – Zero Waste Model – Delhi Metro – Energy Efficiency and Sustainable Transport

**CONTACT PERIODS:**

Lecture: 30 Periods

Tutorial: - Periods

Practical: - Periods

Project: - Periods

Total: 30 Periods

**TEXTBOOKS:**

1. E. Bharucha, "Environmental Studies for Undergraduate Courses", 2nd edition, Hyderabad, University Press (India) Pvt. Ltd, 2005
2. R. Rajagopalan, "Environmental Studies: From Crisis to Cure", 3rd edition, New Delhi, Oxford University Press, 2016
3. R. R. Hiremath, "Sustainable Development", 1st edition, New Delhi, Himalaya Publishing House, 2008

**REFERENCES:**

1. Anubha Kaushik and C.P. Kaushik, "Environmental Studies" 6th edition, New Age International Publishers, New Delhi, 2018
2. Benny Joseph, "Environmental Studies", 3rd edition, New Delhi, McGraw Hill Education, 2017
3. M. Anji Reddy, "Textbook of Environmental Science and Technology", 3rd edition, BS Publications, 2019
4. R. B. Singh, "Disaster Management", 1st edition, New Delhi, Rawat Publications, 2006
5. .V. Desai, "Environment and Sustainable Development" 1st edition, Mumbai, Himalaya Publishing House, 2009



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## SEMESTER II

| U25RMCC05 | தமிழரும் தொழில்நுட்பமும் / Tamils and Technology<br>(Common to all programmes) | Category: MCC |   |   |   |   |
|-----------|--------------------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                                | L             | T | P | J | C |
|           |                                                                                | 1             | 0 | 0 | 0 | 1 |

## COURSE OBJECTIVES:

- To learn weaving, ceramic and construction technology of Tamils
- To understand the agriculture, irrigation and manufacturing technology of Tamils
- To realize the development of scientific Tamil and Tamil computing

## COURSE OUTCOMES:

|                                                                                                    |            |
|----------------------------------------------------------------------------------------------------|------------|
| CO 1: Understand the weaving and ceramic technology of ancient Tamil people nature                 | Understand |
| CO 2: Understand the construction technology, building materials in Sangam period and case studies | Understand |
| CO 3: Infer the metal process, coin and beads manufacturing with relevant archeological evidence   | Understand |
| CO 4: Realize the agriculture methods, irrigation technology and pearl diving                      | Understand |
| CO 5: Apply the knowledge of scientific Tamil and Tamil computing                                  | Understand |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | 2    | -    | -    | -    |
| CO 2       | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | 2    | -    | -    | -    |
| CO 3       | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | 2    | -    | -    | -    |
| CO 4       | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | 2    | -    | -    | -    |
| CO 5       | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | 2    | -    | -    | -    |

## SYLLABUS:

## UNIT I: WEAVING AND CERAMIC TECHNOLOGY

3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries

## UNIT II: DESIGN AND CONSTRUCTION TECHNOLOGY

3

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo-Saracenic architecture at Madras during British Period

## UNIT III: MANUFACTURING TECHNOLOGY

3

Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel, Copper and gold – Coins as source of history – Minting of Coins – Bead-making industries – Stone beads – Glass beads – Terracotta beads – Shell beads/ bone beads – Archeological evidences – Gem stone types described in Silappathikaram

**UNIT IV: AGRICULTURE AND IRRIGATION TECHNOLOGY**

3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society

**UNIT V: SCIENTIFIC TAMIL & TAMIL COMPUTING**

3

Development of Scientific Tamil – The role of journals in the development of scientific Tamil – Scientific Tamil vocabulary – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project

**CONTACT PERIODS:**

**Lecture:** 15 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 15 Periods

**TEXTBOOKS:**

1. Tamils and Technology, K. Jayanthi Ravikrishna, Sri Krishna publications, Mahalakshmi Nagar, Velappanchavadi, First Edition 2023
2. Tamils and Technology, S. Priyadharshini, V. K. Publications

**REFERENCES:**

1. The Contributions of the Tamils to Indian Culture, Dr. M. Valarmathi, International Institute of Tamil Studies, C.I.T Campus, Tharamani, Chennai, First Edition 1995
2. Studies in the History of India with Special Reference to Tamil Nadu, Dr. K. K. Pillay, 1979



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## SEMESTER II

|           |                                                                   |               |   |   |   |   |
|-----------|-------------------------------------------------------------------|---------------|---|---|---|---|
| U25RMCC07 | Professional Skill Development - II<br>(Common to all programmes) | Category: MCC |   |   |   |   |
|           |                                                                   | L             | T | P | J | C |
|           |                                                                   | 15 Hours      |   |   |   | 1 |

## COURSE OUTCOMES:

- CO 1:** Demonstrate technical skill competency through attainment of industry-relevant certifications, participation in competitions, internships, and project-based learning activities **Apply**
- CO 2:** Apply research, innovation, and problem-solving skills to develop impactful solutions through projects, publications, patents, and higher education preparation **Apply**
- CO 3:** Exhibit leadership, ethical responsibility, community engagement, and professional digital presence to enhance career readiness and lifelong learning **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 2   | -   | 3   | 1   | -   | -   | 2   | 2    | -    | -    | -    |
| CO 2       | 2   | 3   | 3   | 3   | 2   | 2   | -   | -   | 1   | 1    | -    | -    | -    |
| CO 3       | -   | -   | 3   | -   | -   | 2   | 2   | 3   | 3   | 3    | 2    | -    | -    |

## GUIDELINES:

- Certifications and Skill Credentials - Free awareness certs, NPTEL/Coursera, Associate-level, Professional-level, Expert-level
- Competitions, Hackathons, and Technical Challenges - Online, institution, state, national, international competitions and hackathons, Kaggle medals
- GATE Preparation and Performance - Study plan, mock tests, registration, appearing, score percentile
- Academic, Industry, and Innovation Projects - Mini-projects, intermediate projects, industry-grade deployed projects, funded or published projects
- Internships and Industrial Training - Virtual, on-site short, core role, CoE on-campus, PPO, PPO converted to offer
- Research Publications, Patents, Intellectual Property - Reading journals, survey papers, conference papers, Scopus/WoS, Q1/Q2 journals, patents from provisional to granted
- Leadership, Community, Digital Presence - Club membership, event roles, office bearer, president, outreach, LinkedIn, GitHub, portfolio, Google Scholar

## CONTACT PERIODS:

Lecture: - Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 0 Periods

  
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## SEMESTER III

| U25MA301 | Probability and Statistical Modeling for Computing Systems<br>(Common to AD, AM, CB, CS, IT, SC) | Category: BSC |   |   |   |   |
|----------|--------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                                                  | L             | T | P | J | C |
|          |                                                                                                  | 2             | 0 | 2 | 0 | 3 |

## PRE-REQUISITES:

- U25MA101 - Calculus and Differential Equations / U25RMA101 - Multivariable Calculus and Applications

## COURSE OBJECTIVES:

- To provide in-depth statistical and probability theory knowledge
- To facilitate with students, use their understanding of statistical methods for data analysis and inference in their areas of study
- To provide the knowledge of time series component analysis in their area of study

## COURSE OUTCOMES:

- CO 1:** Explain the probability concepts, and apply Bayes' rule to solve probabilistic problems and analyse discrete probability distributions **Understand**
- CO 2:** Define continuous random variables and interpret statistical data using appropriate continuous probability distributions **Apply**
- CO 3:** Illustrate and apply the concepts of two-dimensional random variables and compute covariance and correlation, and linear regression analysis **Apply**
- CO 4:** Obtain point and interval estimates, apply hypothesis testing involving means and Chi-square test for independence of attributes **Apply**
- CO 5:** Estimate the trend analysis, cyclical, seasonal and irregular variations of time series analysis in forecasting **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | 1   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 2       | 3   | 2   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 3       | 3   | 2   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 4       | 3   | 2   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 5       | 3   | 2   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | 2    | -    |

## SYLLABUS:

## UNIT I: PROBABILITY AND DISCRETE RANDOM VARIABLES

6 + 6

Probability – Addition rule – Conditional probability – Baye's theorem – Discrete random variables – Mean and variance – Binomial and Poisson distributions

## UNIT II: CONTINUOUS RANDOM VARIABLES

6 + 6

Continuous random variables – Probability density functions – Cumulative distribution functions – Mean and variance – Uniform and Normal distributions

**UNIT III: JOINT PROBABILITY DISTRIBUTIONS**

**6 + 6**

Two dimensional discrete and continuous random variables – Marginal probability distribution – Independence, covariance – Correlation and linear regression analysis

**UNIT IV: STATISTICAL INFERENCE**

**6 + 6**

Estimation – Point estimation, interval estimation – Determining the sample size in estimation – Hypothesis testing – Hypotheses concerning means – Large, small samples – Chi square test for independence of attributes

**UNIT V: TIME SERIES AND FORECASTING**

**6 + 6**

Variations in Time Series – Trend Analysis – Cyclical Variation – Seasonal Variation – Irregular Variation – Time series analysis in forecasting

**LIST OF EXPERIMENTS**

1. Discrete Random Variables – Mean and Variance of discrete RVs. – Special discrete probability distributions
2. Continuous Random Variables – Mean and Variance of continuous RVs. – Special continuous probability distributions
3. Joint Probability Distributions – Marginal probability distributions. – Covariance and Correlation.
4. Inferential Statistics – Estimation theory – Testing of hypotheses
5. Time Series and Forecasting – Trend analysis in time series – Cyclic variation in forecasting

**CONTACT PERIODS:**

Lecture: 30 Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 60 Periods

**TEXTBOOKS:**

1. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", Wiley India, New Delhi, 2018
2. Richard I Levin and David S Rubin, "Statistics for Management", Pearson Education, 2005

**REFERENCES:**

1. Richard A. Johnson, "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, New Delhi, 2017
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, "Probability & Statistics for Engineers & Scientists", Pearson Education, New Delhi, 2016
3. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi 2020
4. Sheldon M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic press, USA, 2020

  
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## SEMESTER III

| U25ADG01 | Digital Principles and Computer Organization<br>(Common to AD, AM) | Category: ESC |   |   |   |   |
|----------|--------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                    | L             | T | P | J | C |
|          |                                                                    | 3             | 0 | 0 | 0 | 3 |

## COURSE OBJECTIVES:

- To assess the concepts and working principles of combinational digital circuits with basic gates
- To study the fundamental concepts and operations of a digital computer
- To learn the design and functioning of the data path, control unit and working mechanism of pipelined execution with memory and I/O interfacing

## COURSE OUTCOMES:

- CO 1:** Simplify and design combinational logic circuits such as adders, subtractors, comparators, decoders, encoders, multiplexers, and demultiplexers using Boolean algebra and Karnaugh maps **Apply**
- CO 2:** Analyze and design synchronous sequential circuits including flip-flops, registers, and counters using Moore and Mealy models with appropriate state minimization and assignment techniques. **Analyze**
- CO 3:** Explain the evolution, organization, and instruction set architecture of computers, including addressing modes, instruction sequencing, and performance measurement metrics **Understand**
- CO 4:** Design and analyze processor datapaths and control units using hardwired and microprogrammed approaches, and evaluate pipelining concepts along with associated hazards **Apply**
- CO 5:** Describe the organization of memory systems and various I/O interfacing techniques such as interrupts, DMA, and standard I/O interfaces **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 2       | 3   | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 3       | 2   | 1   | -   | -   | 2   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 4       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | 1    | 1    | -    |
| CO 5       | 3   | 2   | 1   | 1   | 2   | -   | -   | -   | -   | -    | 1    | 1    | -    |

## SYLLABUS:

## UNIT I: COMBINATIONAL LOGIC

9

Combinational Circuits – Karnaugh Map – Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder – Magnitude Comparator – Decoder – Encoder – Multiplexers Demultiplexers

## UNIT II: SYNCHRONOUS SEQUENTIAL LOGIC

9

Introduction to Sequential Circuits – Flip-Flops – Triggering of FF– Analysis of clocked sequential circuits – Moore/Mealy models – State minimization – State assignment – Registers – Counters.

**UNIT III: COMPUTER FUNDAMENTALS**

9

Evolution of Computers – Machine Instructions: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Bus Structure – Performance Measurement – Basic performance equation, Clock rate – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes – Interaction between Assembly and High - Level Language

**UNIT IV: PROCESSOR DATAPATH AND CONTROL UNIT**

9

Instruction Execution – Building a data path – Fetching and storing words – Register Transfer – Execution of Instruction – Computer registers – Computer instructions – Designing a control unit – Hardwired control – Microprogrammed control. Basic concepts of pipelining – Instruction pipeline – Pipeline hazards – Instruction level parallelism – Computer principles – ASIC, FPGA, RISC versus CISC

**UNIT V: MEMORY SYSTEM AND INPUT OUTPUT ORGANIZATION**

9

Basic concepts of memory – Read Only Memories – Random Access Memory – Cache memories – mapping functions – Page Replacement Algorithms – Virtual memories – Secondary storage – Accessing I/O Devices – Interrupts – Direct Memory Access – Standard I/O Interfaces: PCI – SCSI – USB

**CONTACT PERIODS:**

|                            |                            |                             |                           |                          |
|----------------------------|----------------------------|-----------------------------|---------------------------|--------------------------|
| <b>Lecture:</b> 45 Periods | <b>Tutorial:</b> - Periods | <b>Practical:</b> - Periods | <b>Project:</b> - Periods | <b>Total:</b> 45 Periods |
|----------------------------|----------------------------|-----------------------------|---------------------------|--------------------------|

**TEXTBOOKS:**

1. M. Morris Mano and Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", 6th edition, Pearson Education, 2018
2. William Stallings, "Computer Organization and Architecture: Designing for Performance", 12th edition, Pearson Education, 2024
3. John L. Hennessy and David A. Patterson, "Computer Architecture: A Quantitative Approach", 7th edition, Morgan Kaufmann, 2025

**REFERENCES:**

1. Mostafa Abd-El-Barr and Hesham El-Rewini, "Fundamentals of Computer Organization and Architecture", Wiley, 2005
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, "Computer Organization and Embedded Systems", 6th edition, McGraw-Hill Education, 2022
3. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016

  
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## SEMESTER III

| U25AD301 | Artificial Intelligence | Category: PCC |   |   |   |   |
|----------|-------------------------|---------------|---|---|---|---|
|          |                         | L             | T | P | J | C |
|          |                         | 3             | 0 | 0 | 0 | 3 |

## COURSE OBJECTIVES:

- To introduce the foundational concepts of intelligent agents, problem-solving methods, and search strategies in artificial intelligence
- To develop the ability to model, analyze, and solve decision-making, logical reasoning, and constraint-based problems using appropriate AI techniques
- To understand and apply knowledge representation and uncertainty models for designing intelligent systems

## COURSE OUTCOMES:

- CO 1: Explain the principles of intelligent agents, rationality and implement uninformed search strategies Apply
- CO 2: Apply heuristic, informed, adversarial, and local search algorithms to solve structured and unstructured AI problems Apply
- CO 3: Analyze constraint satisfaction problems and game environments to determine suitable search, propagation, and reasoning strategies Analyze
- CO 4: Implement logical inference methods using propositional and first-order logic to derive conclusions from knowledge bases Apply
- CO 5: Construct uncertainty models such as Bayesian networks and ontological representations for intelligent decision-making Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    |
| CO 3       | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    |
| CO 5       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    |

## SYLLABUS:

UNIT I: INTELLIGENT AGENTS 9

Introduction to AI – Agents and Environments – Concept of rationality – Nature of environments – Structure of agents – Problem solving agents – Search algorithms – Uninformed search strategies (BFS, DFS, UCS, IDS, Bidirectional Search)

UNIT II: PROBLEM-SOLVING AS SEARCH 9

Heuristic search strategies – Greedy best-first Search – A\* Algorithm – Heuristic functions – Local search and optimization problems – Hill climbing – Simulated Annealing – Genetic algorithms

UNIT III: ADVERSARIAL SEARCH AND VARIABLE BASED MODEL 9

Game theory – Optimal decisions in games – Alpha-beta search – Stochastic games – Partially observable games – Constraint satisfaction problems – Constraint Propagation – Backtracking search for CSP – Local search for CSP – Structure of CSP

**UNIT IV: LOGIC BASED MODEL**

9

Knowledge-based agents – Propositional logic – Syntax and semantics – Knowledge Base – Inference rule – CNF – Resolution – Agents based on propositional logic – First-order logic – Syntax and semantics – Inferences in first-order logic – Forward chaining – Backward chaining – Resolution

**UNIT V: UNCERTAINTY MODEL AND KNOWLEDGE REPRESENTATION**

9

Uncertainty in AI – Bayesian Networks – Monte Carlo Search – Ontological engineering – Categories and objects – Events – Mental objects and modal logic – Reasoning systems for categories – Reasoning with default information

**CONTACT PERIODS:**

Lecture: 45 Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 45 Periods

**TEXTBOOKS:**

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", 4th Edition, Pearson Education, 2022
2. Kevin Knight, Elaine Rich, "Artificial Intelligence", 5th Edition, Tata McGraw-Hill, 2025

**REFERENCES:**

1. David L. Poole & Alan Mackworth, "Artificial Intelligence: Foundations of Computational Agents", 2nd Edition, Cambridge University Press, 2017
2. Denis Rothman, "Artificial Intelligence by Example: Develop machine intelligence from scratch using real artificial intelligence use cases", 1st Edition, Packt, 2018
3. Dan W. Patterson, "Introduction to AI and ES", 1st Edition, Pearson Education, 2007



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## SEMESTER III

| U25ADG02 | Data Structures and Algorithms<br>(Common to AD, BM, EC, EE, MI) | Category: PCC |   |   |   |   |
|----------|------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                  | L             | T | P | J | C |
|          |                                                                  | 3             | 0 | 2 | 0 | 4 |

## COURSE OBJECTIVES:

- To understand the fundamental concepts of ADT and data structure types
- To learn linear and non linear data structures
- To explore tree and graph data structures

## COURSE OUTCOMES:

- CO 1:** Implement linear data structures such as lists, stacks and queues using array-based and linked-list-based techniques Apply
- CO 2:** Apply searching and sorting techniques to solve real-time data organization problems Apply
- CO 3:** Apply tree-based data structures including binary trees, binary search trees and AVL trees to perform efficient data representation, traversal and manipulation Apply
- CO 4:** Apply graph representations and graph algorithms to solve problems involving traversal, shortest paths, topological ordering and minimum spanning trees Apply
- CO 5:** Explain the analysis of algorithms, time and space complexity Understand

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 2       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 3       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 4       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 5       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |

## SYLLABUS:

## UNIT I: LINEAR DATA STRUCTURES – LIST, STACKS, QUEUES

9 + 6

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list-based implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of linked list: Polynomial ADT, Radix sort, Multilist. Stack ADT – Operations – Applications – Symbol balancing – Evaluating arithmetic expressions – Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – DeQueue – Applications of queues

## UNIT II: SEARCHING, SORTING AND HASHING TECHNIQUES

9 + 6

Searching: Linear Search—Binary Search. Sorting: Bubble sort-Insertion sort-Selection sort- Merge sort - Quick sort. Hashing – Hash Functions – Separate Chaining – Open Addressing –Rehashing – Extendible Hashing

## UNIT III: NON-LINEAR DATA STRUCTURES – TREES

9 + 6

Tree ADT – Tree traversals – Binary Tree ADT – Expression trees – Binary search tree ADT –AVL Trees

**UNIT IV: NON-LINEAR DATA STRUCTURES - GRAPHS**

9 + 6

Introduction to Graph – Types of graph-Representation of graphs – Graph traversal: Breadth-first traversal – Depth-first traversal – Topological ordering –Dijkstra's algorithm- Minimum spanning tree algorithms – Prims algorithm - Kruskal's Algorithm

**UNIT V: ALGORITHM ANALYSIS**

9 + 6

Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency – Asymptotic Notations and its properties – Mathematical analysis for Recursive and Non recursive algorithms.

**LIST OF EXPERIMENTS**

1. A small library stores the list of newly arrived books in an array-based structure. The librarian wants to maintain the order of arrival. Given the arrival sequence: "AI Basics", "Data Science", "Python 101", "Algorithms", "Machine Learning", Insert them into an array-based List ADT. A book "Cyber Security" arrives and must be inserted at position 3. Later, "Python 101" is removed as it's damaged. Design the array-based List ADT operations to update the list and display the final order.
2. A hospital needs to maintain a waiting list of patients dynamically as patients arrive and get treated. Insert patients: John, Priya, Abdul, Meera in order. A senior citizen "Ravi" should be added after Priya. "Abdul" leaves before consultation. Using Linked List ADT, show how the list changes after each operation.
3. An airport check-in counter processes passengers using a circular queue system. Passengers arriving in order: P1, P2, P3, P4, P5. The queue size is 4 due to staff shortage. • Enqueue all passengers in order and show how overflow occurs. Two passengers are processed (dequeued). P6 and P7 arrive. Simulate these operations using array-based circular queue and show rear/front updates.
4. A bank uses a linked-list-based queue for serving customers. Customers: A, B, C arrive. Then D arrives. B and C are served. Implement the queue operations and show the dynamic linked list changes.
5. A sports event records running times of participants. The unsorted times are 15.2, 12.8, 20.5, 11.6, 19.3. The coach wants to sort the times to shortlist top performers. Apply Bubble Sort and Insertion Sort separately to sort the timings. Show the status of the list after each pass for both algorithms.
6. An online store wants to quickly sort product prices for discount analysis. Prices are 499, 199, 999, 350, 150, 750. Use Quick Sort (first element as pivot) and show partition steps. Use Merge Sort and show the splitting and merging stages.
7. A college stores roll numbers of students in a system. For a particular exam, the roll numbers are sorted [101, 115, 130, 145, 152, 170, 185]. • Apply Binary Search and show mid calculations for each iteration. Compare it with how Linear Search would behave for the same case. A teacher wants to find whether roll number 152 is present.
8. A company stores employee IDs in a hash table of size 10. Employee IDs: [1001, 1123, 1198, 1455, 1677]. Apply open addressing and closed addressing hashing techniques and show the optimal one.
9. A university stores student scores in a BST for quick rank retrieval. Scores: [75, 60, 90, 45, 65, 85, 95]. Construct the BST. Apply inorder, preorder, and postorder traversal. Later, student scores 45, 65 and 75 need removal due to correction. Show the tree after each deletion and state the rule used.
10. A delivery company wants to find the fastest delivery route between warehouses in a city. Given a weighted graph (distances between warehouses): A → B : 4 A → C : 2 B → D : 5 C → B : 1 C → D : 8 D → E : 6 Apply Dijkstra's algorithm starting from A and determine: Shortest path from A to all other warehouses. Distance table update for each step.
11. A telecom company wants to lay cables between cities at minimum cost. The network between cities is modeled as a weighted graph. Apply Prim's algorithm to find the Minimum Spanning Tree and list the edges selected at each step, growing MST, total cost.
12. A power grid network wants to connect electricity stations with minimal wiring cost. The weighted edges between stations are provided. Apply Kruskal's algorithm by sorting edges by weight.

**CONTACT PERIODS:**

Lecture: 45 Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 75 Periods

**TEXTBOOKS:**

1. Reema Thareja, "Data Structures and Algorithms", 1st edition, Oxford University Press, 2025
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, "Fundamentals of Data Structures in C", 2nd Edition, Techno Series, 2024

**REFERENCES:**

1. R. Venkatesan, S. Lovelyn Rose, "Data Structures", 2nd Edition, Wiley, 2019
2. Seymour Lipschutz, "Data Structures", 2nd Edition, McGraw Hill Education, 2017
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "The Design and Analysis of Computer Algorithms", 1st Edition, Pearson Education Asia, 2013

  
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## SEMESTER III

| U25ADG03 | Data Exploration and Visualization<br>(Common to AD, CS) | Category: PCC |   |   |   |   |
|----------|----------------------------------------------------------|---------------|---|---|---|---|
|          |                                                          | L             | T | P | J | C |
|          |                                                          | 2             | 0 | 2 | 0 | 3 |

## PRE-REQUISITES:

- U25CSG05 - Computational problem-solving using python / U25RCSG04 - Python Programming

## COURSE OBJECTIVES:

- Introduce the core purpose of EDA, types of data, and statistical thinking that underpins exploration to analyze single and multi-variable relationships and visualize them meaningfully
- Teach handling and visualization of temporal, text and categorical, image data, introducing use of it in upcoming courses respectively
- Familiarize students with essential visualization tools, introduce design principles and storytelling which helps to present data clearly, and ethically in real-world scenarios

## COURSE OUTCOMES:

- CO 1:** Explain the principles, objectives, and scope of exploratory data analysis and identify appropriate Understand statistical measures for different data types
- CO 2:** Apply univariate, bivariate, and multivariate EDA techniques using Python-based tools to summarize and interpret diverse datasets. **Apply**
- CO 3:** Analyze time series, textual, and categorical datasets using appropriate preprocessing, transformation, and visualization techniques **Analyze**
- CO 4:** Create interactive and meaningful data visualizations using modern libraries (Matplotlib, Seaborn, Plotly) and business intelligence tools (Power BI, Tableau) **Apply**
- CO 5:** Design and present insightful dashboards and visual narratives that incorporate ethical visualization practices, accessibility, and storytelling principles **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | 1    | 2    | 2    |
| CO 2       | 3   | 2   | 1   | 1   | 3   | -   | -   | -   | -   | -    | 2    | 2    | 3    |
| CO 3       | 3   | 3   | 2   | 2   | 3   | -   | -   | -   | -   | -    | 2    | 2    | 3    |
| CO 4       | 3   | 2   | 1   | 1   | 3   | -   | -   | -   | 2   | -    | 3    | 2    | 3    |
| CO 5       | 3   | 2   | 1   | 1   | -   | -   | 3   | -   | 3   | 3    | 3    | 2    | 3    |

## SYLLABUS:

## UNIT I: FOUNDATION OF DATA AND ANALYSIS

6 + 6

Introduction to EDA – Types of Data – Measure of central tendency and dispersion: Mean, median, mode, variance, standard deviation, IQR, percentiles – Outlier and anomalies – Introduction to python for EDA – AI based EDA framework

**UNIT II: UNIVARIATE, BIVARIATE, AND MULTIVARIATE ANALYSIS****6 + 6**

Univariate analysis and visualization: Frequency tables, histograms, density plots, boxplots, violin plots – Bivariate analysis: Scatterplots, grouped bar plots, covariance, correlation coefficients – Multivariate analysis: Heatmaps, scatter matrix, pair plots; identifying trends and clusters – Dimensionality reduction: PCA – Feature selection, multicollinearity detection – Transformation

**UNIT III: TIME SERIES, CATEGORICAL, TEXTUAL DATA EXPLORATION****6 + 6**

Time series data: Components lag, autocorrelation. Examples: sales, climate, IoT – Visualization of time series – Categorical Data – Textual data – Overview of data cleaning and visualization for time series and textual data

**UNIT IV: VISUALIZATION TOOLS AND BEST PRACTICES****6 + 6**

History of Data Visualization: Classic visualizations – Python visualization libraries – Power BI and Tableau Basics – Introduction to D3.js – Chart selection and design guidelines – Color schemes and accessibility of the design

**UNIT V: STORYTELLING, ETHICS, AND COMMUNICATION****6 + 6**

Design insightful dashboards – Storytelling – Visual ethics and bias – Visual clarity and simplicity – Presentation visuals – Applications area

**LIST OF EXPERIMENTS**

1. Matplotlib Basics: Code simple charts from sample data (scatter, line, bar). Practice labeling axes and titles.
2. Statistical Plots: Use Seaborn to make histograms, boxplots, and scatterplots with regression lines. Detect outliers and describe distributions.
3. Data Cleaning in Python: Work with pandas to load datasets, identify/handle missing values and anomalous data points. Re-plot after cleaning to see impact.
4. Interactive Charts with Plotly: Build interactive scatter/line charts and dashboards using Plotly or Dash. Add tooltips and filters.
5. Tableau Workshop: Connect Tableau to a real-world multi-type, multivariable, and big dataset. Create a dashboard with charts.
6. Power BI Workshop: Integration with Excel/SQL to import data. Create an interactive dashboard, explain it like a story.
7. Geospatial EDA: Using packages like folium or Power BI's map visuals to handle spatial data.
8. D3.js Introduction: Use a simple HTML/JavaScript template. Load data (CSV/JSON) and make a basic D3 bar chart or force-directed graph to introduce web visuals.
9. Real-time Data Dashboards: Using live APIs (e.g., weather, finance) to build dashboards.
10. Storytelling & Presentation Practice: Students prepare a mini report/presentation on a small dataset. Focus on narrative flow and design. Feedback on clarity and engagement.
11. Final Project Work: Students choose an individual/group problem statement with various dataset, perform EDA, create visuals, and prepare a short presentation. (Projects should apply course tools and principles. They encourage creativity and personal interest – e.g. sports, social data.)

**CONTACT PERIODS:**

**Lecture:** 30 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Claus O. Wilke, "Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures", O'Reilly Media, 2019

2. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", 2nd Edition, O'Reilly, 2014
3. Tamara Munzner, "Visualization Analysis and Design", 1st edition, CRC Press, 2014
4. Stephanie D. H. Evergreen, "Effective Data Visualization: The Right Chart for the Right Data", 1st edition, SAGE Publications, 2016

**REFERENCES:**

1. Jyoti Gaikwad, AI-Based Exploratory Data Analysis, International Journal of Scientific Research in Computer Science, Engineering and Information Technology, April 2025, Vol. 11(2), DOI: 10.32628/CSEIT25112860.
2. Eric Pimpler, "Data Visualization and Exploration with R", GeoSpatial Training Services, 2017
3. Christian Tominski & Heidrun Schumann, "Interactive Visual Data Analysis", 1st edition, CRC Press, 2020
4. Alex C. Telea, Data Visualization: Principles and Practice, 1st edition, CRC Press, 2019
5. <https://learn.microsoft.com/power-bi> – Microsoft Power BI Documentation
6. <https://www.kaggle.com/learn/data-visualization> – Practical Visualization Exercises



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## SEMESTER III &amp; IV

| U25CSG11 | Object Oriented Programming Using Java<br>(Common to AD, AM, BM, CB, CS, EC, EE, IT, MI, SC) | Category: PCC |   |   |   |   |
|----------|----------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                                              | L             | T | P | J | C |
|          |                                                                                              | 3             | 0 | 0 | 0 | 3 |

## COURSE OBJECTIVES:

- To introduce object-oriented programming concepts and Core Java programming fundamentals
- To develop Java applications using classes, inheritance, polymorphism, interfaces, and exception handling mechanisms
- To provide programming skills in multithreading, collections framework, and file handling using Java APIs
- To enable students to develop modular and reusable Java applications using standard libraries and object-oriented design principles

## COURSE OUTCOMES:

- CO 1:** Describe object-oriented programming concepts and Java fundamentals for developing simple applications **Understand**
- CO 2:** Develop Java applications using inheritance, polymorphism, abstract classes, interfaces, and packages **Apply**
- CO 3:** Develop Java programs incorporating exception handling and multithreading concepts **Apply**
- CO 4:** Develop Java applications using collections, generics, and related utility classes **Apply**
- CO 5:** Develop Java applications using file handling, stream processing, and object serialization techniques **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 2       | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 3       | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |
| CO 4       | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |
| CO 5       | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |

## SYLLABUS:

## UNIT I: INTRODUCTION TO OBJECT-ORIENTED PROGRAMMING AND JAVA BASICS

9

Procedure-Oriented vs Object-Oriented Java Features and Platform: JVM, JRE, JDK – Java Program Structure & Memory Layout – Classes and Objects – Static and non-static members, static and non-static Methods, Constructors – Access Modifiers, Abstraction and Encapsulation – Scanner and System classes

## UNIT II: INHERITANCE AND POLYMORPHISM

9

Inheritance and types – Polymorphism: Method Overloading and Overriding – Abstract Classes and Methods – Interfaces. Java packages : Built in and user defined packages

## UNIT III: EXCEPTION HANDLING AND MULTITHREADING

9

Exception Handling: try, catch, throw, throws, finally – Built in exception classes and User defined Exceptions – Multithreading: Thread Lifecycle, Creating Threads, Thread Class and Runnable Interface, Thread Priorities, Synchronization – Inter-thread Communication, Deadlock prevention

**UNIT IV: COLLECTIONS FRAMEWORK AND GENERICS**

9

Collections Framework – Generics and Type Safety – Wrapper Classes and Autoboxing/Unboxing – Interfaces and Classes: List, Set, Map, Queue – Implementations: ArrayList, LinkedList, HashSet, TreeSet, HashMap, TreeMap – Iterators – Comparator and Comparable Interfaces

**UNIT V: JAVA I/O AND FILES**

9

Java I/O Framework – Input and Output Streams – Readers and Writers – File I/O using File, FileReader, FileWriter, BufferedReader, BufferedWriter and Files – Console Input using Scanner and Console – Serialization and Deserialization – Object Streams

**CONTACT PERIODS:**

|                            |                            |                             |                           |                          |
|----------------------------|----------------------------|-----------------------------|---------------------------|--------------------------|
| <b>Lecture:</b> 45 Periods | <b>Tutorial:</b> - Periods | <b>Practical:</b> - Periods | <b>Project:</b> - Periods | <b>Total:</b> 45 Periods |
|----------------------------|----------------------------|-----------------------------|---------------------------|--------------------------|

**TEXTBOOKS:**

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, 2018
2. Cay S. Horstmann and Gary Cornell, "Core Java 2, Vol 1, Fundamentals", 11th Edition, Pearson Education, 2020

**REFERENCES:**

1. J. Nino and F. A. Hosch, "An Introduction to Programming and OO Design using Java", 1st Edition, John Wiley & Sons, 2018
2. Paul Deitel and Harvey Deitel, "Java SE 8 for Programmers", 3rd Edition, Pearson, 2015
3. E. Balagurusamy, "Programming with Java", 6th Edition, McGraw Hill Education, 2019



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## SEMESTER III

| U25AD302 | Artificial Intelligence Laboratory | Category: PCC |   |   |   |   |
|----------|------------------------------------|---------------|---|---|---|---|
|          |                                    | L             | T | P | J | C |
|          |                                    | 0             | 0 | 4 | 0 | 2 |

## COURSE OBJECTIVES:

- To develop practical skills in implementing search and optimization algorithms
- To gain experience in solving AI problems using adversarial and constraint-based approaches
- To implement logic-based reasoning systems and inference engines
- To build probabilistic and knowledge representation models for intelligent systems
- To use Python-based AI libraries and tools for developing AI applications

## COURSE OUTCOMES:

|       |                                                                                                                 |       |
|-------|-----------------------------------------------------------------------------------------------------------------|-------|
| CO 1: | Develop intelligent-agent models and implement classical search algorithms                                      | Apply |
| CO 2: | Apply heuristic, optimization, and evolutionary algorithms to solve AI problems                                 | Apply |
| CO 3: | Implement adversarial search and constraint satisfaction techniques for decision-making tasks                   | Apply |
| CO 4: | Construct logic-based reasoning systems using propositional and first-order inference methods                   | Apply |
| CO 5: | Develop probabilistic reasoning and ontology-based knowledge representation models for intelligent applications | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 3       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    |
| CO 5       | 3   | 2   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 2    |

## LIST OF EXPERIMENTS

1. Develop PEAS descriptions for various intelligent agents.
2. Implement Breadth First Search (BFS) and Depth First Search (DFS).
3. Implement Uniform Cost Search and Iterative Deepening Search.
4. Implement Greedy Best First Search and A\* Search.
5. Implement Hill Climbing for optimization problems.
6. Implement Simulated Annealing for optimization tasks.
7. Implement Genetic Algorithms for search and optimization.
8. Implement Minimax and Alpha-Beta Pruning algorithms.
9. Implement Backtracking Search for Constraint Satisfaction Problems.
10. Implement Constraint Propagation and Local Search techniques for CSP.
11. Implement Propositional Logic inference using Resolution and CNF conversion.
12. Implement Bayesian Network-based reasoning and simple Ontology modeling using Protégé.

**CONTACT PERIODS:**

**Lecture:** - Periods      **Tutorial:** - Periods      **Practical:** 60 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, Pearson Education, 2022
2. Kevin Knight, Elaine Rich, "Artificial Intelligence", 5th Edition, Tata McGraw-Hill, 2025

**REFERENCES:**

1. David L. Poole & Alan Mackworth, "Artificial Intelligence: Foundations of Computational Agents", 2nd Edition, Cambridge University Press, 2017
2. Denis Rothman, "Artificial Intelligence by Example: Develop machine intelligence from scratch using real artificial intelligence use cases", 1st Edition, Packt, 2018
3. Dan W. Patterson, "Introduction to AI and ES", 1st Edition, Pearson Education, 2007



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## SEMESTER III &amp; IV

| U25CSG13 | Object Oriented Programming Using Java Laboratory<br>(Common to AD, AM, BM, CB, CS, EC, EE, IT, MI, SC) | Category: PCC |   |   |   |   |
|----------|---------------------------------------------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                                                         | L             | T | P | J | C |
|          |                                                                                                         | 0             | 0 | 2 | 0 | 1 |

## COURSE OBJECTIVES:

- To understand the fundamental concepts of object-oriented programming using Java for developing modular and reusable applications
- To apply inheritance, polymorphism, exception handling, and multithreading concepts in developing robust Java applications
- To develop collection-based and file-processing applications using Java I/O, generics, and collections framework for real-world problem solving

## COURSE OUTCOMES:

- CO 1: Implement the fundamental concepts of object-oriented programming, Java program structure, classes, objects, and encapsulation principles Apply
- CO 2: Develop Java applications using inheritance, polymorphism, abstract classes, interfaces, and packages Apply
- CO 3: Implement exception handling and multithreading mechanisms for developing reliable and concurrent applications Apply
- CO 4: Utilize collections framework, generics, and sorting mechanisms for efficient data management and processing Apply
- CO 5: Develop file handling and object persistence applications using Java I/O streams, serialization, and deserialization techniques Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 5       | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |

## LIST OF EXPERIMENTS

1. Design and implementation of Java programs demonstrating classes, objects, constructors, and methods
2. Development of applications illustrating static and non-static members, access modifiers, abstraction, and encapsulation
3. Implementation of console-based applications using Scanner and System classes for input and output processing
4. Design and implementation of applications demonstrating inheritance and its various types
5. Development of applications illustrating compile-time and runtime polymorphism using method overloading and method overriding
6. Implementation of applications using abstract classes, interfaces, and dynamic method dispatch mechanisms
7. Design and development of modular Java applications using built-in and user-defined packages
8. Implementation of robust exception handling mechanisms using built-in and user-defined exceptions
9. Development of multithreaded applications using Thread class and Runnable interface

10. Design and implementation of synchronized multithreaded applications with inter-thread communication
11. Development of applications demonstrating thread lifecycle management and deadlock prevention techniques
12. Implementation of generic collection-based applications using List, Set, Map, and Queue interfaces
13. Design of applications utilizing Comparator and Comparable interfaces for customized sorting operations
14. Development of file processing applications using Java I/O streams, readers, writers, and buffered streams
15. Implementation of object persistence mechanisms using serialization and deserialization techniques

**CONTACT PERIODS:**

Lecture: - Periods      Tutorial: - Periods      Practical: 30 Periods      Project: - Periods      Total: 30 Periods

**REFERENCES:**

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, 2018
2. Cay.S.Horstmann and Gary Cornell, "Core Java 2, Vol 1, Fundamentals", 11th Edition, Pearson Education, 2020



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## SEMESTER II

| U25MNC02 | Essence of Indian Traditional Knowledge<br>(Common to all programmes) | Category: MNC |   |   |   |   |
|----------|-----------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                       | L             | T | P | J | C |
|          |                                                                       | 1             | 0 | 0 | 0 | 0 |

## COURSE OBJECTIVES:

- Understand the Concept of culture in ancient, medieval and modern period.
- Know the need and importance of Indian languages and Literature.
- Understand the various religion and philosophy in various periods.

## COURSE OUTCOMES:

|                                                                   |            |
|-------------------------------------------------------------------|------------|
| CO 1: Understand Philosophy of Indian culture                     | Understand |
| CO 2: Distinguish the Indian languages and literature.            | Understand |
| CO 3: Learn the philosophy of ancient, medieval and modern Indian | Remember   |
| CO 4: Acquire the information about the fine arts in India        | Apply      |
| CO 5: Know the contribution of scientists different eras          | Understand |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | 2   | -   | 1   | -   | -   | 3   | -   | -   | -    | -    | -    | -    |
| CO 2       | -   | 2   | -   | 1   | -   | -   | 3   | -   | -   | -    | -    | -    | -    |
| CO 3       | -   | 2   | -   | 1   | -   | -   | 3   | -   | -   | -    | -    | -    | -    |
| CO 4       | -   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    |
| CO 5       | -   | 2   | -   | 1   | -   | -   | 3   | -   | -   | -    | -    | -    | -    |

## SYLLABUS:

## UNIT I: INTRODUCTION TO CULTURE

5

Culture, Civilization, Culture and heritage, General characteristics of culture, Importance of culture in human literature, Indian culture, Ancient India, Medieval India, Modern India

## UNIT II: INDIAN LANGUAGES AND LITERATURE

5

Indian Languages and Literature-I: The role of Sanskrit, Significance of scriptures to current society, Indian philosophies, other Sanskrit literature, Literature of south India Indian Languages and Literature-II: Northern Indian Languages & literature, Temples and Temple types, Sculptors 's specialties, Temples Individualities Festivals and hopes

## UNIT III: RELIGION AND PHILOSOPHY

5

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (Selected Movements only)

**UNIT IV: ARTS, SCIENCE, TECHNOLOGY & ENGINEERING IN INDIA**

5

Indian painting, Handicrafts, Music, Divisions of Indian classical music, Modern Indian music, Dance and drama, Indian architecture (ancient, medieval and modern), Science and technology in India, Development of science in different periods, Sushruta and Charaka, sages of South India, herbal treatments, Surgery methods of healers, Yoga and pranayama practices, Herbal usages and medication-making methods.

**UNIT V: EDUCATION SYSTEM IN INDIA**

5

Education in ancient, Medieval and modern India, Aims of education, subjects, languages, science and scientists of Ancient India, Medieval India and Modern India

**CONTACT PERIODS:**

**Lecture:** 25 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 25 Periods

**TEXTBOOKS:**

1. Kapil Kapoor, "Text and Interpretation: The India Tradition", ISBN: 81246033375, 2005.
2. "Science in Sanskrit", Samskrita Bharti Publisher, ISBN: 978-8187276333, 2007.

**REFERENCES:**

1. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989.
2. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN: 9788120810990, 2014.
3. S. Narain, "Examinations in Ancient India", Arya Book Depot, 1993.
4. NCERT, "Position Paper on Arts, Music, Dance and Theatre", 2000.
5. B. Kumar Mohanta & Vipin Kumar Singh, "Traditional Knowledge System and Technology in India", 2012.

  
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## SEMESTER III

| U25RMCC08 | Professional Skill Development - III<br>(Common to all programmes) | Category: MCC |   |   |   |   |
|-----------|--------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                    | L             | T | P | J | C |
|           |                                                                    | 15 Hours      |   |   |   | 1 |

## COURSE OUTCOMES:

- CO 1:** Demonstrate technical skill competency through attainment of industry-relevant certifications, participation in competitions, internships, and project-based learning activities **Apply**
- CO 2:** Apply research, innovation, and problem-solving skills to develop impactful solutions through projects, publications, patents, and higher education preparation **Apply**
- CO 3:** Exhibit leadership, ethical responsibility, community engagement, and professional digital presence to enhance career readiness and lifelong learning **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 2   | -   | 3   | 1   | -   | -   | 2   | 2    | -    | -    | -    |
| CO 2       | 2   | 3   | 3   | 2   | 2   | 2   | -   | -   | 1   | 1    | -    | -    | -    |
| CO 3       | -   | -   | 3   | -   | -   | 2   | 2   | 3   | 3   | 3    | 2    | -    | -    |

## GUIDELINES:

- Certifications and Skill Credentials - Free awareness certs, NPTEL/Coursera, Associate-level, Professional-level, Expert-level
- Competitions, Hackathons, and Technical Challenges - Online, institution, state, national, international competitions and hackathons, Kaggle medals
- GATE Preparation and Performance - Study plan, mock tests, registration, appearing, score percentile
- Academic, Industry, and Innovation Projects - Mini-projects, intermediate projects, industry-grade deployed projects, funded or published projects
- Internships and Industrial Training - Virtual, on-site short, core role, CoE on-campus, PPO, PPO converted to offer
- Research Publications, Patents, Intellectual Property - Reading journals, survey papers, conference papers, Scopus/WoS, Q1/Q2 journals, patents from provisional to granted
- Leadership, Community, Digital Presence - Club membership, event roles, office bearer, president, outreach, LinkedIn, GitHub, portfolio, Google Scholar

## CONTACT PERIODS:

Lecture: - Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 0 Periods

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## SEMESTER IV

| U25MA401 | Discrete Mathematics<br>(Common to AD, AM, CB, CS, IT, SC) | Category: BSC |   |   |   |   |
|----------|------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                            | L             | T | P | J | C |
|          |                                                            | 3             | 0 | 0 | 0 | 3 |

## COURSE OBJECTIVES:

- To develop logical reasoning and combinatorial counting skills including recurrence relations and induction
- To introduce the concepts of algebraic structures and graph theory concepts with matrix representations
- To facilitate the students to use fundamental principles of discrete structures in their respective field

## COURSE OUTCOMES:

|                                                                                                    |       |
|----------------------------------------------------------------------------------------------------|-------|
| CO 1: Apply logical connectives, truth tables, and quantifiers to validate propositions            | Apply |
| CO 2: Apply counting principles and solve linear recurrence relations using mathematical induction | Apply |
| CO 3: Classify algebraic structures (semigroups, monoids, groups) and analyse subgroup properties  | Apply |
| CO 4: Apply graph terminology, matrix representations, and identify Euler/Hamilton paths           | Apply |
| CO 5: Apply Boolean algebra and Karnaugh maps to minimize Boolean expressions                      | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 2       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 3       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 4       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 5       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |

## SYLLABUS:

## UNIT I: LOGIC AND PROOFS

9

Propositions – Logical connectives, truth tables, propositional equivalences – Tautology and contradiction – Predicates and quantifiers – Rules of inference – Methods of proofs

## UNIT II: COMBINATORICS

9

Basics of counting – Sum rule, product rule – Pigeonhole principle – permutations and combinations – Recurrence relations – Linear homogeneous recurrence relations – Mathematical induction

## UNIT III: ALGEBRAIC STRUCTURES

9

Relation and function – Types and properties, algebraic structures – Semigroups, monoids, groups, and abelian groups – Subgroups and their properties – Applications

## UNIT IV: GRAPH THEORY

9

Introduction to graphs and graph models – Graph terminology and types of graphs, complete, bipartite and regular graphs – Matrix representation of graphs and adjacency matrix – Graph isomorphism – Connectivity, paths, circuits and connected components – Euler and Hamilton graphs

**UNIT V: BOOLEAN ALGEBRA**

9

Boolean algebra and basic postulates – Principle of duality – Canonical forms of Boolean expressions– Karnaugh map and Minimization techniques – Applications

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, Special Indian Edition, 2016
2. Tremblay, J.P. and Manohar, R. "Discrete Mathematical Structures with Applications to Computer Science", 7th Edition, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2011

**REFERENCES:**

1. Susanna S. Epp, "Discrete Mathematics with Applications", 4th Edition, Cengage Learning, 2011
2. Richard Johnsonbaugh, "Discrete Mathematics", 7th Edition, Pearson, 2013
3. Bernard Kolman, Robert C. Busby, and Sharon Cutler Ross, "Discrete Mathematical Structures", 6th Edition, Pearson, 2013
4. Oscar Levin, "Discrete Mathematics: An Open Introduction", 4th Edition, Chapman & Hall, 2025

  
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## SEMESTER IV

| U25AMG02 | Machine Learning Essentials<br>(Common to AD, AM, CB) | Category: PCC |   |   |   |   |
|----------|-------------------------------------------------------|---------------|---|---|---|---|
|          |                                                       | L             | T | P | J | C |
|          |                                                       | 3             | 0 | 0 | 0 | 3 |

## PRE-REQUISITES:

- U25CSG04 - Python Programming \ U25RCSG04 - Python Programming

## COURSE OBJECTIVES:

- To introduce the fundamental principles, types of learning, and evaluation metrics in Machine Learning
- To develop the ability to design and implement supervised and unsupervised learning algorithms for regression, classification, clustering, and association rule mining
- To enable students to apply advanced ensemble and probabilistic learning techniques, feature engineering, and model interpretability methods for real-world analytical problem-solving

## COURSE OUTCOMES:

- CO 1: Explain the foundational concepts, learning paradigms, and evaluation metrics using standard ML frameworks and datasets **Understand**
- CO 2: Develop regression models to interpret numerical and categorical data patterns using appropriate regression algorithms and preprocessing techniques **Apply**
- CO 3: Implement and compare classification algorithms for solving real-world predictive modelling problems using labelled datasets and machine learning tools **Apply**
- CO 4: Utilize unsupervised learning approaches to discover hidden patterns, extract associations and reduce data dimensions using clustering and dimensionality reduction techniques **Apply**
- CO 5: Apply advanced and ensemble ML strategies to enhance predictive models and interpret complex data patterns using ensemble algorithms and evaluation techniques **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | -   | 1   | 2   | -   | -   | -   | -   | -    | 2    | -    | 3    |
| CO 2       | 3   | 3   | 2   | 2   | 3   | -   | -   | -   | -   | -    | 1    | -    | 3    |
| CO 3       | 3   | 3   | 2   | 2   | 3   | -   | -   | -   | -   | -    | 1    | -    | 3    |
| CO 4       | 3   | 2   | 1   | 3   | 3   | -   | -   | -   | -   | -    | 1    | -    | 3    |
| CO 5       | 3   | 2   | 2   | 3   | 3   | 1   | 1   | -   | -   | -    | 2    | -    | 3    |

## SYLLABUS:

## UNIT I: FUNDAMENTALS OF MACHINE LEARNING

9

Introduction – Scope and Applications of ML – Types of Learning: Supervised, Unsupervised, Semi-supervised, Reinforcement – ML Project Workflow – Model Representation and Evaluation – Overfitting and Underfitting – Bias-Variance Tradeoff – Evaluation Metrics: Accuracy, Precision, Recall, F1-score, ROC Curve

**UNIT II: SUPERVISED LEARNING: REGRESSION TECHNIQUES**

9

Linear, Multiple, and Polynomial Regression – Regularization: Ridge and Lasso Regression – Logistic Regression for Classification – Evaluation of Regression Models – Case Studies using Regression Algorithms

**UNIT III: SUPERVISED LEARNING: CLASSIFICATION TECHNIQUES**

9

Decision Tree and Random Forest Classifiers – K-Nearest Neighbor (KNN) – Naïve Bayes Classifier – Support Vector Machine (SVM) – Model Selection: Cross-Validation, Grid Search – Performance Evaluation: Confusion Matrix, ROC Curve

**UNIT IV: UNSUPERVISED LEARNING AND FEATURE EXTRACTION**

9

Clustering Techniques: K-Means, Hierarchical, DBSCAN – Evaluation Metrics for Clustering – Association Rule Mining: Apriori, FP-Growth – Dimensionality Reduction: PCA, LDA – Applications of Unsupervised Learning

**UNIT V: ADVANCED AND EMERGING MACHINE LEARNING TECHNIQUES**

9

Ensemble Learning: Bagging, Boosting, AdaBoost, Gradient Boosting, XGBoost – Probabilistic Learning: Bayesian Networks and Hidden Markov Models (Concepts) – Feature Selection and Feature Scaling Techniques – Model Interpretability: SHAP, LIME – Case Studies and Recent Trends in ML

**CONTACT PERIODS:**

**Lecture:** 45 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 45 Periods

**TEXTBOOKS:**

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 3rd edition, O'Reilly Media, 2023
2. John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics", 2nd edition, The MIT Press, 2020

**REFERENCES:**

1. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python", 1st edition, O'Reilly Media, 2017
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", 1st edition, The MIT Press, 2016
3. Kevin P. Murphy, "Machine Learning – A Probabilistic Perspective", 1st edition, The MIT Press, 2012
4. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 1st edition, Springer, 2006



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## SEMESTER III &amp; IV

| U25CSG16 | Database Management Systems<br>(Common to AD, AM, CB, CS, IT, SC) | Category: PCC |   |   |   |   |
|----------|-------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                   | L             | T | P | J | C |
|          |                                                                   | 3             | 0 | 0 | 0 | 3 |

## COURSE OBJECTIVES:

- To understand the fundamental concepts and architecture of database systems and design database schemas using appropriate data models
- To develop database applications using SQL and PL/SQL and apply database design principles such as normalization and transaction management
- To explore storage structures, indexing, and query optimization techniques and understand NoSQL database models for developing modern database applications using MongoDB

## COURSE OUTCOMES:

|       |                                                                                                        |            |
|-------|--------------------------------------------------------------------------------------------------------|------------|
| CO 1: | Explain database fundamentals and design database schemas using the ER model                           | Understand |
| CO 2: | Construct database applications and perform CRUD operations using SQL and advanced SQL features        | Apply      |
| CO 3: | Implement normalization and transaction management techniques to ensure data integrity and consistency | Apply      |
| CO 4: | Utilize indexing, hashing, and query processing techniques to improve data retrieval efficiency        | Apply      |
| CO 5: | Develop NoSQL database solutions using modern data models for data-driven applications                 | Apply      |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 3    | 2    | -    |
| CO 3       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 3    | 2    | -    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |
| CO 5       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 2    | 2    | -    |

## SYLLABUS:

## UNIT I: DATABASE CONCEPTS AND DATA MODELING

9

Introduction to DBMS – Database System Architecture – Levels of Abstraction – Views of data – Data Models – DBMS vs RDBMS – Relational Model: Relational Databases – Keys – Integrity Constraints – Relational Algebra – ER Model: Entities – Attributes – Relationships – ER diagrams – Mapping ER model to Relational tables

## UNIT II: SQL FUNDAMENTALS

9

SQL: Data Types – Types of SQL Commands – Operators – Clauses – Aggregate Functions – Joins – Nested Queries – Set Operations – Condition Logic – Advanced SQL: Views – PL/ SQL: Functions – Cursor – Exception Handling – Stored Procedures – Triggers

**UNIT III: DATABASE DESIGN AND PROCESSING**

9

Normalization: Functional Dependencies – Lossy/Lossless Decomposition – Dependency preservation – 1NF,2NF,3NF – BCNF – 4NF, 5NF – Transaction: Transaction Concepts and States – ACID Properties – Schedules – Serializability – Concurrency control – Locking protocols – Deadlock – Transaction recovery

**UNIT IV: DATABASE STORAGE AND INDEXING**

9

RAID Levels – File Organization – Data dictionary Storage – Indexing and Hashing: Ordered Indices – B tree Index – B+ tree Index – Static Hashing – Dynamic Hashing – Querying Processing and optimization

**UNIT V: NOSQL DATABASES**

9

NoSQL: Need for NoSQL – Characteristics and Applications – CAP Theorem – BASE vs ACID – NoSQL vs SQL– Types of NOSQL: Key-Value database – Document database – Column-Oriented database – Graph Database – MongoDB: Data Model and Architecture – CRUD Operations – Indexing and aggregation

**CONTACT PERIODS:**

Lecture: 45 Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 45 Periods

**TEXTBOOKS:**

1. A. Silberschatz, H. F. Korth and S. Sudarshan, "Database System Concepts", 7th edition, McGraw-Hill, 2019
2. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 8th edition, Pearson, 2026

**REFERENCES:**

1. Carlos Coronel and Steven Morris, "Database Systems: Design, Implementation and Management", 13th edition, Cengage Learning, 2021
2. Hector Garcia-Molina, Jeffrey D. Ullman and Jennifer Widom, "Database Systems: The Complete Book", 2nd edition, Pearson, 2009



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## SEMESTER IV

| U25AD401 | Image Processing and Visual Analytics | Category: PCC |   |   |   |   |
|----------|---------------------------------------|---------------|---|---|---|---|
|          |                                       | L             | T | P | J | C |
|          |                                       | 2             | 0 | 2 | 0 | 3 |

## PRE-REQUISITES:

- U25MA301 - Applied Probability and Statistics for Computing

## COURSE OBJECTIVES:

- To introduce the fundamental principles of digital image formation, processing, and representation
- To enable learners to apply segmentation, feature extraction, and vision algorithms for effective image analysis
- To develop skills in building modern computer vision models using machine learning and OpenCV-based implementations

## COURSE OUTCOMES:

|       |                                                                                                                               |            |
|-------|-------------------------------------------------------------------------------------------------------------------------------|------------|
| CO 1: | Explain the principles of image formation, perception, and representation                                                     | Understand |
| CO 2: | Apply image enhancement, filtering and restoration techniques in spatial and frequency domains                                | Apply      |
| CO 3: | Perform image segmentation and feature extraction using traditional and modern methods                                        | Analyze    |
| CO 4: | Apply machine learning techniques to develop basic image recognition models for computer vision applications                  | Apply      |
| CO 5: | Implement and evaluate computer vision techniques for real-time applications such as tracking, detection, and motion analysis | Analyze    |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | 3    | -    |
| CO 2       | 3   | 2   | 1   | 1   | 3   | -   | -   | -   | -   | -    | -    | 3    | -    |
| CO 3       | 3   | 3   | 2   | 2   | 3   | -   | -   | -   | -   | -    | -    | 3    | -    |
| CO 4       | 3   | 2   | 1   | 1   | 3   | -   | -   | -   | -   | -    | 2    | 3    | -    |
| CO 5       | 3   | 3   | 2   | 2   | 3   | -   | -   | -   | -   | -    | 2    | 3    | -    |

## SYLLABUS:

## UNIT I: INTRODUCTION TO COMPUTER VISION AND IMAGE FUNDAMENTALS

6 + 6

Digital image fundamentals – Image formation and sensing – Color models – Sampling and quantization – Image representation – Introduction to computer vision – Applications in surveillance, robotics, and medical imaging

## UNIT II: IMAGE ENHANCEMENT AND RESTORATION

6 + 6

Image enhancement in spatial and frequency domains – Histogram processing – Filtering techniques – Image restoration using inverse and Wiener filters – Edge detection using Canny, Sobel, and Laplacian operators

## UNIT III: IMAGE SEGMENTATION AND FEATURE EXTRACTION

6 + 6

Segmentation techniques: Thresholding, region growing, clustering-based segmentation (K-means, Mean-shift) – Feature extraction using HOG, SIFT, and SURF – Shape descriptors – Image registration

**UNIT IV: MACHINE LEARNING FOR COMPUTER VISION****6 + 6**

Introduction to machine learning based image recognition – Dataset preparation and feature selection Classification techniques: KNN and SVM – Dimensionality reduction basics: PCA – Model evaluation: accuracy score and confusion matrix

**UNIT V: COMPUTER VISION APPLICATIONS****6 + 6**

Basic motion detection – Object tracking using Meanshift and Camshift – Morphological operations for shape analysis and object detection – Face and gesture recognition using OpenCV – Overview of applications in robotics, healthcare, and surveillance

**LIST OF EXPERIMENTS**

1. Basic image operations using OpenCV – Reading, displaying, resizing, and color conversions.
2. Image enhancement techniques – Histogram equalization, smoothing, and sharpening filters
3. Image restoration – Implementation of noise models and inverse/Wiener filtering
4. Edge detection and feature extraction using Canny, Sobel, and Laplacian operators
5. Segmentation using thresholding, K-means, and Mean-shift algorithms
6. Feature extraction using HOG, SIFT, and SURF descriptors
7. Image Classification using K-Nearest Neighbors (KNN) or Support Vector Machine (SVM)
8. Object Tracking using Meanshift or Camshift

**CONTACT PERIODS:**

**Lecture:** 30 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Gary Bradski & Adrian Kaehler, "Learning OpenCV 4: Computer Vision with Python and OpenCV", 3rd edition, O'Reilly, 2021
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd edition, Springer, 2022

**REFERENCES:**

1. Gonzalez, Rafael C., and Richard E. Wood, "Digital Image Processing" 4th edition, Pearson Education, 2018
2. Christopher Bishop, "Pattern Recognition and Machine Learning", 2nd edition, Springer, 2016



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## SEMESTER IV

| U25CSG17 | Operating Systems<br>(Common to AD, AM, CB, CS, IT, SC) | Category: PCC |   |   |   |   |
|----------|---------------------------------------------------------|---------------|---|---|---|---|
|          |                                                         | L             | T | P | J | C |
|          |                                                         | 2             | 0 | 2 | 0 | 3 |

## COURSE OBJECTIVES:

- To explore the structure, functions, and evolution of modern operating systems across various architectures and process management concepts
- To study memory and deadlock management techniques for efficient resource utilization
- To explore file systems, storage management, and modern virtualization technologies such as RAID, virtual machines, and hypervisors

## COURSE OUTCOMES:

- CO 1: Describe the structure, functions, and architectural models of modern operating systems Understand
- CO 2: Utilize process management concepts such as scheduling, multithreading, synchronization, and Interprocess communication in solving computing problems Apply
- CO 3: Describe deadlock conditions and strategies for detection, prevention, avoidance, and recovery Understand
- CO 4: Utilize memory management techniques such as paging, segmentation, and memory-mapped files to manage and evaluate system memory effectively Apply
- CO 5: Implement file system and storage management mechanisms, including disk scheduling, RAID, and virtualization concepts Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 2       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 3       | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | -    |
| CO 4       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |
| CO 5       | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | -    |

## SYLLABUS:

## UNIT I: OPERATING SYSTEM OVERVIEW

6 + 6

Overview of Computer System – Memory Hierarchy – Cache Memory – Interrupts – Operating system overview – Objectives and functions – Evolution of Operating Systems – Architecture of Operating System: Monolithic, Layered, Microkernel, Modular – System Calls – System Programs – System Boot

## UNIT II: PROCESS MANAGEMENT

6 + 6

Process concepts – Process Control Block (PCB) – Process lifecycle – Process scheduling and CPU scheduling algorithms – Threads and multithreading – Interprocess Communication (IPC) – Process synchronization and mutual exclusion – Classical synchronization problems – Synchronization mechanisms

**UNIT III: DEADLOCK MANAGEMENT**

6 + 6

Principles of Deadlock – Necessary conditions – Deadlock Detection – Resource allocation Graph – Deadlock Avoidance – Banker's algorithm – Deadlock Prevention – Deadlock Recovery – Real - world Case Study: Deadlock in Databases, Distributed Systems

**UNIT IV: MEMORY MANAGEMENT**

6 + 6

Main Memory – Contiguous Allocation – Fixed Partitioning – Swapping – Virtual Memory – Paging – Segmentation – Demand Paging – Page Replacement Algorithms – Modern Memory Concepts: Thrashing and Working Set Model – Memory-mapped Files

**UNIT V: STORAGE MANAGEMENT**

6 + 6

File System Structure – Allocation Methods – Free Space Management – Disk Structure – Disk Scheduling Algorithms – Swap Space Management – Modern Storage: SSDs vs HDD, RAID levels – Introduction to Virtualization: Virtual Machines and Hypervisors

**LIST OF EXPERIMENTS**

1. Introduction to UNIX Commands and Shell Programming
2. Implementation of Process Creation and Management using System Calls
3. Simulation of CPU Scheduling Algorithms (FCFS, SJF, Round Robin)
4. Implementation of Interprocess Communication using Pipes or Shared Memory
5. Process Synchronization using Semaphores (Producer–Consumer Problem)
6. Simulation of Deadlock Avoidance using Banker's Algorithm
7. Implementation of Page Replacement Algorithms (FIFO, LRU)

**CONTACT PERIODS:**

**Lecture:** 30 Periods      **Tutorial:** - Periods      **Practical:** 30 Periods      **Project:** - Periods      **Total:** 60 Periods

**TEXTBOOKS:**

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th edition, John Wiley and Sons Inc., 2021
2. Andrew S. Tanenbaum and Herbert Bos, "Modern Operating Systems", 5th edition, Pearson Education, 2022

**REFERENCES:**

1. Maurice J. Bach, "The Design of the Unix Operating System", 3rd edition, Pearson Education, 2017
2. Ramaz Elmasri, A. Gil Carrick and David Levine, "Operating Systems: A Spiral Approach", 1st edition, Tata McGraw Hill, 2010
3. Achyut S. Godbole and Atul Kahate, "Operating Systems", 3rd edition, McGraw Hill Education, 2016



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## SEMESTER III &amp; IV

| U25CSG18 | Database Management Systems Laboratory<br>(Common to AD, AM, CB, CS, IT, SC) | Category: PCC |   |   |   |   |
|----------|------------------------------------------------------------------------------|---------------|---|---|---|---|
|          |                                                                              | L             | T | P | J | C |
|          |                                                                              | 0             | 0 | 2 | 2 | 2 |

## COURSE OBJECTIVES:

- To provide hands-on experience in creating and manipulating databases using SQL commands
- To practice database programming concepts including procedures, functions, triggers, and indexing
- To familiarize students with NoSQL databases and the development of simple database applications

## COURSE OUTCOMES:

|                                                                                                              |       |
|--------------------------------------------------------------------------------------------------------------|-------|
| CO 1: Construct database schemas using Data Definition Language (DDL) commands                               | Apply |
| CO 2: Construct database schemas using Data Definition Language (DDL) commands                               | Apply |
| CO 3: Develop database programs using PL/SQL constructs such as procedures, functions, cursors, and triggers | Apply |
| CO 4: Build document-based databases and execute CRUD operations using MongoDB                               | Apply |
| CO 5: Develop a simple database application by integrating a programming language with a relational database | Apply |

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 3   | 2   | 1   | 1   | 2   | -   | -   | -   | 2   | 2    | 2    | 2    | -    |
| CO 2       | 3   | 2   | 1   | 1   | 2   | -   | -   | -   | 2   | 2    | 2    | 2    | -    |
| CO 3       | 3   | 2   | 1   | 1   | 2   | -   | -   | -   | 2   | 2    | 2    | 2    | -    |
| CO 4       | 3   | 2   | 1   | 1   | 3   | -   | -   | -   | 2   | 2    | 2    | 2    | -    |
| CO 5       | 3   | 2   | 1   | 1   | 3   | -   | -   | -   | 2   | 2    | 2    | 2    | -    |

## LIST OF EXPERIMENTS

1. Design an ER Diagram for a real-world application (Library /Ecommerce/ College/ Bank / Hospital Management System)
2. Create the relational schema & Implement DDL with Integrity Constraints
3. Implementation of DML, DCL Commands
4. Implementation of Clauses and Operators
5. Implementation of Date and String Functions
6. Implementation of Aggregate Functions and Grouping Operations
7. Implementation of SQL Queries using Joins, Set Operations, and Views
8. Implementation of Functions and Procedures
9. Implementation of Triggers using PL/SQL
10. Implementation of Cursors and Exception Handling
11. Implement Indexing, query optimization techniques and simulate B Tree and B+ Tree
12. Create a database using MongoDB and perform CRUD operations
13. Develop a Database Application by integrating Java with MYSQL and perform CRUD operations

## CONTACT PERIODS:

Lecture: - Periods      Tutorial: - Periods      Practical: 30 Periods      Project: 30 Periods      Total: 60 Periods

**REFERENCES:**

1. Rick Silva, "Database System Concepts Lab Manual", 1st Edition, McGraw Hill Education, 2016
2. Oracle Corporation, "Oracle Database PL/SQL Language Reference", Latest edition, Oracle Documentation, 2023
3. Paul DuBois, "MySQL Cookbook: Solutions for Database Developers and Administrators", 3rd edition, O'Reilly Media, 2014



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## SEMESTER IV

| U25AMG03 | Machine Learning Laboratory<br>(Common to AD, AM, CB) | Category: PCC |   |   |   |   |
|----------|-------------------------------------------------------|---------------|---|---|---|---|
|          |                                                       | L             | T | P | J | C |
|          |                                                       | 0             | 0 | 2 | 2 | 2 |

## PRE-REQUISITES:

- U25CSG04 - Python Programming \ U25RCSG04 - Python Programming

## COURSE OBJECTIVES:

- To provide hands-on experience in implementing machine learning algorithms for data preprocessing, model development, and performance evaluation using real-world datasets
- To enable students to apply supervised, unsupervised, and advanced ensemble learning techniques to build, compare, and interpret predictive models effectively

## COURSE OUTCOMES:

- CO 1:** Implement data preprocessing, visualization, and performance evaluation techniques for preparing datasets in ML using appropriate data processing tools and visualization libraries **Apply**
- CO 2:** Develop and compare supervised and unsupervised learning models to analyse and interpret real-world datasets using appropriate machine learning algorithms and evaluation metrics **Apply**
- CO 3:** Apply advanced ensemble learning and model interpretation techniques to enhance predictive performance and explain model behaviour using ensemble algorithms **Apply**

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | 2   | 2   | -   | 3   | 3   | -   | -   | -   | -   | -    | 1    | -    | 3    |
| CO 2       | 3   | 3   | 2   | 3   | 3   | -   | -   | -   | -   | -    | 1    | -    | 3    |
| CO 3       | 3   | 2   | 2   | 3   | 3   | 1   | 1   | -   | -   | -    | 2    | -    | 3    |

## LIST OF EXPERIMENTS

- Implement basic data preprocessing techniques using Python (NumPy & Pandas)
- Explore data visualization for feature understanding and correlation analysis
- Evaluate model performance using different metrics
- Implement Simple and Multiple Linear Regression models
- Apply Polynomial, Ridge, and Lasso Regression
- Perform Logistic Regression for binary classification problems
- Implement Decision Tree and Random Forest Classifiers
- Compare K-Nearest Neighbor (KNN) and Support Vector Machine (SVM) classifiers
- Perform K-Means and Hierarchical Clustering on real datasets
- Implement Principal Component Analysis (PCA) for dimensionality reduction
- Apply Ensemble Methods: Bagging, Boosting, and Random Forest.
- Analyze Model Interpretability using SHAP or LIME
- Mini Project

**CONTACT PERIODS:**

**Lecture:** - Periods    **Tutorial:** - Periods    **Practical:** 30 Periods    **Project:** 30 Periods    **Total:** 60 Periods

**TEXTBOOKS:**

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 3rd edition, O'Reilly Media, 2023
2. John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics", 2nd edition, The MIT Press, 2020

**REFERENCES:**

1. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python", 1st edition, O'Reilly Media, 2017
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", 1st edition, The MIT Press, 2016
3. Kevin P. Murphy, "Machine Learning – A Probabilistic Perspective", 1st edition, The MIT Press, 2012
4. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 1st edition, Springer, 2006



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## SEMESTER IV

| U25MNC03 | Indian Constitution<br>(Common to all programmes) | Category: MNC |   |   |   |   |
|----------|---------------------------------------------------|---------------|---|---|---|---|
|          |                                                   | L             | T | P | J | C |
|          |                                                   | 1             | 0 | 0 | 0 | 0 |

## COURSE OBJECTIVES:

- To understand the evolution and importance of the Constitution.
- To understand salient features of the Indian Constitution and philosophy of Fundamental Rights
- To gain the knowledge about the state government and local level administration

## COURSE OUTCOMES:

- CO 1:** Understand the historical background of the Constitution making and its importance for building a democratic India Understand
- CO 2:** Understand the value of Fundamental Rights and Duties for becoming a good citizen of India Understand
- CO 3:** Analyze the powers of the Central Government Analyze
- CO 4:** Understand the role and responsibilities of State and Local Administration Understand
- CO 5:** Apply knowledge in strengthening constitutional institutions like Election Commission and UPSC for sustaining democracy Apply

## CO - PO MAPPING:

| Particular | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO 1       | -   | -   | -   | -   | -   | 1   | 2   | 3   | -   | -    | -    | -    | -    |
| CO 2       | -   | -   | -   | -   | -   | 1   | 2   | 3   | -   | -    | -    | -    | -    |
| CO 3       | -   | -   | -   | -   | -   | 1   | 2   | 3   | -   | -    | -    | -    | -    |
| CO 4       | -   | -   | -   | -   | -   | 1   | 2   | 3   | -   | -    | -    | -    | -    |
| CO 5       | -   | -   | -   | -   | -   | 1   | 2   | 3   | -   | -    | -    | -    | -    |

## SYLLABUS:

UNIT I: HISTORICAL BACKGROUND OF INDIAN CONSTITUTION 5

Introduction to Indian Constitution: Constitution Meaning of the term, History of Making of the Indian Constitution, Evolution of the Indian Constitution, Drafting Committee (Composition and Working).

UNIT II: FEATURES OF INDIAN CONSTITUTION 5

Philosophy and salient features of the Indian Constitution, Citizenship, Fundamental Rights, Duties and their significance, Directive Principles of State Policy, Rights Protective Mechanisms in India; Right to Education Act 2009; Right to Information 2005.

UNIT III: UNION GOVERNMENT 5

Union Legislature (Parliament), Lok Sabha and Rajya Sabha (with Powers and Functions), Union Executive, President of India (with Powers and Functions), Prime Minister and Council of Ministers (with Powers and Functions), Cabinet and Central Secretariat, Union Judiciary (Supreme Court).

**UNIT IV: STATE GOVERNMENT AND LOCAL ADMINISTRATION**

5

Governor, Chief Minister and Council of Ministers, State Secretariat – Roles and Responsibilities, District Administration, Head, Municipalities – Mayor and Role of Elected Representatives, Panchayati Raj, Zila Panchayat – Roles and Responsibilities, Block Level and Village Level Organizational Hierarchy

**UNIT V: CONSTITUTIONAL INSTITUTIONS**

5

Election Commission of India – Powers and Functions, Electoral Process in India, Methods of Constitutional Amendments and their Limitations, Important Constitutional and Emergency Provisions. Case Studies.

**CONTACT PERIODS:**

**Lecture:** 25 Periods      **Tutorial:** - Periods      **Practical:** - Periods      **Project:** - Periods      **Total:** 25 Periods

**TEXTBOOKS:**

1. Durga Das Basu, "Introduction to the Constitution of India", Prentice Hall of India Pvt. Ltd., New Delhi.
2. Subash Kashyap, "Indian Constitution", National Book Trust.

**REFERENCES:**

1. M. Laxmikanth, "Indian Polity", McGraw Hill Education India, 2013.
2. M. P. Jain, "Indian Constitution Law," 7th Edition, Lexis Nexis, 2014.
3. Raj Kumar, "Ambedkar and Constitution", Commonwealth Publication Pvt. Ltd., New Delhi, 2011



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## SEMESTER IV

| U25RMCC09 | Professional Skill Development - IV<br>(Common to all programmes) | Category: MCC |   |   |   |   |
|-----------|-------------------------------------------------------------------|---------------|---|---|---|---|
|           |                                                                   | L             | T | P | J | C |
|           |                                                                   | 15 Hours      |   |   |   | 1 |

## COURSE OUTCOMES:

- CO 1:** Demonstrate technical skill competency through attainment of industry-relevant certifications, participation in competitions, internships, and project-based learning activities **Apply**
- CO 2:** Apply research, innovation, and problem-solving skills to develop impactful solutions through projects, publications, patents, and higher education preparation **Apply**
- CO 3:** Exhibit leadership, ethical responsibility, community engagement, and professional digital presence to enhance career readiness and lifelong learning **Apply**

## CO - PO MAPPING:

| Particular  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| <b>CO 1</b> | 3   | 2   | 2   | -   | 3   | 1   | -   | -   | 2   | 2    | -    | -    | -    |
| <b>CO 2</b> | 2   | 3   | 3   | 3   | 2   | 2   | -   | -   | 1   | 1    | -    | -    | -    |
| <b>CO 3</b> | -   | -   | 3   | -   | -   | 2   | 2   | 3   | 3   | 3    | 2    | -    | -    |

## GUIDELINES:

- Certifications and Skill Credentials - Free awareness certs, NPTEL/Coursera, Associate-level, Professional-level, Expert-level
- Competitions, Hackathons, and Technical Challenges - Online, institution, state, national, international competitions and hackathons, Kaggle medals
- GATE Preparation and Performance - Study plan, mock tests, registration, appearing, score percentile
- Academic, Industry, and Innovation Projects - Mini-projects, intermediate projects, industry-grade deployed projects, funded or published projects
- Internships and Industrial Training - Virtual, on-site short, core role, CoE on-campus, PPO, PPO converted to offer
- Research Publications, Patents, Intellectual Property - Reading journals, survey papers, conference papers, Scopus/WoS, Q1/Q2 journals, patents from provisional to granted
- Leadership, Community, Digital Presence - Club membership, event roles, office bearer, president, outreach, LinkedIn, GitHub, portfolio, Google Scholar

## CONTACT PERIODS:

Lecture: - Periods      Tutorial: - Periods      Practical: - Periods      Project: - Periods      Total: 0 Periods

  
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