

**B. TECH. FOUR YEAR DEGREE**

**PROGRAM CURRICULUM**

(Applicable for the batches admitted from A.Y. 2025-26)

**COMPUTER SCIENCE AND  
ENGINEERING**



**A D I T Y A**  
**U N I V E R S I T Y**

Aditya Nagar, ADB Road, Surampalem - 533 437



# ADITYA UNIVERSITY

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## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

### **Vision**

To be a globally recognized center of excellence in Computer Science through quality education, innovative practices, Sustainable technologies.

### **Mission**

M1: Provide transformative and inclusive education through robust curriculum, modern pedagogy, and state-of-art infrastructure.

M2: Foster innovation and research by developing sustainable technological solutions that address real-world challenges.

M3: Strengthen collaborations with industry, academia, and global partners to promote knowledge sharing and entrepreneurial growth.

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

#### **Graduates of the Program will:**

#### **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

PEO1: Apply emerging tools and technologies to solve interdisciplinary problems.

PEO2: Advance in education and research by applying innovative ideas and project-based learning.

PEO3: Work collaboratively and establish leadership with ethical, social, and financial accountability.

### **Program Specific Outcomes (PSOs)**

#### **After successful completion of the program, the graduates will be able to:**

PSO1: Apply advanced computing tools and technologies for effective software design, development, and deployment.

PSO2: Design, configure, and secure computing infrastructure services by applying emerging technologies

## PROGRAM OUTCOMES (PO's)

The 11 Program Outcomes are described as below.

After successful completion of the program, the graduates will be able to

- PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- PO3 **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- PO4 **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
- PO5 **Engineering tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- PO6 **The Engineer and the world :** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- PO7 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
- PO8 **Individual and collaborative teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- PO9 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO10 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO11 **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## **Department of Computer Science and Engineering**

### **B.Tech (CSE) Program Curriculum-2025 (Applicable for the batches admitted from A.Y. 2025-26)**

#### **UG Programs Offered**

- B. Tech in (Computer Science and Engineering)
- B. Tech in (Computer Science and Engineering) with
  - Minor degree in Civil Engineering
  - Minor degree in Electrical and Electronics Engineering
  - Minor degree in Mechanical Engineering
  - Minor degree in Electronics and Communication Engineering
  - Minor degree in Petroleum Technology
  - Minor degree in Mining Engineering
  - Minor degree in Agricultural Engineering
  - Minor degree in Entrepreneurship Development and Incubation
  - minor degree in Quantum Technologies

#### **Minor Streams offered in B.Tech (Computer Science and Engineering)**

- Minor Stream in Network Security
- Minor Stream in Machine Intelligence
- Minor Stream in Data Engineering
- Minor Stream in Mobile Application Development
- Minor Stream in Cyber Security industry integrated Program- L&T
- Minor Stream in Agile Methodology with DevOps Programming integrated Program- L&T
- Minor Stream in Cloud Infrastructure (Certification Programs - CISCO, Red hat, Oracle, AWS, Google & Microsoft)

### Credit Division Category-wise

| S.No                                                 | Broad Category of Course                                                                                                                    | UGC        | Credits    |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|
| 1                                                    | Major Core Courses (MCC)                                                                                                                    | 80         | 84         |
| 2                                                    | Minor Stream Courses (MSC)<br>(or)<br>Minor Stream Courses (Min 20 credits) and<br>University Open Elective Courses (UEC) (upto 12 credits) | 32         | 32         |
| 3                                                    | Multidisciplinary Courses (MDC)                                                                                                             | 9          | 9          |
| 4                                                    | Ability Enhancement Courses (AEC)                                                                                                           | 8          | 9          |
| 5                                                    | Skill Enhancement Courses (SEC)                                                                                                             | 9          | 6          |
| 6                                                    | Value Added Courses (VAC)                                                                                                                   | 6-8        | 4          |
| 7                                                    | Summer Internships (SI)                                                                                                                     | 2-4        | 4          |
| 8                                                    | Full Semester Internship (PROJ)                                                                                                             | 12         | 12         |
| 9                                                    | Mandatory Courses (MC)                                                                                                                      |            | 0          |
| <b>Total Credits to be earned for B. Tech Degree</b> |                                                                                                                                             | <b>160</b> | <b>160</b> |

**Foundation Courses – FC**

**Intermediate-level Courses – IC**

**Advanced Courses – AC**

### Major Core Courses (MCC)

| Course Code            | Course Name                                                                       | Level | L         | T        | P         | C         | CIE | SEE | Total | Pre-requisite |
|------------------------|-----------------------------------------------------------------------------------|-------|-----------|----------|-----------|-----------|-----|-----|-------|---------------|
| 2501MA01               | Linear algebra & Calculus                                                         | FC    | 2         | 1        |           | 3         | 50  | 50  | 100   | -             |
| 2501PH02               | Modern Physics                                                                    | FC    | 2         |          | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS01 /<br>2601DS01 | Programming for Problem Solving Using C* / Problem Solving Through C Programming# | FC    | 2         |          | 2         | 4         | 50  | 50  | 100   | -             |
| 2501IT01/<br>2601AI01  | Business Intelligence Lab* / Business Intelligence & AI Tools Lab#                | FC    |           |          | 2         | 2         | 50  | 50  | 100   | -             |
| 2501ME01               | Engineering Graphics                                                              | FC    | 1         |          | 2         | 3         | 50  | 50  | 100   | -             |
| 2501MA02               | Differential equations & Vector Calculus                                          | FC    | 2         | 1        |           | 3         | 50  | 50  | 100   | -             |
| 2501CS03/<br>2601DS02  | Data Structures* / Data Structures using C++#                                     | FC    | 2         |          | 2         | 4         | 50  | 50  | 100   | PPSC          |
| 2501CS08               | Object Oriented Programming through C++*                                          | IC    | 2         |          | 2         | 4         | 50  | 50  | 100   | PPSC          |
| 2501IT42               | Programming with Python                                                           | FC    | 2         |          | 2         | 4         | 50  | 50  | 100   | PPSC          |
| 2501CS71               | Computer Organization & Architecture                                              | FC    | 2         | 1        |           | 3         | 50  | 50  | 100   | DLD           |
| 2501MA08               | Discrete Mathematics                                                              | IC    | 2         | 1        |           | 3         | 50  | 50  | 100   | LAC           |
| 2501CS11               | Theory of Computation                                                             | IC    | 2         | 1        |           | 3         | 50  | 50  | 100   | DMS           |
| 2501IT05               | Database Management Systems                                                       | IC    | 2         |          | 2         | 4         | 50  | 50  | 100   | PPSC          |
| 2501IT07               | Agile Software Engineering                                                        | IC    | 2         |          | 1         | 3         | 50  | 50  | 100   | PPSC          |
| 2501MA09               | Probability & Statistics                                                          | IC    | 2         | 1        |           | 3         | 50  | 50  | 100   | LAC           |
| 2501IT06               | Java Programming                                                                  | IC    | 2         |          | 2         | 4         | 50  | 50  | 100   | PPSC          |
| 2601AI02               | Full Stack Application Development using MERN#                                    | IC    | 2         |          | 2         | 4         | 50  | 50  | 100   | JP            |
| 2501CS13               | Operating Systems                                                                 | IC    | 2         |          | 1         | 3         | 50  | 50  | 100   | -             |
| 2501AI02               | Artificial Intelligence                                                           | IC    | 2         |          | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS07               | Computer Networks                                                                 | IC    | 2         |          | 1         | 3         | 50  | 50  | 100   | -             |
| 2501AI03               | Data Mining                                                                       | IC    | 1         |          | 2         | 3         | 50  | 50  | 100   | -             |
| 2501CS10               | Advanced Data Structures & Algorithm Analysis                                     | AC    | 2         |          | 1         | 3         | 50  | 50  | 100   | DS            |
| 2501IT04               | Compiler Design                                                                   | AC    | 2         |          | 1         | 3         | 50  | 50  | 100   | TOC           |
| 2501AI05               | Machine Learning                                                                  | AC    | 2         |          | 2         | 4         | 50  | 50  | 100   | DAE           |
| 2501AI04               | Big Data Analytics                                                                | AC    | 2         |          | 1         | 3         | 50  | 50  | 100   | DM            |
| 2501IT03               | Cryptography & Network Security                                                   | AC    | 2         |          | 1         | 3         | 50  | 50  | 100   | CN            |
| 2501CS15               | Software Architecture                                                             | AC    | 2         |          | 1         | 3         | 50  | 50  | 100   | ASE           |
|                        | <b>Total</b>                                                                      |       | <b>48</b> | <b>6</b> | <b>30</b> | <b>84</b> |     |     |       |               |

### Multidisciplinary Courses (MDC)

| Course Code  | Course Name                                | Level | L        | T        | P        | C        | CIE | SEE | Total | Pre-requisite |
|--------------|--------------------------------------------|-------|----------|----------|----------|----------|-----|-----|-------|---------------|
| 2501EC95     | Digital Logic Design                       | FC    | 2        | 1        |          | 3        | 50  | 50  | 100   | -             |
| 2501EE01     | Basic Electrical & Electronics Engineering | FC    | 2        |          | 2        | 4        | 50  | 50  | 100   | -             |
| 2501MB01     | Engineering Economics & Management         | FC    | 2        |          |          | 2        | 50  | 50  | 100   | -             |
| <b>Total</b> |                                            |       | <b>6</b> | <b>1</b> | <b>2</b> | <b>9</b> |     |     |       |               |

### Ability Enhancement Courses (AEC)

| Course Code  | Course Name                              | Level | L        | T | P        | C        | CIE | SEE | Total | Pre-requisite |
|--------------|------------------------------------------|-------|----------|---|----------|----------|-----|-----|-------|---------------|
| 2501EN01     | Essential Cognitive Skills for Engineers | FC    |          |   | 1        | 1        | 100 | -   | 100   | -             |
| 2501UC07     | Design Thinking using AI                 | FC    |          |   | 1        | 1        | 100 | -   | 100   | -             |
| 2501EN02     | Advanced Cognitive Skills for Engineers  | FC    |          |   | 1        | 1        | 100 | -   | 100   | ECSE          |
| 2501UC08     | Universal Human Values                   | FC    | 2        |   |          | 2        | 100 | -   | 100   | -             |
| 2501UC09     | Technical Paper Publication              | AC    |          |   | 2        | 2        | 100 | -   | 100   | -             |
| 2501CS72     | Student Activity Based Learning          | AC    |          |   |          | 2        | 100 | -   | 100   | -             |
| <b>Total</b> |                                          |       | <b>2</b> |   | <b>5</b> | <b>9</b> |     |     |       |               |

### Skill Enhancement Courses (SEC)

| Course Code           | Course Name                                                       | Level | L | T | P        | C        | CIE | SEE | Total | Pre-requisite |
|-----------------------|-------------------------------------------------------------------|-------|---|---|----------|----------|-----|-----|-------|---------------|
| 2501AI34/<br>2601CS01 | Web Application Development using MERN Stack*/ Linux Programming# | AC    |   |   | 2        | 2        | 50  | 50  | 100   | -             |
| 2501CS17              | Object Oriented Analysis & Design using UML                       | IC    |   |   | 2        | 2        | 50  | 50  | 100   | ASE           |
| 2501IT08              | Bigdata Spark                                                     | AC    |   |   | 2        | 2        | 50  | 50  | 100   | -             |
| <b>Total</b>          |                                                                   |       |   |   | <b>6</b> | <b>6</b> |     |     |       |               |

### Value Added Courses (VAC)

| Course Code  | Course Name              | Level | L | T | P         | C        | CIE | SEE | Total | Pre-requisite |
|--------------|--------------------------|-------|---|---|-----------|----------|-----|-----|-------|---------------|
| 2501UC11     | Employability Skills-I   | FC    |   |   | 3         | 0        | 100 | -   | 100   | -             |
| 2501UC13     | Employability Skills-II  | FC    |   |   | 3         | 0        | 100 |     | 100   | ES-I          |
| 2501AI06     | Data Analysis Essentials | IC    |   |   | 2         | 2        | 50  | 50  | 100   | PP            |
| 2501UC14     | Employability Skills-III | IC    |   |   | 3         | 0        | 100 |     | 100   | ES-II         |
| 2501UC15     | Employability Skills-IV  | IC    |   |   | 3         | 0        | 100 |     | 100   | ES-III        |
| 2501CS04     | Internet of Things       | FC    |   |   | 1         | 1        | 50  | 50  | 100   | -             |
| 2501UC16     | Employability Skills-V   | AC    |   |   | 3         | 1        | 100 |     | 100   | ES-IV         |
| <b>Total</b> |                          |       |   |   | <b>18</b> | <b>4</b> |     |     |       |               |

### Summer Internships (SI)

| Course Code  | Course Name          | Level | L | T | P        | C        | CIE | SEE | Total | Pre-requisite |
|--------------|----------------------|-------|---|---|----------|----------|-----|-----|-------|---------------|
| 2501CS20     | Summer Internship-I  | IC    |   |   | 2        | 2        | 100 | -   | 100   | -             |
| 2501CS21     | Summer Internship-II | AC    |   |   | 2        | 2        | 100 | -   | 100   | -             |
| <b>Total</b> |                      |       |   |   | <b>4</b> | <b>4</b> |     |     |       |               |

### Full Semester Internship (PROJ)

| Course Code  | Course Name              | Level | L | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|--------------------------|-------|---|---|-----------|-----------|-----|-----|-------|---------------|
| 2501CS22     | Full Semester Internship | AC    |   |   | 12        | 12        | 50  | 50  | 100   | -             |
| <b>Total</b> |                          |       |   |   | <b>12</b> | <b>12</b> |     |     |       |               |

### Mandatory Courses (MC)

| Course Code  | Course Name                            | Level | L         | T | P | C        | CIE | SEE | Total | Pre-requisite |
|--------------|----------------------------------------|-------|-----------|---|---|----------|-----|-----|-------|---------------|
| 2501AC01     | Environmental Science                  | FC    | 2         |   |   | 0        | 100 | -   | 100   | -             |
| 2501AC02     | Constitution of India                  | FC    | 2         |   |   | 0        | 100 | -   | 100   | -             |
| 2501AC03     | Research Methodology                   | FC    | 2         |   |   | 0        | 100 | -   | 100   | -             |
| 2501AC04     | Intellectual Property Rights & Patents | FC    | 2         |   |   | 0        | 100 | -   | 100   | -             |
| 2501AC05     | Indian Knowledge Systems               | FC    | 2         |   |   | 0        | 100 | -   | 100   | -             |
| <b>Total</b> |                                        |       | <b>10</b> |   |   | <b>0</b> |     |     |       |               |



### Minor Stream: Network Security

| Course Code  | Course Name                           | Level | L         | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|---------------------------------------|-------|-----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501CS32     | Cyber Security Essentials             | FC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS30     | Information Security Analysis & Audit | FC    | 2         |   |           | 2         | 50  | 50  | 100   | -             |
| 2501CS23     | Cloud Computing                       | FC    | 2         |   | 2         | 4         | 50  | 50  | 100   | -             |
| 2501CS24     | Wireless Networks                     | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS25     | Cloud IoT & Edge ML                   | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS28     | Ethical Hacking                       | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | -             |
| 2501CS27     | Digital Forensics                     | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS26     | Block Chain Technologies              | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | CSE           |
| 2501CS31     | Cyber Laws                            | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS33     | Secure Coding Techniques              | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                                       |       | <b>20</b> |   | <b>12</b> | <b>32</b> |     |     |       |               |

### Minor Stream: Machine Intelligence

| Course Code  | Course Name                 | Level | L         | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|-----------------------------|-------|-----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501AI07     | Computer Vision             | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | DAE           |
| 2501AI14     | Soft Computing              | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | AI            |
| 2501AI10     | Natural Language Processing | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | DAE           |
| 2501AI11     | Deep Learning               | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | DAE           |
| 2501AI13     | Recommender Systems         | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | DAE           |
| 2501AI09     | Reinforcement Learning      | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | ML            |
| 2501AI16     | Prompt Engineering & GenAI  | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | ML            |
| 2501AI15     | AI Chatbot                  | IC    | 2         |   |           | 2         | 50  | 50  | 100   | DAE           |
| 2501AI17     | Federated Machine Learning  | AC    | 2         |   |           | 2         | 50  | 50  | 100   | ML            |
| 2501AI08     | Expert Systems              | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                             |       | <b>20</b> |   | <b>12</b> | <b>32</b> |     |     |       |               |

### Minor Stream: Data Engineering

| Course Code  | Course Name                               | Level | L         | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|-------------------------------------------|-------|-----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501CS12     | NoSQL Databases                           | FC    | 2         |   |           | 2         | 50  | 50  | 100   | -             |
| 2501CS34     | Fundamentals of Data Science              | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | PPSC          |
| 2501AI26     | Information Retrieval Systems             | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS36     | Business Intelligence & Analytics         | IC    | 2         |   | 2         | 4         | 50  | 50  | 100   | PPSC          |
| 2501AI18     | Mining Massive Data Sets                  | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | DM            |
| 2501CS37     | Health Care Data Analytics                | IC    | 2         |   | 2         | 4         | 50  | 50  | 100   | PPSC          |
| 2501AI19     | Data Visualization                        | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | DAE           |
| 2501CS38     | Security & Privacy for Big Data Analytics | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS40     | Social Networks & Semantic Web            | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS14     | Finance & Retail Analytics                | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                                           |       | <b>20</b> |   | <b>12</b> | <b>32</b> |     |     |       |               |

### Minor Stream: Mobile Application Development

| Course Code  | Course Name                 | Level | L         | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|-----------------------------|-------|-----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501IT12     | Flutter Fundamentals        | FC    |           |   | 2         | 2         | 50  | 50  | 100   | -             |
| 2501IT14     | Web Technologies            | FC    | 2         |   | 2         | 4         | 50  | 50  | 100   | JP            |
| 2501IT15     | Software Testing            | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | ASE           |
| 2501IT16     | Software Project Management | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | ASE           |
| 2501IT17     | Mobile Operating System     | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS24     | Wireless Networks           | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501AI24     | API & Micro Services        | IC    | 2         |   | 2         | 4         | 50  | 50  | 100   | JP            |
| 2501CS25     | Cloud IoT & Edge ML         | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS28     | Ethical Hacking             | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | -             |
| 2501IT22     | Software Quality Assurance  | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | ASE           |
| <b>Total</b> |                             |       | <b>18</b> |   | <b>14</b> | <b>32</b> |     |     |       |               |

### Minor Stream in Cyber Security industry integrated Program- L&T<sup>#</sup>

| Course Code  | Course Name                                      | Level | L         | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|--------------------------------------------------|-------|-----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501CS32     | Cyber Security Essentials                        | FC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS30     | Information Security Analysis & Audit            | FC    | 2         |   |           | 2         | 50  | 50  | 100   | -             |
| 2501CS42     | Linux Administration                             | IC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501IT03     | Cryptography & Network Security                  | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS43     | Secure Networking                                | AC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS44     | Application Security                             | AC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS45     | Ethical Hacking & Penetration Testing            | AC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS46     | Cyber Forensic                                   | AC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS47     | Malware Analysis & Governance, Risk & Compliance | AC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS31     | Cyber Laws                                       | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS33     | Secure Coding Techniques                         | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                                                  |       | <b>10</b> |   | <b>22</b> | <b>32</b> |     |     |       |               |

### Minor Stream in Agile Methodology with DevOps Programming integrated Program- L&T<sup>#</sup>

| Course Code  | Course Name                                              | Level | L        | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|----------------------------------------------------------|-------|----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501CS48     | IT Infrastructure Management                             | FC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS49     | Web Engineering                                          | FC    |          |   | 2         | 2         | 50  | 50  | 100   | -             |
| 2501CS50     | Intro to Azure& AWS DevOps                               | FC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS51     | Intro to Google Cloud DevOps                             | FC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS52     | Cloud fundamentals & DevOps                              | IC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS53     | Agile with DevOps fundamentals & Usage                   | IC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501IT16     | Software Project Management                              | IC    | 2        |   | 1         | 3         | 50  | 50  | 100   | ASE           |
| 2501CS54     | Agile based project automation with DevOps               | AC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS55     | DevOps Container Services                                | AC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS56     | CI &CD (Continuous Integration & Continuous Development) | AC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS57     | Object Oriented Software Engineering                     | AC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                                                          |       | <b>2</b> |   | <b>30</b> | <b>32</b> |     |     |       |               |

**Note:** # -The Syllabus for the industry partnered course will be released in the department as and when required

**Minor Stream in Cloud Infrastructure (Certification Programs - CISCO, Red hat, Oracle, AWS, Google & Microsoft)**

| Course Code  | Course Name                                   | Level | L | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|-----------------------------------------------|-------|---|---|-----------|-----------|-----|-----|-------|---------------|
| 2501CS68     | Enterprise Linux Fundamentals                 | FC    |   |   | 2         | 2         | 50  | 50  | 100   | -             |
| 2501CS58     | Linux System Administration                   | FC    |   |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS59     | Introduction to Cloud Networking              | FC    | 1 |   | 3         | 4         | 50  | 50  | 100   | -             |
| 2501CS60     | Routing & Switching Essentials                | FC    |   |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS62     | Advanced Cloud Networking                     | IC    | 1 |   | 3         | 4         | 50  | 50  | 100   | -             |
| 2501CS67     | Introduction to Cloud Computing Core Concepts | IC    |   |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS61     | Cloud Architecture & Platform Services        | FC    |   |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS63     | Enterprise Cloud Infrastructure               | IC    |   |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS69     | Cloud Security                                | IC    | 1 |   | 3         | 4         | 50  | 50  | 100   | -             |
| 2501CS64     | Machine Learning Services on Cloud            | IC    |   |   | 3         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                                               |       | 3 |   | <b>29</b> | <b>32</b> |     |     |       |               |

### University Open Elective Courses

| Branch | Course Code | Course Name                                                    | Level | L | T | P | C | CIE | SEE | Offered to                                      | Pre-requisite |
|--------|-------------|----------------------------------------------------------------|-------|---|---|---|---|-----|-----|-------------------------------------------------|---------------|
| CE     | 2501CE66    | Natural Disaster Management & Mitigation                       |       | 3 | 0 | 0 | 3 |     |     | EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| CE     | 2501CE81    | Wastewater Management                                          |       | 3 | 0 | 0 | 3 |     |     | EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| CE     | 2501CE82    | Integrated Solid Waste Management for a Smart City             |       | 3 | 0 | 0 | 3 |     |     | EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| CE     | 2501CE83    | Watershed Management                                           |       | 3 | 0 | 0 | 3 |     |     | EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| EEE    | 2501EE53    | Electric Power Generation, Transmission & Distribution Systems | AC    | 3 | 0 | 0 | 3 | 50  | 50  | CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E   |               |
| EEE    | 2501EE36    | Electric Energy Storage Systems                                | FC    | 3 | 0 | 0 | 3 | 50  | 50  | CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E   |               |
| EEE    | 2501EE43    | Electrical safety                                              | IC    | 3 | 0 | 0 | 3 | 50  | 50  | CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E   |               |
| EEE    | 2501EE54    | Hybrid & Electric Vehicles                                     | IC    | 3 | 0 | 0 | 3 | 50  | 50  | CE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E       |               |
| ME     | 2501ME37    | Solar Energy Systems                                           | FC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| ME     | 2501ME58    | Industry 5.0 for Engineers                                     | AC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| ME     | 2501ME73    | Organizational Behavior                                        | FC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| ME     | 2501ME36    | Sustainable Energy Systems                                     | FC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| ECE    | 2501EC97    | Biomedical Electronics                                         | FC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E |               |

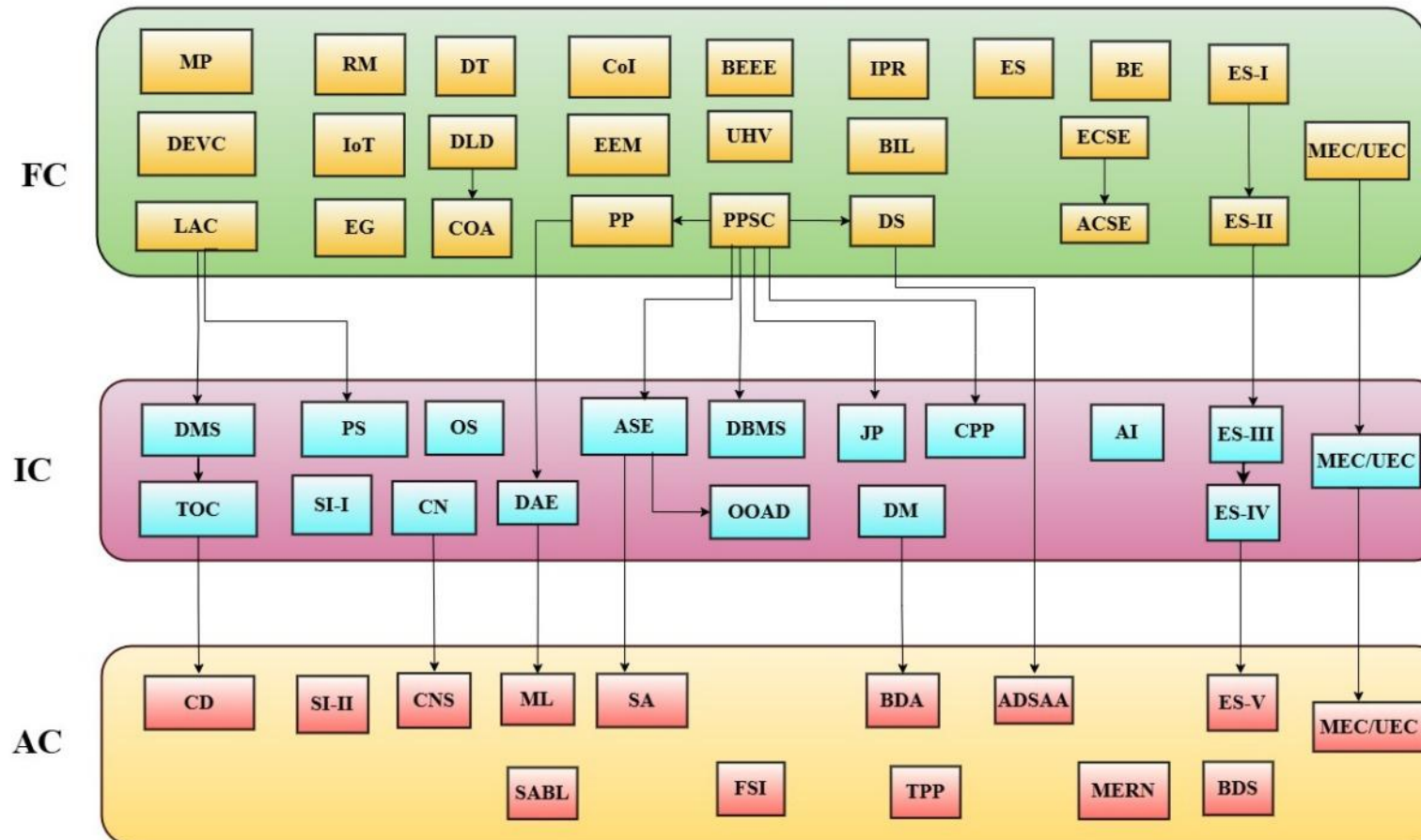
|       |                   |                                               |    |   |  |   |   |    |    |                                                 |              |
|-------|-------------------|-----------------------------------------------|----|---|--|---|---|----|----|-------------------------------------------------|--------------|
| ECE   | 2501EC98          | Fundamentals of Wireless Communications       | FC | 3 |  |   | 3 | 50 | 50 | CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E  |              |
| ECE   | 2501EC99          | Principles of Embedded Systems                | FC | 3 |  |   | 3 | 50 | 50 | CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E  |              |
| ECE   | 2501ECA0          | Electronics for Healthcare                    | FC | 3 |  |   | 3 | 50 | 50 | CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E  |              |
| ECE   | 2501ECA1          | Basics of VLSI Design                         | FC | 3 |  |   | 3 | 50 | 50 | CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E |              |
| ECE   | 2501ECA2          | System on Chip Design                         | FC | 3 |  |   | 3 | 50 | 50 | CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E |              |
| ECE   | 2501ECA3          | Introduction to Quantum Computing             | FC | 3 |  |   | 3 | 50 | 50 | CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E  |              |
| CSE   | 2501CS03/2601DS02 | Data Structures* / Data Structures using C++# | FC | 2 |  | 2 | 4 | 50 | 50 | CE, ME, PT, Min.E                               | PPSC         |
| CSE   | 2501CS13          | Operating Systems                             | IC | 2 |  | 1 | 3 | 50 | 50 | CE, EEE, ME, ECE, PT, Min.E, Ag.E               | -            |
| IT    | 2501IT05          | Database Management Systems                   | IC | 2 |  | 2 | 4 | 50 | 50 | CE, EEE, ME, ECE, PT, Min.E,Ag.E                | PPSC / CP&DS |
| IT    | 2501CS07          | Computer Networks                             | AC | 2 |  | 1 | 3 | 50 | 50 | CE, EEE, ME, ECE, PT, Min.E,Ag.E                | -            |
| AI&ML | 2501AI02          | Artificial Intelligence                       | FC | 2 |  | 1 | 3 | 50 | 50 | CE, EEE, ECE, PT, Min.E                         | -            |
| AI&ML | 2501AI05          | Machine Learning                              | AC | 2 |  | 2 | 4 | 50 | 50 | CE, ECE, PT, Min.E                              | DAUP         |
| DS    | 2501CS34          | Fundamental of Data Science                   | FC | 2 |  | 1 | 3 | 50 | 50 | CE, EEE, ME, ECE, PT, Min.E,Ag.E                | PPSC / CP&DS |

**Note:** \*Courses are applicable only to students admitted in the year 2025.

#Courses are applicable to the students admitted from the year 2026 onwards.

All the other courses are applicable to students admitted from the year 2025 onwards.

## B.Tech(CSE) Program Curriculum Pre-requisite Flow Chart

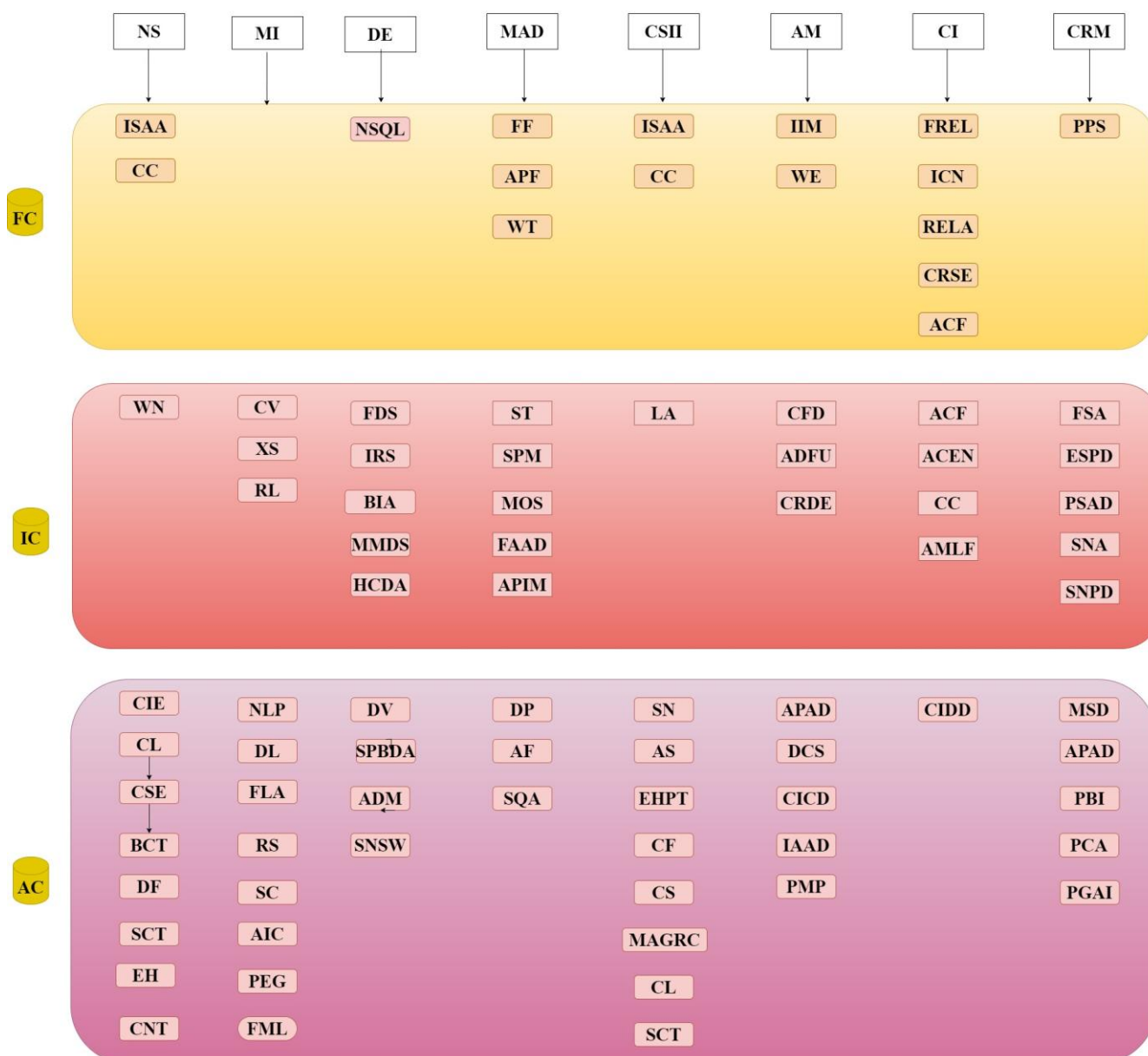


| Foundation Level Courses:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Intermediate Level Courses:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Advanced Level Courses:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LAC</b> - Linear algebra & Calculus<br><b>MP</b> - Modern Physics<br><b>PPSC</b> - Programming for Problem Solving Using C<br><b>BIL</b> - Business Intelligence Lab<br><b>EG</b> - Engineering Graphics<br><b>DLD</b> - Digital Logic Design<br><b>ECSE</b> - Essential Cognitive Skills for Engineers<br><b>DT</b> - Design Thinking using AI<br><b>ES</b> - Environmental Science<br><b>DEVC</b> - Differential equations & vector calculus<br><b>DS</b> - Data Structures<br><b>PP</b> - Programming with Python<br><b>COA</b> - Computer Organization & Architectures<br><b>EEM</b> - Engineering Economics & Management<br><b>BEEE</b> - Basic Electrical & Electronics Engineering<br><b>ACSE</b> - Advanced Cognitive Skills for Engineers<br><b>UHV</b> - Universal Human Values<br><b>ES-I</b> - Employability Skills-I<br><b>ES-II</b> - Employability Skills-II<br><b>CoI</b> - Constitution of India<br><b>RM</b> - Research Methodology<br><b>IPR</b> - Intellectual Property Rights & Patents<br><b>IoT</b> - Internet of Things<br><b>BE</b> - Biology for Engineers<br><b>MSC/UEC</b> - Courses from Minor Stream(s) or University Open Elective(s) | <b>DMS</b> - Discrete Mathematics<br><b>CPP</b> - Object Oriented Programming through C++<br><b>TOC</b> - Theory of Computation<br><b>DBMS</b> - Database Management Systems<br><b>ASE</b> - Agile Software Engineering<br><b>DAE</b> - Data Analysis Essentials<br><b>PS</b> - Probability & Statistics<br><b>JP</b> - Java Programming<br><b>OS</b> - Operating Systems<br><b>AI</b> - Artificial Intelligence<br><b>ES-III</b> - Employability Skills-III<br><b>CN</b> - Computer Networks<br><b>ES-IV</b> - Employability Skills-IV<br><b>OOAD</b> - Object Oriented Analysis & Design using UML<br><b>SI-I</b> - Summer Internship - I<br><b>DM</b> - Data Mining<br><b>MSC/UEC</b> - Courses from Minor Stream(s) or University Open Elective(s) | <b>ADSAA</b> - Advanced Data Structures and Algorithm Analysis<br><b>MERN</b> - Web Application Development using MERN Stack<br><b>CD</b> - Compiler Design<br><b>ML</b> - Machine Learning<br><b>BDA</b> - Big Data Analytics<br><b>CNS</b> - Cryptography & Network Security<br><b>SA</b> - Software Architecture<br><b>BDS</b> - Bigdata Spark<br><b>SI-II</b> - Summer Internship - II<br><b>TPP</b> - Technical Paper Publication<br><b>ABL</b> - Student Activity Based Learning<br><b>ES-V</b> - Employability Skills-V<br><b>FSI</b> - Full Semester Internship<br><br><b>MEC/UEC</b> - Minor Elective Courses/ University Open Elective Courses |



### B.Tech (CSE) Minor Stream

#### Pre-requisite flowchart



|                                            | <b><u>FC-Foundation Course</u></b>                                                                    | <b><u>IC-Intermediate-Level Course</u></b>                                                                                                                                                                                                                          | <b><u>AC-Advanced Course</u></b>                                                                                                                                                                                                                                                                   |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NS: Network Security</b>                | <b>ISAA:</b> Information Security Analysis and Audit<br><b>CC:</b> Cloud Computing                    | <b>WN:</b> Wireless Networks                                                                                                                                                                                                                                        | <b>SCT:</b> Secure Coding Techniques<br><b>BCT:</b> Block Chain Technologies<br><b>CIE:</b> Cloud IoT & Edge ML<br><b>EH:</b> Ethical Hacking<br><b>CL:</b> Cyber Laws<br><b>DF:</b> Digital Forensics<br><b>CSE:</b> Cyber Security Essentials<br><b>CNT:</b> Computational Number Theory         |
| <b>MI: Machine Intelligence</b>            |                                                                                                       | <b>CV:</b> Computer Vision<br><b>XS:</b> Expert Systems<br><b>RL:</b> Reinforcement Learning                                                                                                                                                                        | <b>DL:</b> Deep Learning<br><b>FLA:</b> Fuzzy Logic and its Applications<br><b>RS:</b> Recommender Systems<br><b>NLP:</b> Natural Language Processing<br><b>SC:</b> Soft Computing<br><b>AIC:</b> AI Chatbot<br><b>PEG:</b> Prompt Engineering and GenAI<br><b>FML:</b> Federated Machine Learning |
| <b>DE: Data Engineering</b>                | <b>NSQL:</b> NoSQL Databases                                                                          | <b>FDS:</b> Fundamentals of Data Science<br><b>IRS:</b> Information Retrieval Systems<br><b>BIA:</b> Business Intelligence and Analytics<br><b>MMDS:</b> Mining Massive Data Sets<br><b>SNA:</b> Social Network Analysis<br><b>HCDA:</b> Health Care Data Analytics | <b>DV:</b> Data Visualization<br><b>SPBDA:</b> Security and Privacy for Big Data Analytics<br><b>ADM:</b> Advanced Database Management<br><b>SNSW:</b> Social Networks and Semantic Web                                                                                                            |
| <b>MAD: Mobile Application Development</b> | <b>FF:</b> Flutter Fundamentals<br><b>APF:</b> Adobe Photoshop & Figma<br><b>WT:</b> Web Technologies | <b>FAAD:</b> Fundamentals Android Application Development<br><b>ST:</b> Software Testing                                                                                                                                                                            | <b>DP:</b> Dart Programming<br><b>AF:</b> Advanced Flutter<br><b>SQA:</b> Software Quality Assurance                                                                                                                                                                                               |

|                                                                                     |                                                                                                                                                                                                                                                          |                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                     |                                                                                                                                                                                                                                                          | <b>SPM:</b> Software Project management<br><b>MOS:</b> Mobile Operating System<br><b>APIM:</b> API&Micro Services                                                    |                                                                                                                                                                                                                                                                                                                        |
| <b>CS: Cyber Security Industry Integrated Program-L &amp; T</b>                     | <b>ISAA:</b> Information Security Analysis and Audit<br><b>CC:</b> Cloud Computing                                                                                                                                                                       | <b>LA:</b> Linux Administration                                                                                                                                      | <b>SN:</b> Secure Networking<br><b>AS:</b> Application Security<br><b>EHPT:</b> Ethical Hacking & Penetration Testing<br><b>CF:</b> Cyber Forensic<br><b>CS:</b> Cyber Security<br><b>CL:</b> Cyber Laws<br><b>SCT:</b> Secure Coding Techniques<br><b>MAGRC:</b> Malware Analysis and Governance, Risk and Compliance |
| <b>AM: Agile Methodology with DevOps Programming Industry Integrated -L &amp; T</b> | <b>WE:</b> Web Engineering<br><b>IIM:</b> IT Infrastructure Management                                                                                                                                                                                   | <b>CFD:</b> Cloud Fundamentals and DevOps<br><b>ADFU:</b> Agile with DevOps Fundamentals and Usage<br><b>CRDE:</b> Career Readiness in Digital Era                   | <b>APAD:</b> Agile based Project Automation with DevOps<br><b>DCS:</b> DevOps Container Services<br><b>CICD:</b> CI and CD (Continuous Integration and Continuous Development)<br><b>IAAD:</b> Intro to Azure and AWS DevOps<br><b>PMP:</b> Project Management for Professionals                                       |
| <b>CI: Cloud Infrastructure</b>                                                     | <b>FREL:</b> Fundamentals of Redhat Enterprise Linux<br><b>ICN:</b> Introduction to Cisco Networks<br><b>RELA:</b> Redhat Enterprise Linux Administration<br><b>CRSE:</b> Cisco Routing and Switching Essentials<br><b>ACF:</b> Azure Cloud Fundamentals | <b>ACF:</b> AWS Cloud Foundations<br><b>ACEN:</b> Advanced Cisco Enterprise Networking<br><b>CC:</b> Cloud security<br><b>AMLF:</b> AWS Machine learning Foundations | <b>CIDD:</b> Continuous Integration and Deployment DevOps                                                                                                                                                                                                                                                              |
| <b>CRM: Customer Relationship Management</b>                                        | <b>PPS:</b> Principles of Pega Systems                                                                                                                                                                                                                   | <b>ESPD:</b> Essentials of Salesforce Platform Development<br><b>PSAD:</b> Pega System                                                                               | <b>MSD:</b> Mastering Salesforce Development<br><b>APAD:</b> Advanced Power APPS Development<br><b>PBI:</b> Power BI<br><b>PCA:</b> Pega CSA Advanced<br><b>PGAI:</b> PEGA GenAI                                                                                                                                       |

|  |  |                                                                                                                                                                             |  |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  |  | Architecture and Design<br><b>SNA:</b> Service Now Administration<br><b>SNPD:</b> Service Now Platform Development<br><b>FSA:</b> Fundamentals of Salesforce Administration |  |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

## Suggestive Semester-wise Curriculum

### I SEMESTER

| Course code         | Course Title                                                                      | Course   |       | Credits  |          |          |           | Total Hours |
|---------------------|-----------------------------------------------------------------------------------|----------|-------|----------|----------|----------|-----------|-------------|
|                     |                                                                                   | Category | Level | L        | T        | P        | Total     |             |
| 2501MA01            | Linear Algebra & Calculus                                                         | MCC      | FC    | 2        | 1        |          | 3         | 3           |
| 2501PH02            | Modern Physics                                                                    | MCC      | FC    | 2        |          | 1        | 3         | 4           |
| 2501CS01 / 2601DS01 | Programming for Problem Solving Using C* / Problem Solving Through C Programming# | MCC      | FC    | 2        |          | 2        | 4         | 6           |
| 2501IT01/ 2601AI01  | Business Intelligence Lab* / Business Intelligence & AI Tools Lab#                | MCC      | FC    |          |          | 2        | 2         | 4           |
| 2501ME01            | Engineering Graphics                                                              | MCC      | FC    | 1        |          | 2        | 3         | 5           |
| 2501EC95            | Digital Logic Design                                                              | MDC      | FC    | 2        | 1        |          | 3         | 3           |
| 2501EN01            | Essential Cognitive Skills for Engineers                                          | AEC      | FC    |          |          | 1        | 1         | 2           |
| 2501UC07            | Design Thinking using AI                                                          | AEC      | FC    |          |          | 1        | 1         | 2           |
| <b>Total</b>        |                                                                                   |          |       | <b>9</b> | <b>2</b> | <b>9</b> | <b>20</b> | <b>29</b>   |

### II SEMESTER

| Course code        | Course Title                                  | Course   |       | Credits   |          |           |           | Total Hours |
|--------------------|-----------------------------------------------|----------|-------|-----------|----------|-----------|-----------|-------------|
|                    |                                               | Category | Level | L         | T        | P         | Total     |             |
| 2501MA02           | Differential Equations & Vector Calculus      | MCC      | FC    | 2         | 1        |           | 3         | 3           |
| 2501CS03/ 2601DS02 | Data Structures* / Data Structures using C++# | MCC      | FC    | 2         |          | 2         | 4         | 6           |
| 2501IT42           | Programming with Python                       | MCC      | FC    | 2         |          | 2         | 4         | 6           |
| 2501CS71           | Computer Organization & Architecture          | MCC      | FC    | 2         | 1        |           | 3         | 3           |
| 2501EE01           | Basic Electrical & Electronics Engineering    | MDC      | FC    | 2         |          | 2         | 4         | 6           |
| 2501EN02           | Advanced Cognitive Skills for Engineers       | AEC      | FC    |           |          | 1         | 1         | 2           |
| 2501UC08           | Universal Human Values                        | AEC      | FC    | 2         |          |           | 2         | 2           |
| 2501UC11           | Employability Skills-I                        | VAC      | FC    |           |          | 3         | 0         | 3           |
| 2501AC01           | Environmental Science                         | MC       | FC    | 2         |          |           | 0         | 2           |
| <b>Total</b>       |                                               |          |       | <b>14</b> | <b>2</b> | <b>10</b> | <b>21</b> | <b>33</b>   |

### III SEMESTER

| Course code           | Course Title                                               | Course   |       | Credits   |          |           |           | Total Hours |
|-----------------------|------------------------------------------------------------|----------|-------|-----------|----------|-----------|-----------|-------------|
|                       |                                                            | Category | Level | L         | T        | P         | Total     |             |
| 2501MA08              | Discrete Mathematics                                       | MCC      | IC    | 2         | 1        |           | 3         | 3           |
| 2501CS08/2<br>501IT06 | Object Oriented Programming through C++*/Java Programming# | MCC      | IC    | 2         |          | 2         | 4         | 6           |
| 2501IT05              | Database Management Systems                                | MCC      | IC    | 2         |          | 2         | 4         | 6           |
| 2501IT07              | Agile Software Engineering                                 | MCC      | IC    | 2         |          | 1         | 3         | 4           |
| 2501CS10              | Advanced Data Structures & Algorithm Analysis              | MCC      | AC    | 2         |          | 1         | 3         | 4           |
| 2501UC13              | Employability Skills-II                                    | VAC      | FC    |           |          | 3         | 0         | 3           |
| 2501AI06              | Data Analysis Essentials                                   | VAC      | IC    |           |          | 2         | 2         | 4           |
| 2501AC02              | Constitution of India                                      | MC       | FC    | 2         |          |           | 0         | 2           |
|                       | <b>Total</b>                                               |          |       | <b>12</b> | <b>2</b> | <b>11</b> | <b>19</b> | <b>32</b>   |

### IV SEMESTER

| Course code           | Course Title                                                      | Course      |       | Credits   |          |          |           | Total Hours |
|-----------------------|-------------------------------------------------------------------|-------------|-------|-----------|----------|----------|-----------|-------------|
|                       |                                                                   | Category    | Level | L         | T        | P        | Total     |             |
| 2501MA09              | Probability & Statistics                                          | MCC         | IC    | 2         | 1        |          | 3         | 3           |
| 2501IT06/<br>2601AI02 | Java Programming*/ Full Stack Application Development using MERN# | MCC         | IC    | 2         |          | 2        | 4         | 6           |
| 2501CS13              | Operating Systems                                                 | MCC         | IC    | 2         |          | 1        | 3         | 4           |
| 2501AI02              | Artificial Intelligence                                           | MCC         | IC    | 2         |          | 1        | 3         | 4           |
| 2501CS11              | Theory of Computation                                             | MCC         | IC    | 2         | 1        |          | 3         | 3           |
|                       | Minor Stream Course-1/<br>University Open Elective Course-1       | MSC/UE<br>C | FC/IC | 2         |          |          | 2         | 2           |
| 2501AI34/<br>2601CS01 | Web Application Development using MERN Stack*/ Linux Programming# | SEC         | AC    |           |          | 2        | 2         | 4           |
| 2501UC14              | Employability Skills-III                                          | VAC         | IC    |           |          | 3        | 0         | 3           |
| 2501AC03              | Research Methodology                                              | MC          | FC    | 2         |          |          | 0         | 2           |
|                       | <b>Total</b>                                                      |             |       | <b>14</b> | <b>2</b> | <b>9</b> | <b>20</b> | <b>31</b>   |

### V SEMESTER

| Course code | Course Title                                                  | Course   |       | Credits   |   |           |           | Total Hours |
|-------------|---------------------------------------------------------------|----------|-------|-----------|---|-----------|-----------|-------------|
|             |                                                               | Category | Level | L         | T | P         | Total     |             |
| 2501CS07    | Computer Networks                                             | MCC      | IC    | 2         |   | 1         | 3         | 4           |
| 2501IT04    | Compiler Design                                               | MCC      | AC    | 2         |   | 1         | 3         | 4           |
| 2501AI05    | Machine Learning                                              | MCC      | AC    | 2         |   | 2         | 4         | 6           |
|             | Minor Stream Course – 2/<br>University Open Elective Course-2 | MSC/UEC  | IC/AC | 2         |   | 1         | 3         | 4           |
|             | Minor Stream Course-3/ University<br>Open Elective Course-3   | MSC/UEC  | IC/AC | 2         |   | 2         | 4         | 4           |
| 2501UC15    | Employability Skills-IV                                       | VAC      | IC    |           |   | 3         | 0         | 3           |
| 2501CS17    | Object Oriented Analysis & Design<br>using UML                | SEC      | IC    |           |   | 2         | 2         | 4           |
| 2501CS20    | Summer Internship-I                                           | SI       | IC    |           |   | 2         | 2         | 4           |
| 2501AC04    | Intellectual Property Rights &<br>Patents                     | MC       | FC    | 2         |   |           | 0         | 2           |
|             | <b>Total</b>                                                  |          |       | <b>12</b> |   | <b>14</b> | <b>21</b> | <b>35</b>   |

### VI SEMESTER

| Course code | Course Title                                                  | Course   |       | Credits   |   |          |           | Total Hours |
|-------------|---------------------------------------------------------------|----------|-------|-----------|---|----------|-----------|-------------|
|             |                                                               | Category | Level | L         | T | P        | Total     |             |
| 2501AI03    | Data Mining                                                   | MCC      | IC    | 1         |   | 2        | 3         | 5           |
| 2501AI04    | Big Data Analytics                                            | MCC      | AC    | 2         |   | 1        | 3         | 4           |
| 2501CS10    | Engineering Economics &<br>Management                         | MDC      | FC    | 2         |   |          | 2         | 2           |
|             | Minor Stream Course-4/ University<br>Open Elective Course-4   | MSC/UEC  | IC/AC | 2         |   | 2        | 4         | 4           |
|             | Minor Stream Course – 5/<br>University Open Elective Course-5 | MSC/UEC  | IC/AC | 2         |   | 1        | 3         | 4           |
|             | Minor Stream Course-6/<br>University Open Elective Course-6   | MSC/UEC  | IC/AC | 2         |   | 1        | 3         | 4           |
|             | Minor Stream Course-7/ University<br>Open Elective Course-7   | MSC/UEC  | IC/AC | 2         |   | 1        | 3         | 4           |
| 2501CS04    | Internet of Things                                            | VAC      | FC    |           |   | 1        | 1         | 2           |
| 2501AC05    | Indian Knowledge Systems                                      | MC       | FC    | 2         |   |          | 0         | 2           |
|             | <b>Total</b>                                                  |          |       | <b>15</b> |   | <b>9</b> | <b>22</b> | <b>31</b>   |

### VII SEMESTER

| Course code | Course Title                                                  | Course   |       | Credits   |   |           |           | Total Hours |
|-------------|---------------------------------------------------------------|----------|-------|-----------|---|-----------|-----------|-------------|
|             |                                                               | Category | Level | L         | T | P         | Total     |             |
| 2501IT03    | Cryptography & Network Security                               | MCC      | AC    | 2         |   | 1         | 3         | 4           |
| 2501CS15    | Software Architecture                                         | MCC      | AC    | 2         |   | 1         | 3         | 4           |
|             | Minor Stream Course – 8/<br>University Open Elective Course-8 | MSC/UEC  | AC    | 2         |   | 2         | 4         | 4           |
|             | Minor Stream Course – 9/<br>University Open Elective Course-9 | MSC/UEC  | AC    | 2         |   | 1         | 3         | 4           |
|             | Minor Stream Course-10/<br>University Open Elective Course-10 | MSC/UEC  | AC    | 2         |   | 1         | 3         | 4           |
| 2501IT08    | Bigdata Spark                                                 | SEC      | AC    |           |   | 2         | 2         | 4           |
| 2501CS21    | Summer Internship-II                                          | SI       | AC    |           |   | 2         | 2         | 4           |
|             | <b>Total</b>                                                  |          |       | <b>10</b> |   | <b>10</b> | <b>20</b> | <b>32</b>   |

### VIII SEMESTER

| Course code | Course Title                    | Course   |       | Credits |   |           |           | Total Hours |
|-------------|---------------------------------|----------|-------|---------|---|-----------|-----------|-------------|
|             |                                 | Category | Level | L       | T | P         | Total     |             |
| 2501UC09    | Technical Paper Publication     | AEC      | AC    |         |   | 2         | 2         | 4           |
| 2501CS72    | Student Activity Based Learning | AEC      | AC    |         |   |           | 2         | 0           |
| 2501UC16    | Employability Skills-V          | VAC      | AC    |         |   | 3         | 1         | 3           |
| 2501CS22    | Full Semester Internship        | PROJ     | AC    |         |   | 12        | 12        | 24          |
|             | <b>Total</b>                    |          |       |         |   | <b>17</b> | <b>17</b> | <b>31</b>   |

**Total Credits:160**

**Note:** \*Courses are applicable only to students admitted in the year 2025.

#Courses are applicable to the students admitted from the year 2026 onwards.

All the other courses are applicable to students admitted from the year 2025 onwards.



### Minor Degree in Computer Science and Engineering (offered to other branches students):

| Course Code | Course Name                                                   | Level | L  | T | P | C  | CIE | SEE | Total | Pre-requisite |
|-------------|---------------------------------------------------------------|-------|----|---|---|----|-----|-----|-------|---------------|
| 2501CS13    | Operating Systems                                             | IC    | 2  |   | 1 | 3  | 50  | 50  | 100   | -             |
| 2501CS07    | Computer Networks                                             | IC    | 2  |   | 1 | 3  | 50  | 50  | 100   | -             |
| 2501IT07    | Agile Software Engineering                                    | IC    | 2  |   | 1 | 3  | 50  | 50  | 100   | PPSC          |
| 2501AI03    | Data Mining                                                   | IC    | 1  |   | 2 | 3  | 50  | 50  | 100   | -             |
| 2501CS08    | Object Oriented Programming through C++ (or) Java Programming | IC    | 2  |   | 2 | 4  | 50  | 50  | 100   | PPSC          |
| 2501IT06    |                                                               |       |    |   |   |    |     |     |       |               |
| 2501CS16    | Introduction to MERN Stack Development(or)                    | IC    |    |   | 2 | 2  | 50  | 50  | 100   | JP            |
| 2501CS30    | Information Security Analysis & Audit                         |       | 2  |   |   | 2  | 50  | 50  | 100   | -             |
| 2501CS18    | Advanced MERN Stack Development (or)                          | AC    |    |   | 2 | 2  | 50  | 50  | 100   | IMSD          |
| 2501IT12    | Flutter Fundamentals                                          |       |    |   | 2 | 2  | 50  | 50  | 100   | -             |
|             | Total                                                         |       | 11 |   | 9 | 20 |     |     |       |               |

### Minor Degree in Civil Engineering

| Course Code | Course Name                                                           | Level | L  | T | P | C  | CIE | SEE | Total | Pre-requisite |
|-------------|-----------------------------------------------------------------------|-------|----|---|---|----|-----|-----|-------|---------------|
| 2501CE25    | Repair & Rehabilitation of Structures                                 | FC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501CE43    | Building Planning & Computer-Aided Drawing                            | FC    |    |   | 2 | 2  | 50  | 50  | 100   | -             |
| 2501CE27    | Green Buildings                                                       | FC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501CE40    | Fundamentals of Soil Behaviour                                        | FC    | 2  | 1 |   | 3  | 50  | 50  | 100   | -             |
| 2501CE54    | Railway Engineering (or)Docks & Harbour Engineering                   | FC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501CE47    |                                                                       |       |    |   |   |    |     |     |       |               |
| 2501CE36    | Environmental Impact & Risk Management(or) Environmental Management   | IC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501CE37    |                                                                       |       |    |   |   |    |     |     |       |               |
| 2501CE56    | Urban Transportation Planning (or) Intelligent Transportation Systems | IC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501CE49    |                                                                       |       |    |   |   |    |     |     |       |               |
| Total       |                                                                       |       | 17 | 1 | 2 | 20 |     |     |       |               |

### Minor Degree in Electrical and Electronics Engineering

| Course Code | Course Name                                                         | Level | L  | T | P | C  | CIE | SEE | Total | Pre-requisite     |
|-------------|---------------------------------------------------------------------|-------|----|---|---|----|-----|-----|-------|-------------------|
| 2501EE55    | Operation &Control of Electric machines                             | FC    | 2  |   |   | 2  | 50  | 50  | 100   | BEEE              |
| 2501EE56    | Fundamentals of Power Electronics                                   | FC    | 2  |   |   | 2  | 50  | 50  | 100   | BEEE              |
| 2501EE13    | Electrical Measurements & Instrumentation                           | FC    | 2  | 1 | 1 | 4  | 50  | 50  | 100   | ENA-1/BEEE        |
| 2501EE53    | Electric Power Generation, Transmission and Distribution Systems    | IC    | 3  |   |   | 3  | 50  | 50  | 100   | ENA-1/BEEE        |
| 2501EE34    | Alternative Energy Sources (or) Utilization of Electrical Energy    | IC    | 3  |   |   | 3  | 50  | 50  | 100   | EPGDS / BEEE/ ISM |
| 2501EE27    |                                                                     |       |    |   |   |    |     |     |       |                   |
| 2501EE37    | Hybrid Electric Vehicles (or) Special Electric machines             | AC    | 3  |   |   | 3  | 50  | 50  | 100   | FPE/ OCEM         |
| 2501EE35    |                                                                     |       |    |   |   |    |     |     |       |                   |
| 2501EE43    | Electrical Safety (or) Methods & Algorithms for Intelligent Control | AC    | 3  |   |   | 3  | 50  | 50  | 100   | EPGDS/PS A        |
| 2501EE30    |                                                                     |       |    |   |   |    |     |     |       |                   |
|             | Total                                                               |       | 18 | 1 | 1 | 20 |     |     |       |                   |

### Minor Degree in Mechanical Engineering

| Course Code | Course Name                                                     | Level | L  | T | P | C  | CIE | SEE | Total | Pre-requisite |
|-------------|-----------------------------------------------------------------|-------|----|---|---|----|-----|-----|-------|---------------|
| 2501ME74    | Basic Mechanical Engineering                                    | FC    | 2  |   |   | 2  | 50  | 50  | 100   | -             |
| 2501ME04    | Engineering Thermodynamics                                      | IC    | 2  | 1 |   | 3  | 50  | 50  | 100   | SSP/MP        |
| 2501ME77    | Introduction to Automobile Engineering (or) Mechanics of Solids | IC    | 3  |   |   | 3  | 50  | 50  | 100   | SSP/MP        |
| 2501ME78    |                                                                 |       |    |   |   |    |     |     |       |               |
| 2501ME12    | Heat Power Engineering (or) Refrigeration & Air Conditioning    | IC    | 2  | 1 |   | 3  | 50  | 50  | 100   | ETD           |
| 2501ME40    |                                                                 |       |    |   |   |    |     |     |       |               |
| 2501ME75    | Production Technology                                           | IC    | 3  |   |   | 3  | 50  | 50  | 100   | EW            |
| 2501ME76    | Metallurgy & Material Science                                   | IC    | 3  |   |   | 3  | 50  | 50  | 100   | SSP/MP        |
| 2501ME79    | Theory of Machines (or) Advanced Engineering Metrology          | AC    | 3  |   |   | 3  | 50  | 50  | 100   | SSP/MP        |
| 2501ME80    |                                                                 |       |    |   |   |    |     |     |       |               |
|             | Total                                                           |       | 18 | 2 |   | 20 |     |     |       |               |

### Minor Degree in Electronics & Communication Engineering

| Course Code | Course Name                                                            | Level | L  | T | P | C  | CIE | SEE | Total | Pre-requisite      |
|-------------|------------------------------------------------------------------------|-------|----|---|---|----|-----|-----|-------|--------------------|
| 2501EC87    | Fundamentals of Communications                                         | FC    | 2  |   | 1 | 3  | 50  | 50  | 100   | -                  |
| 2501EC88    | Fundamentals of Signal Processing                                      | FC    | 2  |   | 1 | 3  | 50  | 50  | 100   | -                  |
| 2501EC89    | Analog & Digital Circuits                                              | IC    | 2  |   |   | 2  | 50  | 50  | 100   | BEEE               |
| 2501EC42    | Wireless LAN's & PAN's                                                 | IC    | 2  | 1 |   | 3  | 50  | 50  | 100   | -                  |
| 2501EC90    | Linear & Digital IC Applications (or) Sensors & Actuators              | IC    | 3  |   |   | 3  | 50  | 50  | 100   | ADC                |
| 2501EC91    |                                                                        |       |    |   |   |    |     |     |       |                    |
| 2501EC92    | Embedded Microcontrollers (or) Digital System Design                   | IC    | 2  |   | 1 | 3  | 50  | 50  | 100   | ADC, PPSC          |
| 2501EC93    |                                                                        |       |    |   |   |    |     |     |       |                    |
| 2501EC67    | Introduction to Internet of things (or) Modern Wireless Communications | AC    | 2  |   | 1 | 3  | 50  | 50  | 100   | EM, WLAN's & PAN's |
| 2501EC74    |                                                                        |       | 3  |   |   | 3  | 50  | 50  | 100   | FC                 |
| Total       |                                                                        |       | 15 | 1 | 4 | 20 |     |     |       |                    |

### Minor Degree in Petroleum Technology

| Course Code  | Course Name                                                                                 | Level | L         | T | P | C         | CIE | SEE | Total | Pre-requisite |
|--------------|---------------------------------------------------------------------------------------------|-------|-----------|---|---|-----------|-----|-----|-------|---------------|
| 2501PT27     | Introduction to Petroleum Engineering                                                       | FC    | 2         |   |   | 2         | 50  | 50  | 100   | -             |
| 2501PT35     | Unit Operations in Petroleum Industry                                                       | FC    | 3         |   |   | 3         | 50  | 50  | 100   | -             |
| 2501PT47     | Fundamentals of Geology & Reservoir Engineering                                             | IC    | 3         |   |   | 3         | 50  | 50  | 100   | -             |
| 2501PT48     | Fundamentals of Drilling & Production Engineering (or) Unconventional Hydrocarbon Resources | IC    | 3         |   |   | 3         | 50  | 50  | 100   | -             |
| 2501PT16     |                                                                                             |       |           |   |   |           |     |     |       |               |
| 2501PT49     | Natural Gas Hydrates (or) Fundamentals of Liquefied Natural Gas                             | AC    | 3         |   |   | 3         | 50  | 50  | 100   | -             |
| 2501PT05     |                                                                                             |       |           |   |   |           |     |     |       |               |
| 2501PT50     | Artificial Lift Techniques (or) Enhanced Oil Recovery                                       | AC    | 3         |   |   | 3         | 50  | 50  | 100   | -             |
| 2501PT03     |                                                                                             |       |           |   |   |           |     |     |       |               |
| 2501PT12     | Petroleum Refinery Engineering                                                              | AC    | 3         |   |   | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                                                                                             |       | <b>20</b> |   |   | <b>20</b> |     |     |       |               |

### Minor Degree in Mining Engineering

| Course Code | Course Name                                               | Level | L  | T | P | C  | CIE | SEE | Total | Pre-requisite |
|-------------|-----------------------------------------------------------|-------|----|---|---|----|-----|-----|-------|---------------|
| 2501MN03    | Development of Mineral Deposits                           | FC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501MN41    | Green Mining                                              | FC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501MN06    | Surface Mining                                            | IC    | 3  |   |   | 3  | 50  | 50  | 100   | DMD           |
| 2501MN24    | Drilling & Blasting                                       | IC    | 3  |   |   | 3  |     |     | 100   | DMD           |
| 2501MN07    | Underground Coal Mining                                   | IC    | 3  |   |   | 3  | 50  | 50  | 100   | DMD           |
| 2501MN08    | Technology (or)<br>Underground Metal Mining<br>Technology |       |    |   |   |    |     |     |       |               |
| 2501MN14    | Mine Legislation & General Safety                         | AC    | 3  |   |   | 3  | 50  | 50  | 100   | UCMT/<br>UMMT |
| 2501MN28    | (or)<br>Environmental Pollution & Control                 |       |    |   |   |    |     |     |       |               |
| 2501MN45    | Industrial Safety Practices(or)                           | AC    | 2  |   |   | 2  | 50  | 50  | 100   | -             |
| 2501MN46    | Ground Control                                            |       |    |   |   |    |     |     |       |               |
| Total       |                                                           |       | 20 |   |   | 20 |     |     |       |               |

### Minor Degree in Agricultural Engineering

| Course Code | Course Name                                          | Level | L  | T | P | C  | CIE | SEE | Total | Pre-requisite |
|-------------|------------------------------------------------------|-------|----|---|---|----|-----|-----|-------|---------------|
| 2501AE82    | Fundamentals of Renewable Energy Sources             | FC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501AE83    | Post-harvest Engineering of Cereal Crops             | FC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501AE84    | Ground Water Hydrology                               | FC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501AE85    | Micro Irrigation Systems                             | IC    | 2  |   |   | 2  | 50  | 50  | 100   | -             |
| 2501AE86    | Surface Water Hydrology (or)                         | IC    | 3  |   |   | 3  | 50  | 50  | 100   | GWH           |
| 2501AE87    | Land & Water Management Engineering                  |       |    |   |   |    |     |     |       |               |
| 2501AE88    | Agricultural Process Engineering & Food Quality (or) | AC    | 3  |   |   | 3  | 50  | 50  | 100   | PHECC         |
| 2501AE89    | Post-harvest Engineering for Horticultural Produce   |       |    |   |   |    |     |     |       |               |
| 2501AE90    | Agricultural Machinery & Equipment (or)              | AC    | 3  |   |   | 3  | 50  | 50  | 100   | FRES          |
| 2501AE91    | Design of Bio-energy systems                         |       |    |   |   |    |     |     |       |               |
| TOTAL       |                                                      |       | 20 |   |   | 20 |     |     |       |               |

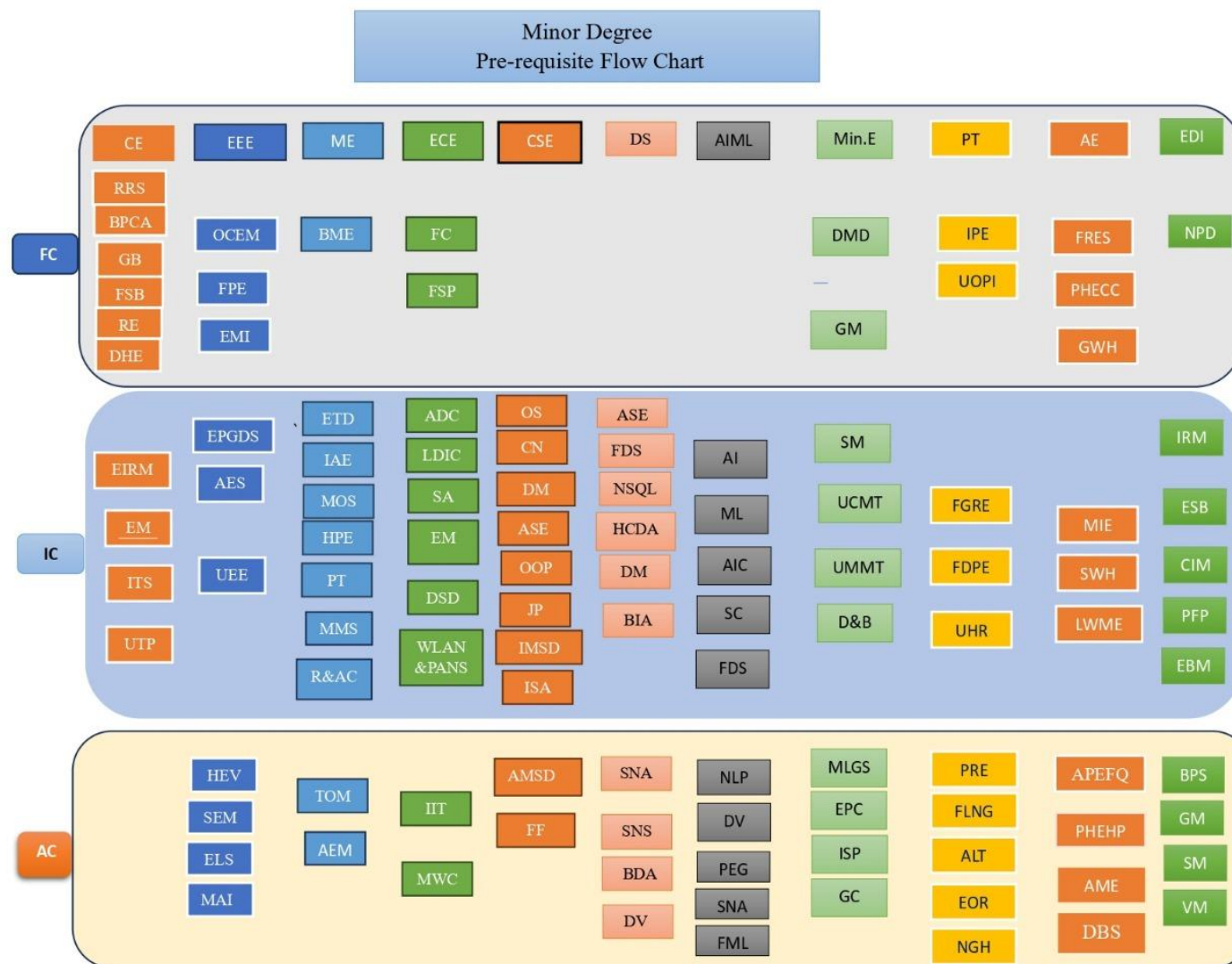
### Minor Degree in Entrepreneurship Development & Incubation

| Course Code | Course Name                                  | Level | L  | T | P | C  | CIE | SEE | Total | Pre-requisite |
|-------------|----------------------------------------------|-------|----|---|---|----|-----|-----|-------|---------------|
| 2501MB07    | New Product Development                      | FC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501MB08    | Entrepreneurship & Small Business Management | IC    | 2  |   |   | 2  | 50  | 50  | 100   | -             |
| 2501MB09    | Insurance & Risk Management                  | IC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501MB10    | Change & Innovations Management              | IC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501MB11    | Personal Financial Planning (or)             | IC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501MB12    | E-Business management                        |       |    |   |   |    |     |     |       |               |
| 2501MB13    | Business Policy & Strategic Management       | AC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501MB14    | (or)Green Marketing                          |       |    |   |   |    |     |     |       |               |
| 2501MB15    | Startup Management                           | AC    | 3  |   |   | 3  | 50  | 50  | 100   | -             |
| 2501MB16    | (or) Venture Management                      |       |    |   |   |    |     |     |       |               |
| Total       |                                              |       | 20 |   |   | 20 |     |     |       |               |

### Minor Degree in Quantum Technologies

| S.No.                         | Course Code | Course Name                                      | L                             | T | P | C | Semester |
|-------------------------------|-------------|--------------------------------------------------|-------------------------------|---|---|---|----------|
| Mandatory Courses             |             |                                                  |                               |   |   |   |          |
| 1                             | 251EC097    | Survey of Quantum technologies and Application   | 3                             | 0 | 0 | 3 | IV       |
| 2                             | 251EC098    | Foundations of Quantum Technologies              | 3                             | 0 | 0 | 3 | V        |
| 3                             | 251EC099    | Basic Programming Lab (or)                       | 1                             | 0 | 2 | 3 | V        |
|                               | 251EC100    | Basic Laboratory Course for Quantum Technologies |                               |   |   |   |          |
| 4                             | 251EC101    | Quantum Algorithms and Cryptography              | 12 week 3 Credit - NPTEL MOOC |   |   | 3 | VII/VIII |
| Any One course from the below |             |                                                  |                               |   |   |   |          |
| 5                             | 251EC102    | Introduction to Quantum Computation              | 3                             | 0 | 0 | 3 | VI       |
| 6                             | 251EC103    | Introduction to Quantum Communication            | 3                             | 0 | 0 | 3 | VI       |

|                                      |          |                                                 |           |          |          |           |     |
|--------------------------------------|----------|-------------------------------------------------|-----------|----------|----------|-----------|-----|
| 7                                    | 251EC104 | Introduction to Quantum Sensing                 | 3         | 0        | 0        | 3         | VI  |
| 8                                    | 251EC105 | Introduction to Quantum Materials               | 3         | 0        | 0        | 3         | VI  |
| <b>Any One course from the below</b> |          |                                                 |           |          |          |           |     |
| 9                                    | 251EC106 | Engineering Foundations of Quantum Technologies | 3         | 0        | 0        | 3         | VII |
| 10                                   | 251EC107 | Solid State Physics for Quantum Technologies    | 3         | 0        | 0        | 3         | VII |
| 11                                   | 251EC108 | Quantum Optics                                  | 3         | 0        | 0        | 3         | VII |
| 12                                   | 251EC109 | Quantum Cybersecurity                           | 3         | 0        | 0        | 3         | VII |
| 13                                   | 251EC110 | Quantum Machine Learning                        | 3         | 0        | 0        | 3         | VII |
| <b>Total</b>                         |          |                                                 | <b>18</b> | <b>0</b> | <b>0</b> | <b>18</b> |     |



| Dept.      | FOUNDATION COURSE |                                            | INTERMEDIATE- LEVEL COURSE |                                                  | ADVANCED COURSE |                                              |
|------------|-------------------|--------------------------------------------|----------------------------|--------------------------------------------------|-----------------|----------------------------------------------|
| <b>CE</b>  | RRS               | Repair & Rehabilitation of Structures      | EIRM                       | Environmental Impact & Risk Management           |                 |                                              |
|            | BPCA              | Building Planning & Computer-Aided Drawing | EM                         | Environmental Management                         |                 |                                              |
|            | GB                | Green Building                             | UTP                        | Urban Transportation Planning                    |                 |                                              |
|            | FSB               | Fundamental of Soil Behaviour              | ITS                        | Intelligent Transportation Systems               |                 |                                              |
|            | RE                | Railway Engineering                        |                            |                                                  |                 |                                              |
|            | DHE               | Docks & Harbour Engineering                |                            |                                                  |                 |                                              |
| <b>EEE</b> | OCE M             | Operation control of Electric Machines     | AES                        | Alternative Energy Sources                       | MAI             | Methods & Algorithms for Intelligent Control |
|            | FPE               | Fundamentals of Power Electronics          | EPGDS                      | Electric Power Generation & Distribution Systems | HEV             | Hybrid Electric Vehicles                     |
|            | EMI               | Electrical Measurements & Instrumentation  | UEE                        | Utilization of Electrical Energy                 | SEM             | Special Electric Machines                    |
|            |                   |                                            |                            |                                                  | ES              | Electrical Safety                            |
| <b>ME</b>  | BME               | Basic Mechanical Engineering               | ETD                        | Engineering Thermodynamics                       | TOM             | Theory of Machines                           |
|            |                   |                                            | IAE                        | Introduction to Automobile Engineering           | AEM             | Advanced Engineering Metrology               |
|            |                   |                                            | MOS                        | Mechanics of Solids                              |                 |                                              |
|            |                   |                                            | HPE                        | Heat Power Engineering                           |                 |                                              |
|            |                   |                                            | PT                         | Production Technology                            |                 |                                              |
|            |                   |                                            | MMS                        | Metallurgy & Material Science                    |                 |                                              |
|            |                   |                                            | R&AC                       | Refrigeration & Air Conditioning                 |                 |                                              |
| <b>ECE</b> | FC                | Fundamentals of Communications             | ADC                        | Analog & Digital Circuits                        | IIT             | Introduction to Internet of things           |
|            |                   |                                            | LDIC                       | Linear & Digital IC Applications                 |                 |                                              |
|            |                   |                                            | SA                         | Sensors & Actuators                              |                 |                                              |
|            | FSP               | Fundamentals of Signal Processing          | EM                         | Embedded Microcontrollers                        | MWC             | Modern Wireless Communications               |
|            |                   |                                            | DSD                        | Digital System Design                            |                 |                                              |
|            |                   |                                            | WLAN & PAN                 | Wireless LANS & PANS                             |                 |                                              |
| <b>CSE</b> |                   |                                            | ASE                        | Agile Software Engineering                       | AMSD            | Advanced MERN Stack Development              |



|               |      |                                       |      |                                                     |      |                                       |
|---------------|------|---------------------------------------|------|-----------------------------------------------------|------|---------------------------------------|
|               |      |                                       |      |                                                     |      |                                       |
|               |      |                                       | OOP  | Object Oriented Programming through C++             |      |                                       |
|               |      |                                       | OS   | Operating Systems                                   | FF   | Flutter Fundamentals                  |
|               |      |                                       | CN   | Computer Networks                                   |      |                                       |
|               |      |                                       | JP   | Java Programming                                    |      |                                       |
|               |      |                                       | IMSD | Introduction to MERN Stack Development              |      |                                       |
|               |      |                                       | ISA  | Information Security Analysis and Audit             |      |                                       |
|               |      |                                       | DM   | Data Mining                                         |      |                                       |
| <b>DS</b>     |      |                                       | DM   | Data Mining                                         | SNA  | Social Network Analysis               |
|               |      |                                       | FDS  | Fundamentals of Data Science                        | DV   | Data Visualization                    |
|               |      |                                       | ASE  | Agile Software Engineering                          | BDA  | Big Data Analytics                    |
|               |      |                                       | NSQL | NoSQL Databases                                     | SNSW | Social Networks and Semantic Web      |
|               |      |                                       | BIA  | Business Intelligence & Analytics                   |      |                                       |
|               |      |                                       | HCDA | Health Care Data Analysis                           |      |                                       |
|               |      |                                       |      |                                                     |      |                                       |
| <b>AIML</b>   |      |                                       | ML   | Machine Learning                                    | DV   | Data Visualization                    |
|               |      |                                       | AI   | Artificial Intelligence                             | PEG  | Prompt Engineering and GenAI          |
|               |      |                                       | AI C | AI Chatbot                                          | SNA  | Social Network Analysis               |
|               |      |                                       | FDS  | Fundamentals of Data Science                        | FML  | Federated Machine Learning            |
|               |      |                                       | SC   | Soft Computing                                      | NLP  | Natural Language Processing           |
| <b>Min. E</b> | DMD  | Development of Mineral Deposits       | SM   | Surface Mining                                      | MLGS | Mine Legislation and General Safety   |
|               | GM   | Green Mining                          | UCMT | Underground Coal Mining Technology                  | EPC  | Environmental Pollution & Control     |
|               |      |                                       | UMMT | Underground Metal Mining Technology                 | ISP  | Industrial Safety Practices           |
|               |      |                                       | DB   | Drilling & Blasting                                 | GC   | Ground Control                        |
| <b>PT</b>     | IPE  | Introduction to Petroleum Engineering | FGRE | Fundamentals of Geology and Reservoir Engineering   | PRE  | Petroleum Refinery Engineering        |
|               | UOPI | Unit operations in Petroleum Industry | FDPE | Fundamentals of Drilling and Production Engineering | FLNG | Fundamentals of Liquefied Natural Gas |
|               |      |                                       |      |                                                     | NGH  | Natural Gas Hydrates                  |
|               |      |                                       | UHR  | Unconventional Hydrocarbon Resources                | ALT  | Artificial Lift Techniques            |

|             |           |                                          |      |                                                |       |                                                    |
|-------------|-----------|------------------------------------------|------|------------------------------------------------|-------|----------------------------------------------------|
|             |           |                                          |      |                                                | EOR   | Enhanced Oil Recovery                              |
| <b>Ag.E</b> | GWH       | Ground Water Hydrology                   | LWME | Land and Water Management                      | DBS   | Design of Bio-Energy Systems                       |
|             | PHEC<br>C | Post-harvest Engineering of Cereal Crops | SWH  | Surface Water Hydrology                        | PHEHP | Post-Harvest Engineering for Horticultural Produce |
|             |           |                                          | MIE  | Micro Irrigation Systems                       |       |                                                    |
|             | FRES      | Fundamentals of Renewable Energy Sources |      |                                                | AME   | Agricultural Machinery and Equipment               |
|             |           |                                          |      |                                                | APEFQ | Agriculture Process Engineering and Food Quality   |
| <b>EDC</b>  | NPD       | New Product Development                  | ESB  | Entrepreneurship and Small Business Management | BPS   | Business Policy & Strategic Management             |
|             |           |                                          | CIM  | Change & Innovations Management                | GM    | Green Marketing                                    |
|             |           |                                          | PFP  | Personal Financial Planning                    | SM    | Startup Management                                 |
|             |           |                                          | EBM  | E-Business Management                          | VM    | Venture Management                                 |
|             |           |                                          | IRM  | Insurance and Risk Management                  |       |                                                    |

### Major Core Courses (MCC)

| Course Code         | Course Name                                                                       | Level | L | T | P | C | CIE | SEE | Total | Pre-requisite |
|---------------------|-----------------------------------------------------------------------------------|-------|---|---|---|---|-----|-----|-------|---------------|
| 2501MA01            | Linear algebra & Calculus                                                         | FC    | 2 | 1 |   | 3 | 50  | 50  | 100   | -             |
| 2501PH02            | Modern Physics                                                                    | FC    | 2 |   | 1 | 3 | 50  | 50  | 100   | -             |
| 2501CS01 / 2601DS01 | Programming for Problem Solving Using C* / Problem Solving Through C Programming# | FC    | 2 |   | 2 | 4 | 50  | 50  | 100   | -             |
| 2501IT01/ 2601AI01  | Business Intelligence Lab* / Business Intelligence & AI Tools Lab#                | FC    |   |   | 2 | 2 | 50  | 50  | 100   | -             |
| 2501ME01            | Engineering Graphics                                                              | FC    | 1 |   | 2 | 3 | 50  | 50  | 100   | -             |
| 2501MA02            | Differential Equations & Vector Calculus                                          | FC    | 2 | 1 |   | 3 | 50  | 50  | 100   | -             |
| 2501CS03/ 2601DS02  | Data Structures* / Data Structures using C++#                                     | FC    | 2 |   | 2 | 4 | 50  | 50  | 100   | PPSC          |
| 2501CS08            | Object Oriented Programming through C++*                                          | IC    | 2 |   | 2 | 4 | 50  | 50  | 100   | PPSC          |
| 2501IT42            | Programming with Python                                                           | FC    | 2 |   | 2 | 4 | 50  | 50  | 100   | PPSC          |
| 2501CS71            | Computer Organization & Architecture                                              | FC    | 2 | 1 |   | 3 | 50  | 50  | 100   | DLD           |
| 2501MA08            | Discrete Mathematics                                                              | IC    | 2 | 1 |   | 3 | 50  | 50  | 100   | LAC           |
| 2501CS11            | Theory of Computation                                                             | IC    | 2 | 1 |   | 3 | 50  | 50  | 100   | DMS           |
| 2501IT05            | Database Management Systems                                                       | IC    | 2 |   | 2 | 4 | 50  | 50  | 100   | PPSC          |
| 2501IT07            | Agile Software Engineering                                                        | IC    | 2 |   | 1 | 3 | 50  | 50  | 100   | PPSC          |
| 2501MA09            | Probability & Statistics                                                          | IC    | 2 | 1 |   | 3 | 50  | 50  | 100   | LAC           |
| 2501IT06            | Java Programming                                                                  | IC    | 2 |   | 2 | 4 | 50  | 50  | 100   | PPSC          |
| 2601AI02            | Full Stack Application Development using MERN#                                    | IC    | 2 |   | 2 | 4 | 50  | 50  | 100   | JP            |
| 2501CS13            | Operating Systems                                                                 | IC    | 2 |   | 1 | 3 | 50  | 50  | 100   | -             |
| 2501AI02            | Artificial Intelligence                                                           | IC    | 2 |   | 1 | 3 | 50  | 50  | 100   | -             |
| 2501CS07            | Computer Networks                                                                 | IC    | 2 |   | 1 | 3 | 50  | 50  | 100   | -             |
| 2501AI03            | Data Mining                                                                       | IC    | 1 |   | 2 | 3 | 50  | 50  | 100   | -             |
| 2501CS10            | Advanced Data Structures & Algorithm Analysis                                     | AC    | 2 |   | 1 | 3 | 50  | 50  | 100   | DS            |
| 2501IT04            | Compiler Design                                                                   | AC    | 2 |   | 1 | 3 | 50  | 50  | 100   | TOC           |
| 2501AI05            | Machine Learning                                                                  | AC    | 2 |   | 2 | 4 | 50  | 50  | 100   | DAE           |
| 2501AI04            | Big Data Analytics                                                                | AC    | 2 |   | 1 | 3 | 50  | 50  | 100   | DM            |

|          |                                    |    |           |          |           |           |    |    |     |     |
|----------|------------------------------------|----|-----------|----------|-----------|-----------|----|----|-----|-----|
| 2501IT03 | Cryptography &<br>Network Security | AC | 2         |          | 1         | 3         | 50 | 50 | 100 | CN  |
| 2501CS15 | Software Architecture              | AC | 2         |          | 1         | 3         | 50 | 50 | 100 | ASE |
|          | <b>Total</b>                       |    | <b>47</b> | <b>6</b> | <b>30</b> | <b>84</b> |    |    |     |     |

## Linear Algebra & Calculus

(Common to CE,EEE,ME,ECE,CSE,IT,AIIML,CSE(DS),PT&Min.E)

**Course Code: 2501MA01**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>1</b> | <b>0</b> | <b>3</b> |

### Course Outcomes:

**At the end of the Course, Student will be able to:**

- CO1:** Solve the system of Linear equations
- CO2:** Calculate Eigen values and Eigen vectors
- CO3:** Apply differential calculus for one and several variable functions
- CO4:** Calculate the Maximum value and Minimum value of a function of several variables
- CO5:** Compute areas and volumes using multiple integrals

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 3    | 2    |      |      |      |      |      |      |      |       |       |
| CO2   | 3    | 2    |      |      |      |      |      |      |      |       |       |
| CO3   | 3    | 2    |      |      |      |      |      |      |      |       |       |
| CO4   | 3    | 2    |      |      |      |      |      |      |      |       |       |
| CO5   | 3    | 2    |      |      |      |      |      |      |      |       |       |

### UNIT – I

**System of linear equations:** Vector Space, Linear Independence, Rank of a matrix by echelon form, normal form, Inverse of Non-singular matrices by Gauss-Jordan method, Solutions of Linear Systems: Existence, Uniqueness, Solving the system by Gauss elimination method.

#### Practice(Using any computational tool)

1. Variables, arithmetic operations, elementary mathematical functions.
2. Defining row vector, column vector, Arithmetic operations on matrices
3. finding transpose of a matrix, inverse of a matrix, determinant of a matrix
4. rank of a matrix, solving system of linear equations.

### UNIT – II

**Eigenvalues, Eigenvectors :** Eigenvalues and properties(without proof), Eigenvectors, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), Quadratic forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation, Nature of Quadratic forms.

#### Practice(Using any computational tool):

1. Computing eigen values and eigen vectors, matrix diagonalization.

### UNIT-III

**One Variable Calculus:** Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

**Several Variable Calculus:** Limit, Continuity, partial derivatives and their geometrical interpretation.

**Practice(Using any computational tool):** Basics of plotting, Plot graphs of single variable functions

#### **UNIT – IV**

**Functions of several variables:** Total differential and differentiability, derivatives of composite and implicit functions, derivatives of higher order and their commutativity, Euler's theorem on homogeneous functions, Taylor's and Maclaurin's expansion of functions of two variables. Jacobians, maxima and minima, constrained maxima/minima problems using Lagrange's method of multipliers.

**Practice(Using any computational tool):** Plot graphs of various multi variable functions

#### **UNIT – V**

**Multiple Integrals:** Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

**Practice(Using any computational tool):** Plotting the region of Integration

Students are advised to use any computational / AI Tool like Wolfram Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

#### **Text Books:**

- 1 Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021· ISBN 978-8184875607
- 2 Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 5th Edition, 2018. ISBN-13. 978-1292174341

#### **Reference Books:**

- 1 Advanced Engineering Mathematics, Michael Greenberg, Pearson publishers, 9th edition. ISBN-13. 9788177585469
- 2 Higher Engineering Mathematics, H. K. Dass, Er. R. Verma, S-Chand publishers, 3rd edition 2023. ISBN 9788121938907

#### **Web Links:**

- 1 <https://archive.nptel.ac.in/courses/111/104/111104137/>
- 2 <https://archive.nptel.ac.in/courses/111/107/111107108/>
- 3 <https://www.khanacademy.org/math/linear-algebra/>
- 4 <https://www.khanacademy.org/math/multivariable-calculus>

## Modern Physics

(Common to EEE, ECE, CSE, IT, AIML & CSE (DS))

|                             |          |          |          |          |
|-----------------------------|----------|----------|----------|----------|
|                             | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code:2501PH02</b> | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

At the end of the Course, Student will be able to:

- CO1** Apply the principles of interference and diffraction to design and enhance the resolving power of grating
- CO2** Familiarize the concepts of LASER's and Optical fibres with applications.
- CO3** Explain the fundamental concepts of Quantum behavior of matter
- CO4** Differentiate various electron theories to understand the properties of solids.
- CO5** Explain the basic concepts of Semiconductors and identify the type of semiconductors using Hall effect.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| <b>CO1</b> | 2   | 1   | -   | -   | -   | -   | -   | 1   | 1   | -    | -    |
| <b>CO2</b> | 2   | 1   | -   | -   | -   | -   | -   | 1   | 1   | -    | -    |
| <b>CO3</b> | 2   | 1   | -   | -   | -   | -   | -   | 1   | 1   | -    | -    |
| <b>CO4</b> | 2   | 1   | -   | -   | -   | -   | -   | 1   | 1   | -    | -    |
| <b>CO5</b> | 2   | 1   | -   | -   | -   | -   | -   | 1   | 1   | -    | -    |

### UNIT-I

#### Wave Optics

**Interference:** Introduction - Principle of Superposition - Interference of light- Conditions for sustained Interference- Interference in thin films (reflected geometry) – Colours in thin films – Newton's Rings (reflected geometry) – Determination of wavelength and refractive index – Applications.

**Diffraction:** Introduction – Fresnel and Fraunhofer Diffraction - Diffraction due to Single slit (quantitative), Double slit (qualitative) - N-Slits Intensity distribution curves (qualitative) – Grating spectrum–Rayleigh's criterion - Resolving powers of grating (qualitative) - Applications.

#### Practice:

1. Determination of Radius of curvature of a plano-convex lens using Newton's Rings.
2. Measurement of Width or thickness of a thin wire by forming interference fringes.
3. Determination of Wavelength of light source using Diffraction grating by normal incidence method.
4. Resolving power of grating.
5. Determination of wavelength of light by using prism.

## UNIT-II

### Lasers & Optical Fibers

**Lasers:** Introduction - Characteristics of Lasers – Spontaneous and Stimulated emission of radiation – population inversion- Einstein's coefficients – Relation - significance - Pumping Mechanisms - Ruby laser – Helium-Neon laser - Applications.

**Optical Fibers:** Introduction – Principle of propagation in Optical Fiber – Angle of acceptance – Expression for Numerical Aperture and condition for propagation – Classification of Optical fibers - Applications.

#### Practice:

1. Determination of Wavelength of He-Ne laser source by using diffraction grating.

## UNIT-III

### Quantum Mechanics

Introduction – Matter waves – de Broglie's hypothesis – Davisson and Germer Experiment - Heisenberg's Uncertainty Principle – interpretation of wave function – Schrödinger Time dependent and Time Independent wave equations– Particle in a potential box.

## Unit-IV

### Free electron Theory

**Free Electron Theory:** Introduction–Classical free electron theory (merits and demerits only) -Quantum Free electron theory – Electrical conductivity- Fermi energy state–Fermi Dirac distribution function - Temperature dependence – Density of states.

**Band theory of solids:** Bloch Theorem – Origin of energy bands in crystalline solids – classification of crystalline solids.

#### Practice:

1. Study the variation of magnetic field along the axis of a circular coil carrying current by using Stewart and Gee's apparatus.
2. Determination of Frequency of electrically maintained tuning fork by Melde's apparatus.

## UNIT-V

### Semiconductor Physics

**Semiconductors** Introduction – Intrinsic semiconductors – density of charge carriers (Qualitative only) – Electrical conductivity –Fermi level - extrinsic semiconductors - P-type & N-type semiconductors-Density of charge carriers (Qualitative only) - Dependence of Fermi energy on carrier concentration and temperature–Hall effect-Hall coefficient - Applications of Hall effect–Drift and Diffusion currents - Einstein's equation

**Semiconductor Devices** Working of PN junction diode – Forward and reverse bias Zener diode -Metal-Oxide-Semiconductor (MOS) structure- Capacitance-voltage characteristics- MOSFET structure - I-V characteristics.

#### Practice:

1. Determination of V-I characteristics and Breakdown voltage of a Zener diode.
2. Determination of Energy band gap of a semiconductor by using P-N junction diode.
3. Study the relation between Temperature and resistance and finding the constants A & B of a thermistor.



4. Determine the resistivity of a semiconductor by four probe method.

**Textbooks:**

1. Engineering Physics, M N Avadhanulu & T.V.S. Arun Murthy, S Chand & Company Ltd, 1st edition 2024. ISBN: 978-93-5870-932-3
2. Engineering Physics, Satyendra Sharma and Jyotshna Sharma, Pearson publications. ISBN: 978-81-3151-178-7

**Reference Books:**

1. Concepts of Modern Physics, Authur Beiser, Shobhit Mahajan and S Rai Choudhary, McGraw Hill (2017). ISBN: 9789351341857
2. Engineering Physics, M.R. Srinivasan, New Age international publishers (2009). ISBN: 978-1848290501
3. Optics, Ajoy Ghatak, 6th Edition McGraw Hill Education, 2017. ISBN: 978-9390113590

**Web Links:**

1. <http://nptel.ac.in/courses/122107035/11>
2. <http://nptel.ac.in/courses/115102023/->
3. <https://phet.colorado.edu/en/simulations/category/physics>
4. <http://physicsgecg.blogspot.in/p/reading-materials.html>

**Programming for Problem Solving using C**  
(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)  
(Syllabus for the batch admitted in the year 2025)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501CS01</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes: At the end of the Course, Student will be able to:**

- CO1:** Demonstrate basics of computer, algorithm and flow chart for problem solving.
- CO2:** Make use of an appropriate control structures to solve given problems.
- CO3:** Solve complex problems using arrays and strings.
- CO4:** Develop modular programming using functions.
- CO5:** Demonstrate dynamic memory allocations and file handling using file operations.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 3    | 2    | 1    | 3    | -    | -    | 2    | -    | -     | 1     |
| <b>CO2</b> | 2    | 3    | 2    | 1    | 3    | -    | -    | 2    | -    | -     | 1     |
| <b>CO3</b> | 2    | 3    | 2    | 1    | 3    | -    | 1    | 2    | -    | -     | 1     |
| <b>CO4</b> | 2    | 3    | 2    | 1    | 3    | -    | 1    | 2    | -    | -     | 1     |
| <b>CO5</b> | 2    | 3    | 2    | 1    | 3    | -    | 1    | 2    | -    | -     | 1     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    | 2    |
| <b>CO2</b> | 2    | 2    |
| <b>CO3</b> | 2    | 2    |
| <b>CO4</b> | 2    | 2    |
| <b>CO5</b> | 2    | 2    |

**UNIT – I**

**Introduction to Programming and Problem Solving**

Introduction to Programming Languages, Basics of a Computer Program- Algorithms, Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms, flowcharts (Using Dia Tool), pseudo code. Structure of C Program, Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, operators, keywords, identifiers, Type Conversion, and Casting.

**Practice 1:**

1. Explore different platforms
  - a. Basic linux environment and its editors like Vi, Vim & Emacs etc.
  - b. Exposure to turbo C, gcc.
  - c. Explore to hacker rank or any other Online coding platform and compiler environment.
  - d. “Hello world” in C.  
<https://www.codechef.com/learn/course/c/CDEVINTRO/problems/CDEV004B>
  - e. Objective: Learn about the syntax of reading from stdin and writing to stdout.  
<https://www.hackerrank.com/challenges/hello-world-c/problem?isFullScreen=true>

- f. Write a simple program to read int, float, char and string using scanf() and display using printf() in all the above given platforms.
2. Basics and Operators
    - a. Sum and Difference of 2 numbers.  
Objective: Learn int and float data types.  
<https://www.hackerrank.com/challenges/sum-numbers-c/problem?isFullScreen=true>  
<https://maya.technicalhub.io/owl-program-details/668b9ec2e069313510b0235a>
    - b. Playing with Characters.  
Objective: Learn how to take a character, a string and a sentence as input in C.  
<https://www.hackerrank.com/challenges/playing-with-characters/problem?isFullScreen=true>
    - c. Bitwise Operators  
Objective: Learn how to work with bits (0,1) and bitwise operators.  
<https://www.hackerrank.com/challenges/bitwise-operators-in-c/problem?isFullScreen=true>
    - d. Conversion of Fahrenheit to Celsius and vice versa.  
<https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30>  
<https://maya.technicalhub.io/owl-program-details/66a0c0dda7d31805366af641>
    - e. Distance travelled by an object.  
<https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a>
    - f. Calculate Simple interest and compound interest.  
<https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab>
  3. Operators and Expressions, Variables and Type conversions.
    - a. Evaluate the following expressions
      - i.  $a/b*c-b+a*d/3$
      - ii.  $j = (i++) + (++i)$
    - b. Square root of a given number.
    - c. Find the area of circle, square, rectangle and triangle.  
<https://maya.technicalhub.io/owl-program-details/6686546930bfbfd35127c869c>  
<https://maya.technicalhub.io/owl-program-details/6688cf91e467bfe336f8352f>  
[https://www.hackerrank.com/challenges/rectangle-area/problem?utm\\_source=chatgpt.com](https://www.hackerrank.com/challenges/rectangle-area/problem?utm_source=chatgpt.com)  
<https://maya.technicalhub.io/owl-program-details/6688ea3ce467bfe336f8ab9d>
    - d. Find the maximum of three numbers using conditional operator.  
<https://maya.technicalhub.io/owl-program-details/668690d230bfbfd35127c9bf5>
    - e. Take marks of 5 subjects in integers, find the total in integer and average in float.

## UNIT – II

### Control Structures

Simple sequential programs, Conditional Statements (if, if-else, else if ladder, switch), Loops (for, nested for loop, while, do-while), break and continue, goto statement.

### Practice:

1. Conditional Statements

- a. Objective: Understand if and else Conditional statements in C.  
<https://www.hackerrank.com/challenges/conditional-statements-in-c/problem?isFullScreen=true>
- b. Roots of a Quadratic Equation.
- c. Generate electricity bill.  
<https://maya.technicalhub.io/owl-program-details/66868f6730bfbd35127c9ba7>
- d. Simulate a calculator using switch case.
- e. Find the given year is a leap year or not.
2. Loops
  - a. Objective: Learn the usage of the for loop in C. <https://www.hackerrank.com/challenges/for-loop-in-c/problem?isFullScreen=true>
  - b. Sum of the digits of a 5-digit number.  
Objective: Learn the usage of while loop and usage of operators - % and /.  
<https://www.hackerrank.com/challenges/sum-of-digits-of-a-five-digit-number/problem?isFullScreen=true>  
<https://maya.technicalhub.io/owl-program-details/66864717f56afec5c0c917e1>
  - c. Given number is a prime or not. (Also Prime numbers between a given range.)  
<https://maya.technicalhub.io/owl-program-details/6687b69ddfe02cea4b5404a3>
  - d. Armstrong Number or not.
  - e. Palindrome or not.  
<https://maya.technicalhub.io/owl-program-details/6687af17dfe02cea4b5376ae>
  - f. Objective: Print a pattern of numbers using Loops.  
<https://www.hackerrank.com/challenges/printing-pattern-2/problem?isFullScreen=true>
  - g. Construct a Pyramid pattern.  
<https://www.codechef.com/practice/course/c/LPCAS02/problems/LCAS20>

### UNIT – III

**Arrays:** Arrays indexing, Accessing programs with array of integers, two dimensional arrays, Introduction to Strings, string handling functions.

**Sorting Techniques:** bubble sort, selection sort.

**Searching Techniques:** linear, Binary search.

#### Practice:

1. 1-Dimensional Arrays
  - a. Objective: Print the sum and free the memory where the array is stored.  
<https://www.hackerrank.com/challenges/1d-arrays-in-c/problem?isFullScreen=true>
  - b. Objective: Working with indices in array.
  - c. Search an element in array (Linear Search).  
<https://maya.technicalhub.io/owl-program-details/6687c40ffd042085d9ec15d6>
  - d. Find min and max elements in array.  
<https://maya.technicalhub.io/owl-program-details/66879493dfe02cea4b529041>
  - e. Insert an element into array.
  - f. Eliminate duplicate elements from array.  
<https://maya.technicalhub.io/owl-program-details/66e920a1aca93b27f3364b57>
  - g. Sorting of elements in an array using Bubble sort.

2. 2-Dimensional Arrays
  - a. Sum of two 2-D arrays.  
<https://maya.technicalhub.io/owl-program-details/66864fa9f56afec5c0c924f6>
  - b. Multiplication of two 2-D arrays.
  - c. Transpose of a Matrix.
  - d. Trace of a Matrix.
  - e. Lower Triangular Matrix.
3. Hacker Rank
  - a. Objective: print each word of the sentence in a new line.
  - b. Count number of alphabets (lowercase, uppercase, consonants, vowels) and digits  
Lowercase to Uppercase, Uppercase to Lowercase, Toggle case, Sentential case  
<https://maya.technicalhub.io/owl-program-details/6698e2fbc6bd470f35b73d8>  
<https://maya.technicalhub.io/owl-program-details/6698ef03cb6bd470f35b7c3e>
  - c. find the frequency of each digit in the given string.  
<https://www.hackerrank.com/challenges/frequency-of-digits-1/problem?isFullScreen=true>
  - d. Find string length, concatenate 2 strings, reverse a string using built-in and without built-in string functions.  
<https://maya.technicalhub.io/owl-program-details/6698ed2dcb6bd470f35b7ae7>

#### UNIT – IV

**Functions:** Introduction to Functions, Function Declaration and Definition, Function call Return **Types and Arguments**, arrays as parameters, Scope and Lifetime of Variables, **storage classes**, **recursion**, functions and arrays.

**Practice:** Functions in C

1. Objective: Learn simple usage of functions.  
<https://www.hackerrank.com/challenges/functions-in-c/problem?isFullScreen=true>
2. Objective: Fibonacci Numbers using recursive function.  
<https://www.hackerrank.com/challenges/ctci-fibonacci-numbers/problem>
3. Objective: N<sup>th</sup> factorial using recursion.
4. Objective: Find the super digit of the integer.
5. Implement LCM
6. Objective: Calculate the Nth term of series.  
<https://www.hackerrank.com/challenges/recursion-in-c/problem?isFullScreen=true>

#### UNIT – V

**Pointer:** Introduction to Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, **functions & pointers** modifying parameters inside functions using pointers, Command line Arguments, Dynamic memory allocation, Null Pointer, generic pointer, dangling pointer.

**File Handling:** -Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

**Practice:**

1. Pointers
  - a. Objective: learn to implement the basic functionalities of pointers in C.  
<https://www.hackerrank.com/challenges/pointer-in-c/problem?isFullScreen=true>
  - b. Objective: Learn using Pointers with Arrays and Functions.  
<https://www.hackerrank.com/challenges/students-marks-sum/problem?isFullScreen=true>

- c. Objective: sort a given array of strings into lexicographically increasing order or into an order in which the string with the lowest length appears first.  
<https://www.hackerrank.com/challenges/sorting-array-of-strings/problem?isFullScreen=true>
- d. Find the sum of a 1D array using malloc().
- e. Swap two numbers using functions and pointers - call by value and reference.
- f. Objective: Dynamic Handling requests by a Librarian to place the books in the shelves.  
<https://www.hackerrank.com/challenges/dynamic-array-in-c/problem?isFullScreen=true>

2. File handling concepts

- a) Write text into and read text from a file.
- b) Write text into and read text from a binary file using fread() and fwrite().
- c) Copy the contents of one file to another file.
- d) Merge two files into the third file using command-line arguments
- e) Find no. of lines, words and characters in a file.

**Text Books:**

- 1 Programming in C, Rema Theraja, Oxford, 2nd edition. ISBN 93-5497-9
- 2 "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall. ISBN 13: 9780131103627

**Reference Books:**

- 1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education. ISBN.No: 9352604172
- 2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill. ISBN No. 0071367993
- 3. Let Us C Yashwanth, Kanetkar, Eighth edition, BPB Publications. ISBN No. 1934015253
- 4. Programming in C A-Practical Approach, Ajay Mittal. Pearson Education. ISBN No. 9788131729342
- 5. R G Dromey How to Solve It by Computer (Prentice-Hall International Series in Computer Science. ISBN-13 : 978-0134340012

**Web Links:**

- 1 <https://www.hackerrank.com/>
- 2 [https://onlinecourses.nptel.ac.in/noc22\\_cs40/preview](https://onlinecourses.nptel.ac.in/noc22_cs40/preview)
- 3 <https://archive.nptel.ac.in/courses/106/104/106104128/>

**Additional Practice:**

| S.No . | Difficulty | Problem Name                                       | Link                                                                                                                                                                                                    |
|--------|------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Easy       | Add Two Numbers                                    | <a href="https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001">https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001</a>                                                 |
| 2      | Easy       | Enormous Input Test                                | <a href="https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTEST">https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTEST</a>   |
| 3      | Easy       | ATM                                                | <a href="https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2">https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2</a>     |
| 4      | Easy       | Number Mirror                                      | <a href="https://www.codechef.com/practice/course/python/PPY01/problems/START01">https://www.codechef.com/practice/course/python/PPY01/problems/START01</a>                                             |
| 5      | Easy       | Sum of Digits                                      | <a href="https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006">https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006</a>                             |
| 6      | Easy       | Remainder                                          | <a href="https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002">https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002</a>                             |
| 7      | Easy       | First and Last Digit                               | <a href="https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004">https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004</a> |
| 8      | Easy       | Reverse The Number                                 | <a href="https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007">https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007</a>                     |
| 9      | Easy       | Life, the Universe, and Everything                 | <a href="https://staging.codechef.com/practice/course/cpp/PRACTICECPP2/problems/TEST">https://staging.codechef.com/practice/course/cpp/PRACTICECPP2/problems/TEST</a>                                   |
| 10     | Easy       | Chef and Operators                                 | <a href="https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT">https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT</a>                       |
| 11     | Easy       | Difference and Sum                                 | <a href="https://www.codechef.com/problems/DIFFSUM">https://www.codechef.com/problems/DIFFSUM</a>                                                                                                       |
| 12     | Easy       | Second Largest                                     | <a href="https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND">https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND</a>                                   |
| 13     | Easy       | Two Sum                                            | <a href="https://leetcode.com/problems/two-sum/">https://leetcode.com/problems/two-sum/</a>                                                                                                             |
| 14     | Easy       | Reverse Integer                                    | <a href="https://leetcode.com/problems/reverse-integer/">https://leetcode.com/problems/reverse-integer/</a>                                                                                             |
| 15     | Easy       | Palindrome Number                                  | <a href="https://leetcode.com/problems/palindrome-number/">https://leetcode.com/problems/palindrome-number/</a>                                                                                         |
| 16     | Easy       | Roman to Integer                                   | <a href="https://leetcode.com/problems/roman-to-integer/">https://leetcode.com/problems/roman-to-integer/</a>                                                                                           |
| 17     | Easy       | Remove Duplicates from Sorted Array                | <a href="https://leetcode.com/problems/remove-duplicates-from-sorted-array/">https://leetcode.com/problems/remove-duplicates-from-sorted-array/</a>                                                     |
| 18     | Easy       | Remove Element                                     | <a href="https://leetcode.com/problems/remove-element/">https://leetcode.com/problems/remove-element/</a>                                                                                               |
| 19     | Easy       | Find the Index of the First Occurrence in a String | <a href="https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/">https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/</a>                       |
| 20     | Easy       | Length of Last Word                                | <a href="https://leetcode.com/problems/length-of-last-word/">https://leetcode.com/problems/length-of-last-word/</a>                                                                                     |
| 21     | Easy       | Plus One                                           | <a href="https://leetcode.com/problems/plus-one/">https://leetcode.com/problems/plus-one/</a>                                                                                                           |
| 22     | Easy       | Merge Sorted Array                                 | <a href="https://leetcode.com/problems/merge-sorted-array/">https://leetcode.com/problems/merge-sorted-array/</a>                                                                                       |
| 23     | Easy       | Majority Element                                   | <a href="https://leetcode.com/problems/majority-element/">https://leetcode.com/problems/majority-element/</a>                                                                                           |
| 24     | Easy       | Single Number                                      | <a href="https://leetcode.com/problems/single-number/">https://leetcode.com/problems/single-number/</a>                                                                                                 |
| 25     | Easy       | Move Zeroes                                        | <a href="https://leetcode.com/problems/move-zeroes/">https://leetcode.com/problems/move-zeroes/</a>                                                                                                     |



|    |        |                                                |                                                                                                                                                                           |
|----|--------|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26 | Easy   | Missing Number                                 | <a href="https://leetcode.com/problems/missing-number/">https://leetcode.com/problems/missing-number/</a>                                                                 |
| 27 | Easy   | Contains Duplicate                             | <a href="https://leetcode.com/problems/contains-duplicate/">https://leetcode.com/problems/contains-duplicate/</a>                                                         |
| 28 | Easy   | Valid Anagram                                  | <a href="https://leetcode.com/problems/valid-anagram/">https://leetcode.com/problems/valid-anagram/</a>                                                                   |
| 29 | Easy   | Valid Parentheses                              | <a href="https://leetcode.com/problems/valid-parentheses/">https://leetcode.com/problems/valid-parentheses/</a>                                                           |
| 30 | Easy   | Fibonacci Number                               | <a href="https://leetcode.com/problems/fibonacci-number/">https://leetcode.com/problems/fibonacci-number/</a>                                                             |
| 31 | Easy   | Climbing Stairs                                | <a href="https://leetcode.com/problems/climbing-stairs/">https://leetcode.com/problems/climbing-stairs/</a>                                                               |
| 32 | Easy   | Binary Search                                  | <a href="https://leetcode.com/problems/binary-search/">https://leetcode.com/problems/binary-search/</a>                                                                   |
| 33 | Easy   | Number of 1 Bits                               | <a href="https://leetcode.com/problems/number-of-1-bits/">https://leetcode.com/problems/number-of-1-bits/</a>                                                             |
| 34 | Easy   | Hamming Weight                                 | <a href="https://leetcode.com/problems/number-of-1-bits/description/">https://leetcode.com/problems/number-of-1-bits/description/</a>                                     |
| 35 | Easy   | Power of Two                                   | <a href="https://leetcode.com/problems/power-of-two/">https://leetcode.com/problems/power-of-two/</a>                                                                     |
| 36 | Easy   | Power of Three                                 | <a href="https://leetcode.com/problems/power-of-three/">https://leetcode.com/problems/power-of-three/</a>                                                                 |
| 37 | Easy   | Same Tree                                      | <a href="https://leetcode.com/problems/same-tree/">https://leetcode.com/problems/same-tree/</a>                                                                           |
| 38 | Easy   | Maximum Subarray                               | <a href="https://leetcode.com/problems/maximum-subarray/">https://leetcode.com/problems/maximum-subarray/</a>                                                             |
| 39 | Medium | Chef and Notebooks                             | <a href="https://www.codechef.com/problems/CNOTE">https://www.codechef.com/problems/CNOTE</a>                                                                             |
| 40 | Medium | Chef and Wildcard Matching                     | <a href="https://www.codechef.com/search?q=TWOSTR">https://www.codechef.com/search?q=TWOSTR</a>                                                                           |
| 41 | Medium | Minimum Moves                                  | <a href="https://www.codechef.com/search?q=SALARY">https://www.codechef.com/search?q=SALARY</a>                                                                           |
| 42 | Medium | Lucky Four                                     | <a href="https://www.codechef.com/search?q=LUCKFOUR">https://www.codechef.com/search?q=LUCKFOUR</a>                                                                       |
| 43 | Medium | Maximum Difference                             | <a href="https://www.codechef.com/search?q=MAXDIFF">https://www.codechef.com/search?q=MAXDIFF</a>                                                                         |
| 44 | Medium | Uncle Johny                                    | <a href="https://www.codechef.com/search?q=JOHNY">https://www.codechef.com/search?q=JOHNY</a>                                                                             |
| 45 | Medium | Chef and Strings                               | <a href="https://www.codechef.com/search?q=CHEFSTLT">https://www.codechef.com/search?q=CHEFSTLT</a>                                                                       |
| 46 | Medium | Two vs Rib                                     | <a href="https://www.codechef.com/search?q=TWOVRIB">https://www.codechef.com/search?q=TWOVRIB</a>                                                                         |
| 47 | Medium | Chef and Array                                 | <a href="https://www.codechef.com/search?q=CHFARRP">https://www.codechef.com/search?q=CHFARRP</a>                                                                         |
| 48 | Medium | Add Two Numbers                                | <a href="https://leetcode.com/problems/add-two-numbers/">https://leetcode.com/problems/add-two-numbers/</a>                                                               |
| 49 | Medium | Longest Substring Without Repeating Characters | <a href="https://leetcode.com/problems/longest-substring-without-repeating-characters/">https://leetcode.com/problems/longest-substring-without-repeating-characters/</a> |
| 50 | Medium | Longest Palindromic Substring                  | <a href="https://leetcode.com/problems/longest-palindromic-substring/">https://leetcode.com/problems/longest-palindromic-substring/</a>                                   |
| 51 | Medium | 3Sum                                           | <a href="https://leetcode.com/problems/3sum/">https://leetcode.com/problems/3sum/</a>                                                                                     |
| 52 | Medium | Container With Most Water                      | <a href="https://leetcode.com/problems/container-with-most-water/">https://leetcode.com/problems/container-with-most-water/</a>                                           |



|    |        |                                  |                                                                                                                                                                               |
|----|--------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 53 | Medium | Integer to Roman                 | <a href="https://leetcode.com/problems/integer-to-roman/">https://leetcode.com/problems/integer-to-roman/</a>                                                                 |
| 54 | Medium | String to Integer (atoi)         | <a href="https://leetcode.com/problems/string-to-integer-atoi/">https://leetcode.com/problems/string-to-integer-atoi/</a>                                                     |
| 55 | Medium | Divide Two Integers              | <a href="https://leetcode.com/problems/divide-two-integers/">https://leetcode.com/problems/divide-two-integers/</a>                                                           |
| 56 | Medium | Rotate Image                     | <a href="https://leetcode.com/problems/rotate-image/">https://leetcode.com/problems/rotate-image/</a>                                                                         |
| 57 | Medium | Set Matrix Zeroes                | <a href="https://leetcode.com/problems/set-matrix-zeroes/">https://leetcode.com/problems/set-matrix-zeroes/</a>                                                               |
| 58 | Medium | Spiral Matrix                    | <a href="https://leetcode.com/problems/spiral-matrix/">https://leetcode.com/problems/spiral-matrix/</a>                                                                       |
| 59 | Medium | Jump Game                        | <a href="https://leetcode.com/problems/jump-game/">https://leetcode.com/problems/jump-game/</a>                                                                               |
| 60 | Medium | Permutations                     | <a href="https://leetcode.com/problems/permutations/">https://leetcode.com/problems/permutations/</a>                                                                         |
| 61 | Medium | Combination Sum                  | <a href="https://leetcode.com/problems/combination-sum/">https://leetcode.com/problems/combination-sum/</a>                                                                   |
| 62 | Medium | Search in Rotated Sorted Array   | <a href="https://leetcode.com/problems/search-in-rotated-sorted-array/">https://leetcode.com/problems/search-in-rotated-sorted-array/</a>                                     |
| 63 | Medium | Group Anagrams                   | <a href="https://leetcode.com/problems/group-anagrams/">https://leetcode.com/problems/group-anagrams/</a>                                                                     |
| 64 | Medium | Sort Colors                      | <a href="https://leetcode.com/problems/sort-colors/">https://leetcode.com/problems/sort-colors/</a>                                                                           |
| 65 | Medium | Subsets                          | <a href="https://leetcode.com/problems/subsets/">https://leetcode.com/problems/subsets/</a>                                                                                   |
| 66 | Medium | Reverse Linked List II           | <a href="https://leetcode.com/problems/reverse-linked-list-ii/">https://leetcode.com/problems/reverse-linked-list-ii/</a>                                                     |
| 67 | Medium | Add Two Numbers II               | <a href="https://leetcode.com/problems/add-two-numbers-ii/">https://leetcode.com/problems/add-two-numbers-ii/</a>                                                             |
| 68 | Medium | Reorder List                     | <a href="https://leetcode.com/problems/reorder-list/">https://leetcode.com/problems/reorder-list/</a>                                                                         |
| 69 | Medium | Linked List Cycle II             | <a href="https://leetcode.com/problems/linked-list-cycle-ii/">https://leetcode.com/problems/linked-list-cycle-ii/</a>                                                         |
| 70 | Medium | K-th Largest Element in an Array | <a href="https://leetcode.com/problems/kth-largest-element-in-an-array/">https://leetcode.com/problems/kth-largest-element-in-an-array/</a>                                   |
| 71 | Medium | Product of Array Except Self     | <a href="https://leetcode.com/problems/product-of-array-except-self/">https://leetcode.com/problems/product-of-array-except-self/</a>                                         |
| 72 | Medium | Word Search                      | <a href="https://leetcode.com/problems/word-search/">https://leetcode.com/problems/word-search/</a>                                                                           |
| 73 | Medium | Unique Paths                     | <a href="https://leetcode.com/problems/unique-paths/">https://leetcode.com/problems/unique-paths/</a>                                                                         |
| 74 | Medium | Minimum Path Sum                 | <a href="https://leetcode.com/problems/minimum-path-sum/">https://leetcode.com/problems/minimum-path-sum/</a>                                                                 |
| 75 | Medium | Temperature Converter - II       | <a href="https://www.codechef.com/practice/course/c/LPCA_S03/problems/LCAS30B">https://www.codechef.com/practice/course/c/LPCA_S03/problems/LCAS30B</a>                       |
| 76 | Medium | Reverse                          | <a href="https://www.hackerrank.com/challenges/reverse-array-c/problem?isFullScreen=true">https://www.hackerrank.com/challenges/reverse-array-c/problem?isFullScreen=true</a> |

|    |        |                                       |                                                                                                                                                                                                               |
|----|--------|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 77 | Medium | Sentence in a new line                | <a href="https://www.hackerrank.com/challenges/printing-tokens-/problem?isFullScreen=true">https://www.hackerrank.com/challenges/printing-tokens-/problem?isFullScreen=true</a>                               |
| 78 | Hard   | Median of Two Sorted Arrays           | <a href="https://leetcode.com/problems/median-of-two-sorted-arrays/">https://leetcode.com/problems/median-of-two-sorted-arrays/</a>                                                                           |
| 79 | Hard   | Regular Expression Matching           | <a href="https://leetcode.com/problems/regular-expression-matching/">https://leetcode.com/problems/regular-expression-matching/</a>                                                                           |
| 80 | Hard   | Wildcard Matching                     | <a href="https://leetcode.com/problems/wildcard-matching/">https://leetcode.com/problems/wildcard-matching/</a>                                                                                               |
| 81 | Hard   | Trapping Rain Water                   | <a href="https://leetcode.com/problems/trapping-rain-water/">https://leetcode.com/problems/trapping-rain-water/</a>                                                                                           |
| 82 | Hard   | First Missing Positive                | <a href="https://leetcode.com/problems/first-missing-positive/">https://leetcode.com/problems/first-missing-positive/</a>                                                                                     |
| 83 | Hard   | Longest Valid Parentheses             | <a href="https://leetcode.com/problems/longest-valid-parentheses/">https://leetcode.com/problems/longest-valid-parentheses/</a>                                                                               |
| 84 | Hard   | Merge k Sorted Lists                  | <a href="https://leetcode.com/problems/merge-k-sorted-lists/">https://leetcode.com/problems/merge-k-sorted-lists/</a>                                                                                         |
| 85 | Hard   | Reverse Nodes in k-Group              | <a href="https://leetcode.com/problems/reverse-nodes-in-k-group/description/">https://leetcode.com/problems/reverse-nodes-in-k-group/description/</a>                                                         |
| 86 | Hard   | Sudoku Solver                         | <a href="https://leetcode.com/problems/sudoku-solver/">https://leetcode.com/problems/sudoku-solver/</a>                                                                                                       |
| 87 | Hard   | N-Queens                              | <a href="https://leetcode.com/problems/n-queens/description/">https://leetcode.com/problems/n-queens/description/</a>                                                                                         |
| 88 | Hard   | Edit Distance                         | <a href="https://leetcode.com/problems/edit-distance/">https://leetcode.com/problems/edit-distance/</a>                                                                                                       |
| 89 | Hard   | Word Ladder II                        | <a href="https://leetcode.com/problems/word-ladder-ii/">https://leetcode.com/problems/word-ladder-ii/</a>                                                                                                     |
| 90 | Hard   | Maximal Rectangle                     | <a href="https://leetcode.com/problems/maximal-rectangle/">https://leetcode.com/problems/maximal-rectangle/</a>                                                                                               |
| 91 | Hard   | Binary Tree Maximum Path Sum          | <a href="https://leetcode.com/problems/binary-tree-maximum-path-sum/">https://leetcode.com/problems/binary-tree-maximum-path-sum/</a>                                                                         |
| 92 | Hard   | Serialize and Deserialize Binary Tree | <a href="https://leetcode.com/problems/serialize-and-deserialize-binary-tree/">https://leetcode.com/problems/serialize-and-deserialize-binary-tree/</a>                                                       |
| 93 | Hard   | Variadic functions in C               | <a href="https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true">https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true</a>                 |
| 94 | Hard   | Small Triangles, Large Triangles      | <a href="https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true">https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true</a> |
| 95 | Hard   | Permutations of Strings               | <a href="https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true">https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true</a>                 |

## Maya Programs

| S.No. | Problem Name         | Maya Program Link                                                                                                                                                 |
|-------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Can Cross the Bridge | <a href="https://maya.technicalhub.io/owl-program-details/6686308df56afec5c0c8e2dd">https://maya.technicalhub.io/owl-program-details/6686308df56afec5c0c8e2dd</a> |
| 2     | Hypotenuse           | <a href="https://maya.technicalhub.io/owl-program-details/6686404ef56afec5c0c90135">https://maya.technicalhub.io/owl-program-details/6686404ef56afec5c0c90135</a> |
| 3     | Heron's Formula      | <a href="https://maya.technicalhub.io/owl-program-details/66864474f56afec5c0c911f5">https://maya.technicalhub.io/owl-program-details/66864474f56afec5c0c911f5</a> |
| 4     | Loss Percentage      | <a href="https://maya.technicalhub.io/owl-program-details/66864868f56afec5c0c91a4a">https://maya.technicalhub.io/owl-program-details/66864868f56afec5c0c91a4a</a> |
| 5     | King Tours           | <a href="https://maya.technicalhub.io/owl-program-details/66864c96f56afec5c0c921f1">https://maya.technicalhub.io/owl-program-details/66864c96f56afec5c0c921f1</a> |

|    |                                               |                                                                                                                                                                   |
|----|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6  | Profit Percentage                             | <a href="https://maya.technicalhub.io/owl-program-details/66865237f56afec5c0c92694">https://maya.technicalhub.io/owl-program-details/66865237f56afec5c0c92694</a> |
| 7  | Area and Perimeter of Square                  | <a href="https://maya.technicalhub.io/owl-program-details/6686546930bfbd35127c869c">https://maya.technicalhub.io/owl-program-details/6686546930bfbd35127c869c</a> |
| 8  | Volume of Sphere                              | <a href="https://maya.technicalhub.io/owl-program-details/6686565530bfbd35127c8818">https://maya.technicalhub.io/owl-program-details/6686565530bfbd35127c8818</a> |
| 9  | Required Points                               | <a href="https://maya.technicalhub.io/owl-program-details/66865b1130bfbd35127c8a04">https://maya.technicalhub.io/owl-program-details/66865b1130bfbd35127c8a04</a> |
| 10 | Instant Noodles                               | <a href="https://maya.technicalhub.io/owl-program-details/66865ddb30bfbd35127c8c0a">https://maya.technicalhub.io/owl-program-details/66865ddb30bfbd35127c8c0a</a> |
| 11 | Find Second Number                            | <a href="https://maya.technicalhub.io/owl-program-details/668660a530bfbd35127c8cde">https://maya.technicalhub.io/owl-program-details/668660a530bfbd35127c8cde</a> |
| 12 | Kmph to Mps                                   | <a href="https://maya.technicalhub.io/owl-program-details/668663ce30bfbd35127c8dfb">https://maya.technicalhub.io/owl-program-details/668663ce30bfbd35127c8dfb</a> |
| 13 | Inches to Centimeters                         | <a href="https://maya.technicalhub.io/owl-program-details/6686665e30bfbd35127c8f3a">https://maya.technicalhub.io/owl-program-details/6686665e30bfbd35127c8f3a</a> |
| 14 | Capacity                                      | <a href="https://maya.technicalhub.io/owl-program-details/668678aa30bfbd35127c95b9">https://maya.technicalhub.io/owl-program-details/668678aa30bfbd35127c95b9</a> |
| 15 | Average of Two Numbers                        | <a href="https://maya.technicalhub.io/owl-program-details/6687b002dfe02cea4b5389d6">https://maya.technicalhub.io/owl-program-details/6687b002dfe02cea4b5389d6</a> |
| 16 | Compound Interest                             | <a href="https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab">https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab</a> |
| 17 | Average Weight                                | <a href="https://maya.technicalhub.io/owl-program-details/6687b93edfe02cea4b54367a">https://maya.technicalhub.io/owl-program-details/6687b93edfe02cea4b54367a</a> |
| 18 | Arithmetic Operations                         | <a href="https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1">https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1</a> |
| 19 | Distance Between Two Points                   | <a href="https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a">https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a</a> |
| 20 | Days into Years, Weeks                        | <a href="https://maya.technicalhub.io/owl-program-details/6687cad1fd042085d9ec95a8">https://maya.technicalhub.io/owl-program-details/6687cad1fd042085d9ec95a8</a> |
| 21 | Convert Seconds to Hours, Minutes and Seconds | <a href="https://maya.technicalhub.io/owl-program-details/6688c926e467bfe336f8007b">https://maya.technicalhub.io/owl-program-details/6688c926e467bfe336f8007b</a> |
| 22 | Hours and Minutes                             | <a href="https://maya.technicalhub.io/owl-program-details/6688e4f0e467bfe336f89673">https://maya.technicalhub.io/owl-program-details/6688e4f0e467bfe336f89673</a> |
| 23 | Romeo and Juliet                              | <a href="https://maya.technicalhub.io/owl-program-details/6688e068e467bfe336f87a8b">https://maya.technicalhub.io/owl-program-details/6688e068e467bfe336f87a8b</a> |
| 24 | Gross Salary of an Employee                   | <a href="https://maya.technicalhub.io/owl-program-details/6688dd95e467bfe336f87682">https://maya.technicalhub.io/owl-program-details/6688dd95e467bfe336f87682</a> |
| 25 | Surface Area and Volume of a Cube             | <a href="https://maya.technicalhub.io/owl-program-details/6688d909e467bfe336f872ca">https://maya.technicalhub.io/owl-program-details/6688d909e467bfe336f872ca</a> |
| 26 | Area of Trapezium                             | <a href="https://maya.technicalhub.io/owl-program-details/6688d637e467bfe336f86c5e">https://maya.technicalhub.io/owl-program-details/6688d637e467bfe336f86c5e</a> |
| 27 | Swap Two Numbers                              | <a href="https://maya.technicalhub.io/owl-program-details/6688d2d0e467bfe336f84f55">https://maya.technicalhub.io/owl-program-details/6688d2d0e467bfe336f84f55</a> |
| 28 | Last Two Digits of a Given Year               | <a href="https://maya.technicalhub.io/owl-program-details/6688ccfae467bfe336f81f90">https://maya.technicalhub.io/owl-program-details/6688ccfae467bfe336f81f90</a> |
| 29 | Arithmetic Operations                         | <a href="https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1">https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1</a> |
| 30 | Uppercase Letters in a String                 | <a href="https://maya.technicalhub.io/owl-program-details/669a2453c03fc56b320b215c">https://maya.technicalhub.io/owl-program-details/669a2453c03fc56b320b215c</a> |
| 31 | Factors Finding                               | <a href="https://maya.technicalhub.io/owl-program-details/66866c4a30bfbd35127c90b4">https://maya.technicalhub.io/owl-program-details/66866c4a30bfbd35127c90b4</a> |

|                            | Basic Programs      | Aditya's Internal Coding Platform (Maya) | Code chef                                                                                                                                                         | Hacker rank | Leet code | Total      |
|----------------------------|---------------------|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------|------------|
| <b>Unit-1</b>              | 4                   | 8                                        | 2                                                                                                                                                                 | 5           | 0         | <b>19</b>  |
| <b>Unit-2</b>              | 4                   | 4                                        | 1                                                                                                                                                                 | 4           | 0         | <b>13</b>  |
| <b>Unit-3</b>              | 8                   | 7                                        | 0                                                                                                                                                                 | 2           | 0         | <b>17</b>  |
| <b>Unit-4</b>              | 3                   | 0                                        | 0                                                                                                                                                                 | 3           | 0         | <b>6</b>   |
| <b>Unit-5</b>              | 7                   | 0                                        | 4                                                                                                                                                                 | 4           | 0         | <b>15</b>  |
| <b>Additional Practice</b> | 0                   | 33                                       | 22                                                                                                                                                                | 5           | 68        | <b>128</b> |
| <b>Total</b>               | <b>26</b>           | <b>52</b>                                | <b>29</b>                                                                                                                                                         | <b>23</b>   | <b>68</b> | <b>198</b> |
| 32                         | String Copy         |                                          | <a href="https://maya.technicalhub.io/owl-program-details/669a03ded62716a9c6d4fa9a">https://maya.technicalhub.io/owl-program-details/669a03ded62716a9c6d4fa9a</a> |             |           |            |
| 33                         | Recursive Digit Sum |                                          | <a href="https://www.hackerrank.com/challenges/recursive-digit-sum/problem">https://www.hackerrank.com/challenges/recursive-digit-sum/problem</a>                 |             |           |            |

**Problem Solving Through C Programming**  
(Common to CE, EEE, ME, ECE, CSE, AIML, CSE(DS), PT & Min.E)  
(Revised Syllabus for batches admitted from 2026 Onwards)

**Course Code: 2601DS01**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes: At the end of the Course, Student will be able to:**

- CO1:** Demonstrate basics of computer, algorithm and flow chart for problem solving.
- CO2:** Make use of an appropriate control structures to solve given problems.
- CO3:** Solve complex problems using arrays and strings.
- CO4:** Develop modular programming using functions and dynamic memory allocation.
- CO5:** Develop programs using structures and file handling operations.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 3    | 2    | 1    | 3    | -    | -    | 2    | -    | -     | 1     |
| <b>CO2</b> | 2    | 3    | 2    | 1    | 3    | -    | -    | 2    | -    | -     | 1     |
| <b>CO3</b> | 2    | 3    | 2    | 1    | 3    | -    | 1    | 2    | -    | -     | 1     |
| <b>CO4</b> | 2    | 3    | 2    | 1    | 3    | -    | 1    | 2    | -    | -     | 1     |
| <b>CO5</b> | 2    | 3    | 2    | 1    | 3    | -    | 1    | 2    | -    | -     | 1     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    | 2    |
| <b>CO2</b> | 2    | 2    |
| <b>CO3</b> | 2    | 2    |
| <b>CO4</b> | 2    | 2    |
| <b>CO5</b> | 2    | 2    |

## UNIT – I

### Introduction to Programming and Problem Solving

Introduction to Programming Languages, Basics of a Computer Program- Algorithms, characteristics of algorithm, flowcharts, pseudo code.

Structure of C Program, Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, operators, keywords, identifiers, Type Conversion, and Casting and operator precedence.

### Practice 1:

4. Explore different platforms
  - g. Basic linux environment and its editors like Vi, Vim & Emacs etc.
  - h. Exposure to turbo C, gcc.
  - i. Explore to hacker rank or any other Online coding platform and compiler environment.
  - j. “Hello world” in C.  
<https://www.codechef.com/learn/course/c/CDEVINTRO/problems/CDEV004B>
  - k. Objective: Learn about the syntax of reading from stdin and writing to stdout.  
<https://www.hackerrank.com/challenges/hello-world-c/problem?isFullScreen=true>

1. Write a simple program to read int, float, char and string using scanf() and display using printf() in all the above given platforms.
5. Basics and Operators
  - g. Sum and Difference of 2 numbers.  
Objective: Learn int and float data types.  
<https://www.hackerrank.com/challenges/sum-numbers-c/problem?isFullScreen=true>  
<https://maya.technicalhub.io/owl-program-details/668b9ec2e069313510b0235a>
  - h. Playing with Characters.  
Objective: Learn how to take a character, a string and a sentence as input in C.  
<https://www.hackerrank.com/challenges/playing-with-characters/problem?isFullScreen=true>
  - i. Bitwise Operators  
Objective: Learn how to work with bits (0,1) and bitwise operators.  
<https://www.hackerrank.com/challenges/bitwise-operators-in-c/problem?isFullScreen=true>
  - j. Conversion of Fahrenheit to Celsius and vice versa.  
<https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30>  
<https://maya.technicalhub.io/owl-program-details/66a0c0dda7d31805366af641>
  - k. Distance travelled by an object.  
<https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a>
  - l. Calculate Simple interest and compound interest.  
<https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab>
6. Operators and Expressions, Variables and Type conversions.
  - f. Evaluate the following expressions
    - i.  $a/b*c-b+a*d/3$
    - ii.  $j = (i++) + (++i)$
  - g. Square root of a given number.
  - h. Find the area of circle, square, rectangle and triangle.  
<https://maya.technicalhub.io/owl-program-details/6686546930bfbd35127c869c>  
<https://maya.technicalhub.io/owl-program-details/6688cf91e467bfe336f8352f>  
[https://www.hackerrank.com/challenges/rectangle-area/problem?utm\\_source=chatgpt.com](https://www.hackerrank.com/challenges/rectangle-area/problem?utm_source=chatgpt.com)  
<https://maya.technicalhub.io/owl-program-details/6688ea3ce467bfe336f8ab9d>
  - i. Find the maximum of three numbers using conditional operator.  
<https://maya.technicalhub.io/owl-program-details/668690d230bfbd35127c9bf5>
  - j. Take marks of 5 subjects in integers, find the total in integer and average in float.

## UNIT – II

**Control Structures** Conditional Statements (if, if-else, else if ladder, switch), Loops (for, nested for loop, while, do-while), break and continue, goto statement.

### Practice:

3. Conditional Statements
  - f. Objective: Understand if and else Conditional statements in C.  
<https://www.hackerrank.com/challenges/conditional-statements-in-c/problem?isFullScreen=true>
  - g. Roots of a Quadratic Equation.
  - h. Generate electricity bill.  
<https://maya.technicalhub.io/owl-program-details/66868f6730bfbd35127c9ba7>

- i. Simulate a calculator using switch case.
- j. Find the given year is a leap year or not.
- 4. Loops
  - h. Objective: Learn the usage of the for loop in C. <https://www.hackerrank.com/challenges/for-loop-in-c/problem?isFullScreen=true>
  - i. Sum of the digits of a 5-digit number.  
Objective: Learn the usage of while loop and usage of operators - % and /.  
<https://www.hackerrank.com/challenges/sum-of-digits-of-a-five-digit-number/problem?isFullScreen=true>  
<https://maya.technicalhub.io/owl-program-details/66864717f56afec5c0c917e1>
  - j. Given number is a prime or not. (Also Prime numbers between a given range.)  
<https://maya.technicalhub.io/owl-program-details/6687b69ddfe02cea4b5404a3>
  - k. Armstrong Number or not.
  - l. Palindrome or not.  
<https://maya.technicalhub.io/owl-program-details/6687af17dfe02cea4b5376ae>
  - m. Objective: Print a pattern of numbers using Loops.  
<https://www.hackerrank.com/challenges/printing-pattern-2/problem?isFullScreen=true>
  - n. Construct a Pyramid pattern.  
<https://www.codechef.com/practice/course/c/LPCAS02/problems/LCAS20>

### UNIT – III

**Arrays:** Definition, types, 1-D array(declaration, initialization, representation, accessing, input and output), 2-D(declaration, initialization, representation, accessing, input and output), searching (Linear search, Binary Search non recursive) and sorting(Bubble Sort, Selection Sort, Insertion Sort).

**Introduction to Strings:** declaration, initialization, representation, accessing, input and output, string handling functions.

#### Practice:

- 4. 1-Dimensional Arrays
  - h. Objective: Print the sum and free the memory where the array is stored.  
<https://www.hackerrank.com/challenges/1d-arrays-in-c/problem?isFullScreen=true>
  - i. Objective: Working with indices in array.  
Search an element in array .  
<https://maya.technicalhub.io/owl-program-details/6687c40ffd042085d9ec15d6>
  - j. Find min and max elements in array.  
<https://maya.technicalhub.io/owl-program-details/66879493dfe02cea4b529041>
  - k. Insert an element into array.
  - l. Eliminate duplicate elements from array.  
<https://maya.technicalhub.io/owl-program-details/66e920a1aca93b27f3364b57>
  - m. Sorting of elements in an array
- 5. 2-Dimensional Arrays
  - f. Sum of two 2-D arrays.  
<https://maya.technicalhub.io/owl-program-details/66864fa9f56afec5c0c924f6>
  - g. Multiplication of two 2-D arrays.
  - h. Transpose of a Matrix.
  - i. Trace of a Matrix.
  - j. Lower Triangular Matrix.
- 6. Strings
  - e. Objective: print each word of the sentence in a new line.
  - f. Count number of alphabets (lowercase, uppercase, consonants, vowels) and digits Lowercase to Uppercase, Uppercase to Lowercase, Toggle case, Sentential case



<https://maya.technicalhub.io/owl-program-details/6698e2fbc6bd470f35b73d8>

<https://maya.technicalhub.io/owl-program-details/6698ef03cb6bd470f35b7c3e>

- g. find the frequency of each digit in the given string.  
<https://www.hackerrank.com/challenges/frequency-of-digits-1/problem?isFullScreen=true>
- h. Find string length, concatenate 2 strings, reverse a string using built-in and without built-in string functions.  
<https://maya.technicalhub.io/owl-program-details/6698ed2dcb6bd470f35b7ae7>

## UNIT – IV

**Pointer:** Introduction to Pointers, dereferencing and address operators, pointer arithmetic, array manipulation using pointers, Dynamic memory allocation, Null Pointer, generic pointer, dangling pointer, pointer to pointer.

**Functions:** Introduction to Functions, Function Declaration and Definition, Function call Return **Types and Arguments**, Scope and Lifetime of Variables (block scope, function scope, program scope and file scope), **storage classes, recursion**, functions and arrays, Command line Arguments, functions and pointers.

### Practice:

#### 7. Functions in C

- a. Objective: Learn simple usage of functions. <https://www.hackerrank.com/challenges/functions-in-c/problem?isFullScreen=true>
- b. Objective: Fibonacci Numbers using recursive function.  
<https://www.hackerrank.com/challenges/ctci-fibonacci-numbers/problem>
- c. Objective: N<sup>th</sup> factorial using recursion.
- d. Objective: Find the super digit of the integer.
- e. Implement LCM
- f. Objective: Calculate the Nth term of series.  
<https://www.hackerrank.com/challenges/recursion-in-c/problem?isFullScreen=true>

#### 8. Pointers

- g. Objective: learn to implement the basic functionalities of pointers in C.  
<https://www.hackerrank.com/challenges/pointer-in-c/problem?isFullScreen=true>
- h. Objective: Learn using Pointers with Arrays and Functions.  
<https://www.hackerrank.com/challenges/students-marks-sum/problem?isFullScreen=true>
- i. Objective: sort a given array of strings into lexicographically increasing order or into an order in which the string with the lowest length appears first.  
<https://www.hackerrank.com/challenges/sorting-array-of-strings/problem?isFullScreen=true>
- j. Find the sum of a 1D array using malloc().
- k. Swap two numbers using functions and pointers - call by value and reference.
- l. Objective: Dynamic Handling requests by a Librarian to place the books in the shelves.  
<https://www.hackerrank.com/challenges/dynamic-array-in-c/problem?isFullScreen=true>

## UNIT – V

**Structures and Unions:** Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, structures and pointers. Unions, Enumerated Data Type - enum variables, Using Typedef keyword, Bit Fields.

**File Handling:** Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, File Operations, Random File Access.

### Practice:

#### 1. Structures

1. Write a C program to find the total, average of n students using structures
2. Copy one structure variable to another structure of the same type.
3. Read student name and marks from the command line and display the student details along with the total.



## 2. File handling concepts

- f) Write text into and read text from a file.
- g) Write text into and read text from a binary file using fread() and fwrite().
- h) Copy the contents of one file to another file.
- i) Merge two files into the third file using command-line arguments
- j) Find no. of lines, words and characters in a file.

### Text Books:

- 1 Programming in C, Rema Theraja, Oxford, 2nd edition. ISBN 93-5497-9
- 2 "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall. ISBN 13: 9780131103627

### Reference Books:

6. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education. ISBN.No: 9352604172
7. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill. ISBN No. 0071367993
8. Let Us C Yashwanth, Kanetkar, Eighth edition, BPB Publications. ISBN No. 1934015253
9. Programming in C A-Practical Approach, Ajay Mittal. Pearson Education. ISBN No. 9788131729342
10. R G Dromey How to Solve It by Computer (Prentice-Hall International Series in Computer Science. ISBN-13 : 978-0134340012

### Web Links:

- 1 <https://www.hackerrank.com/>
- 2 [https://onlinecourses.nptel.ac.in/noc22\\_cs40/preview](https://onlinecourses.nptel.ac.in/noc22_cs40/preview)
- 3 <https://archive.nptel.ac.in/courses/106/104/106104128/>

### Additional Practice:

| S.No | Difficulty | Problem Name         | Link                                                                                                                                                                                                    |
|------|------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Easy       | Add Two Numbers      | <a href="https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001">https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001</a>                                                 |
| 2    | Easy       | Enormous Input Test  | <a href="https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTST">https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTST</a>     |
| 3    | Easy       | ATM                  | <a href="https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2">https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2</a>     |
| 4    | Easy       | Number Mirror        | <a href="https://www.codechef.com/practice/course/python/PPY01/problems/START01">https://www.codechef.com/practice/course/python/PPY01/problems/START01</a>                                             |
| 5    | Easy       | Sum of Digits        | <a href="https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006">https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006</a>                             |
| 6    | Easy       | Remainder            | <a href="https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002">https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002</a>                             |
| 7    | Easy       | First and Last Digit | <a href="https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004">https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004</a> |

|    |        |                                                    |                                                                                                                                                                                     |
|----|--------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8  | Easy   | Reverse The Number                                 | <a href="https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007">https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007</a> |
| 9  | Easy   | Life, the Universe, and Everything                 | <a href="https://staging.codechef.com/practice/course/cpp/PRACTICECPP2/problems/TEST">https://staging.codechef.com/practice/course/cpp/PRACTICECPP2/problems/TEST</a>               |
| 10 | Easy   | Chef and Operators                                 | <a href="https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT">https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT</a>   |
| 11 | Easy   | Difference and Sum                                 | <a href="https://www.codechef.com/problems/DIFFSUM">https://www.codechef.com/problems/DIFFSUM</a>                                                                                   |
| 12 | Easy   | Second Largest                                     | <a href="https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND">https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND</a>               |
| 13 | Easy   | Two Sum                                            | <a href="https://leetcode.com/problems/two-sum/">https://leetcode.com/problems/two-sum/</a>                                                                                         |
| 14 | Easy   | Reverse Integer                                    | <a href="https://leetcode.com/problems/reverse-integer/">https://leetcode.com/problems/reverse-integer/</a>                                                                         |
| 15 | Easy   | Palindrome Number                                  | <a href="https://leetcode.com/problems/palindrome-number/">https://leetcode.com/problems/palindrome-number/</a>                                                                     |
| 16 | Easy   | Roman to Integer                                   | <a href="https://leetcode.com/problems/roman-to-integer/">https://leetcode.com/problems/roman-to-integer/</a>                                                                       |
| 17 | Easy   | Remove Duplicates from Sorted Array                | <a href="https://leetcode.com/problems/remove-duplicates-from-sorted-array/">https://leetcode.com/problems/remove-duplicates-from-sorted-array/</a>                                 |
| 18 | Easy   | Remove Element                                     | <a href="https://leetcode.com/problems/remove-element/">https://leetcode.com/problems/remove-element/</a>                                                                           |
| 19 | Easy   | Find the Index of the First Occurrence in a String | <a href="https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/">https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/</a>   |
| 20 | Easy   | Length of Last Word                                | <a href="https://leetcode.com/problems/length-of-last-word/">https://leetcode.com/problems/length-of-last-word/</a>                                                                 |
| 21 | Easy   | Plus One                                           | <a href="https://leetcode.com/problems/plus-one/">https://leetcode.com/problems/plus-one/</a>                                                                                       |
| 22 | Easy   | Merge Sorted Array                                 | <a href="https://leetcode.com/problems/merge-sorted-array/">https://leetcode.com/problems/merge-sorted-array/</a>                                                                   |
| 23 | Easy   | Majority Element                                   | <a href="https://leetcode.com/problems/majority-element/">https://leetcode.com/problems/majority-element/</a>                                                                       |
| 24 | Easy   | Single Number                                      | <a href="https://leetcode.com/problems/single-number/">https://leetcode.com/problems/single-number/</a>                                                                             |
| 25 | Easy   | Move Zeroes                                        | <a href="https://leetcode.com/problems/move-zeroes/">https://leetcode.com/problems/move-zeroes/</a>                                                                                 |
| 26 | Easy   | Missing Number                                     | <a href="https://leetcode.com/problems/missing-number/">https://leetcode.com/problems/missing-number/</a>                                                                           |
| 27 | Easy   | Contains Duplicate                                 | <a href="https://leetcode.com/problems/contains-duplicate/">https://leetcode.com/problems/contains-duplicate/</a>                                                                   |
| 28 | Easy   | Valid Anagram                                      | <a href="https://leetcode.com/problems/valid-anagram/">https://leetcode.com/problems/valid-anagram/</a>                                                                             |
| 29 | Easy   | Valid Parentheses                                  | <a href="https://leetcode.com/problems/valid-parentheses/">https://leetcode.com/problems/valid-parentheses/</a>                                                                     |
| 30 | Easy   | Fibonacci Number                                   | <a href="https://leetcode.com/problems/fibonacci-number/">https://leetcode.com/problems/fibonacci-number/</a>                                                                       |
| 31 | Easy   | Climbing Stairs                                    | <a href="https://leetcode.com/problems/climbing-stairs/">https://leetcode.com/problems/climbing-stairs/</a>                                                                         |
| 32 | Easy   | Binary Search                                      | <a href="https://leetcode.com/problems/binary-search/">https://leetcode.com/problems/binary-search/</a>                                                                             |
| 33 | Easy   | Number of 1 Bits                                   | <a href="https://leetcode.com/problems/number-of-1-bits/">https://leetcode.com/problems/number-of-1-bits/</a>                                                                       |
| 34 | Easy   | Hamming Weight                                     | <a href="https://leetcode.com/problems/number-of-1-bits/description/">https://leetcode.com/problems/number-of-1-bits/description/</a>                                               |
| 35 | Easy   | Power of Two                                       | <a href="https://leetcode.com/problems/power-of-two/">https://leetcode.com/problems/power-of-two/</a>                                                                               |
| 36 | Easy   | Power of Three                                     | <a href="https://leetcode.com/problems/power-of-three/">https://leetcode.com/problems/power-of-three/</a>                                                                           |
| 37 | Easy   | Same Tree                                          | <a href="https://leetcode.com/problems/same-tree/">https://leetcode.com/problems/same-tree/</a>                                                                                     |
| 38 | Easy   | Maximum Subarray                                   | <a href="https://leetcode.com/problems/maximum-subarray/">https://leetcode.com/problems/maximum-subarray/</a>                                                                       |
| 39 | Medium | Chef and Notebooks                                 | <a href="https://www.codechef.com/problems/CNOTE">https://www.codechef.com/problems/CNOTE</a>                                                                                       |
| 40 | Medium | Chef and Wildcard Matching                         | <a href="https://www.codechef.com/search?q=TWOSTR">https://www.codechef.com/search?q=TWOSTR</a>                                                                                     |

|    |        |                                                |                                                                                                                                                                           |
|----|--------|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 41 | Medium | Minimum Moves                                  | <a href="https://www.codechef.com/search?q=SALARY">https://www.codechef.com/search?q=SALARY</a>                                                                           |
| 42 | Medium | Lucky Four                                     | <a href="https://www.codechef.com/search?q=LUCKFOUR">https://www.codechef.com/search?q=LUCKFOUR</a>                                                                       |
| 43 | Medium | Maximum Difference                             | <a href="https://www.codechef.com/search?q=MAXDIFF">https://www.codechef.com/search?q=MAXDIFF</a>                                                                         |
| 44 | Medium | Uncle Johnny                                   | <a href="https://www.codechef.com/search?q=JOHNY">https://www.codechef.com/search?q=JOHNY</a>                                                                             |
| 45 | Medium | Chef and Strings                               | <a href="https://www.codechef.com/search?q=CHEFSTLT">https://www.codechef.com/search?q=CHEFSTLT</a>                                                                       |
| 46 | Medium | Two vs Rib                                     | <a href="https://www.codechef.com/search?q=TWOVRIB">https://www.codechef.com/search?q=TWOVRIB</a>                                                                         |
| 47 | Medium | Chef and Array                                 | <a href="https://www.codechef.com/search?q=CHFARRP">https://www.codechef.com/search?q=CHFARRP</a>                                                                         |
| 48 | Medium | Add Two Numbers                                | <a href="https://leetcode.com/problems/add-two-numbers/">https://leetcode.com/problems/add-two-numbers/</a>                                                               |
| 49 | Medium | Longest Substring Without Repeating Characters | <a href="https://leetcode.com/problems/longest-substring-without-repeating-characters/">https://leetcode.com/problems/longest-substring-without-repeating-characters/</a> |
| 50 | Medium | Longest Palindromic Substring                  | <a href="https://leetcode.com/problems/longest-palindromic-substring/">https://leetcode.com/problems/longest-palindromic-substring/</a>                                   |
| 51 | Medium | 3Sum                                           | <a href="https://leetcode.com/problems/3sum/">https://leetcode.com/problems/3sum/</a>                                                                                     |
| 52 | Medium | Container With Most Water                      | <a href="https://leetcode.com/problems/container-with-most-water/">https://leetcode.com/problems/container-with-most-water/</a>                                           |
| 53 | Medium | Integer to Roman                               | <a href="https://leetcode.com/problems/integer-to-roman/">https://leetcode.com/problems/integer-to-roman/</a>                                                             |
| 54 | Medium | String to Integer (atoi)                       | <a href="https://leetcode.com/problems/string-to-integer-atoi/">https://leetcode.com/problems/string-to-integer-atoi/</a>                                                 |
| 55 | Medium | Divide Two Integers                            | <a href="https://leetcode.com/problems/divide-two-integers/">https://leetcode.com/problems/divide-two-integers/</a>                                                       |
| 56 | Medium | Rotate Image                                   | <a href="https://leetcode.com/problems/rotate-image/">https://leetcode.com/problems/rotate-image/</a>                                                                     |
| 57 | Medium | Set Matrix Zeroes                              | <a href="https://leetcode.com/problems/set-matrix-zeroes/">https://leetcode.com/problems/set-matrix-zeroes/</a>                                                           |
| 58 | Medium | Spiral Matrix                                  | <a href="https://leetcode.com/problems/spiral-matrix/">https://leetcode.com/problems/spiral-matrix/</a>                                                                   |
| 59 | Medium | Jump Game                                      | <a href="https://leetcode.com/problems/jump-game/">https://leetcode.com/problems/jump-game/</a>                                                                           |
| 60 | Medium | Permutations                                   | <a href="https://leetcode.com/problems/permutations/">https://leetcode.com/problems/permutations/</a>                                                                     |
| 61 | Medium | Combination Sum                                | <a href="https://leetcode.com/problems/combination-sum/">https://leetcode.com/problems/combination-sum/</a>                                                               |
| 62 | Medium | Search in Rotated Sorted Array                 | <a href="https://leetcode.com/problems/search-in-rotated-sorted-array/">https://leetcode.com/problems/search-in-rotated-sorted-array/</a>                                 |
| 63 | Medium | Group Anagrams                                 | <a href="https://leetcode.com/problems/group-anagrams/">https://leetcode.com/problems/group-anagrams/</a>                                                                 |
| 64 | Medium | Sort Colors                                    | <a href="https://leetcode.com/problems/sort-colors/">https://leetcode.com/problems/sort-colors/</a>                                                                       |
| 65 | Medium | Subsets                                        | <a href="https://leetcode.com/problems/subsets/">https://leetcode.com/problems/subsets/</a>                                                                               |
| 66 | Medium | Reverse Linked List II                         | <a href="https://leetcode.com/problems/reverse-linked-list-ii/">https://leetcode.com/problems/reverse-linked-list-ii/</a>                                                 |

|    |        |                                       |                                                                                                                                                                                                               |
|----|--------|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 67 | Medium | Add Two Numbers II                    | <a href="https://leetcode.com/problems/add-two-numbers-ii/">https://leetcode.com/problems/add-two-numbers-ii/</a>                                                                                             |
| 68 | Medium | Reorder List                          | <a href="https://leetcode.com/problems/reorder-list/">https://leetcode.com/problems/reorder-list/</a>                                                                                                         |
| 69 | Medium | Linked List Cycle II                  | <a href="https://leetcode.com/problems/linked-list-cycle-ii/">https://leetcode.com/problems/linked-list-cycle-ii/</a>                                                                                         |
| 70 | Medium | K-th Largest Element in an Array      | <a href="https://leetcode.com/problems/kth-largest-element-in-an-array/">https://leetcode.com/problems/kth-largest-element-in-an-array/</a>                                                                   |
| 71 | Medium | Product of Array Except Self          | <a href="https://leetcode.com/problems/product-of-array-except-self/">https://leetcode.com/problems/product-of-array-except-self/</a>                                                                         |
| 72 | Medium | Word Search                           | <a href="https://leetcode.com/problems/word-search/">https://leetcode.com/problems/word-search/</a>                                                                                                           |
| 73 | Medium | Unique Paths                          | <a href="https://leetcode.com/problems/unique-paths/">https://leetcode.com/problems/unique-paths/</a>                                                                                                         |
| 74 | Medium | Minimum Path Sum                      | <a href="https://leetcode.com/problems/minimum-path-sum/">https://leetcode.com/problems/minimum-path-sum/</a>                                                                                                 |
| 75 | Medium | Temperature Converter - II            | <a href="https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30B">https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30B</a>                                                         |
| 76 | Medium | Reverse                               | <a href="https://www.hackerrank.com/challenges/reverse-array-c/problem?isFullScreen=true">https://www.hackerrank.com/challenges/reverse-array-c/problem?isFullScreen=true</a>                                 |
| 77 | Medium | Sentence in a new line                | <a href="https://www.hackerrank.com/challenges/printing-tokens-/problem?isFullScreen=true">https://www.hackerrank.com/challenges/printing-tokens-/problem?isFullScreen=true</a>                               |
| 78 | Hard   | Median of Two Sorted Arrays           | <a href="https://leetcode.com/problems/median-of-two-sorted-arrays/">https://leetcode.com/problems/median-of-two-sorted-arrays/</a>                                                                           |
| 79 | Hard   | Regular Expression Matching           | <a href="https://leetcode.com/problems/regular-expression-matching/">https://leetcode.com/problems/regular-expression-matching/</a>                                                                           |
| 80 | Hard   | Wildcard Matching                     | <a href="https://leetcode.com/problems/wildcard-matching/">https://leetcode.com/problems/wildcard-matching/</a>                                                                                               |
| 81 | Hard   | Trapping Rain Water                   | <a href="https://leetcode.com/problems/trapping-rain-water/">https://leetcode.com/problems/trapping-rain-water/</a>                                                                                           |
| 82 | Hard   | First Missing Positive                | <a href="https://leetcode.com/problems/first-missing-positive/">https://leetcode.com/problems/first-missing-positive/</a>                                                                                     |
| 83 | Hard   | Longest Valid Parentheses             | <a href="https://leetcode.com/problems/longest-valid-parentheses/">https://leetcode.com/problems/longest-valid-parentheses/</a>                                                                               |
| 84 | Hard   | Merge k Sorted Lists                  | <a href="https://leetcode.com/problems/merge-k-sorted-lists/">https://leetcode.com/problems/merge-k-sorted-lists/</a>                                                                                         |
| 85 | Hard   | Reverse Nodes in k-Group              | <a href="https://leetcode.com/problems/reverse-nodes-in-k-group/description/">https://leetcode.com/problems/reverse-nodes-in-k-group/description/</a>                                                         |
| 86 | Hard   | Sudoku Solver                         | <a href="https://leetcode.com/problems/sudoku-solver/">https://leetcode.com/problems/sudoku-solver/</a>                                                                                                       |
| 87 | Hard   | N-Queens                              | <a href="https://leetcode.com/problems/n-queens/description/">https://leetcode.com/problems/n-queens/description/</a>                                                                                         |
| 88 | Hard   | Edit Distance                         | <a href="https://leetcode.com/problems/edit-distance/">https://leetcode.com/problems/edit-distance/</a>                                                                                                       |
| 89 | Hard   | Word Ladder II                        | <a href="https://leetcode.com/problems/word-ladder-ii/">https://leetcode.com/problems/word-ladder-ii/</a>                                                                                                     |
| 90 | Hard   | Maximal Rectangle                     | <a href="https://leetcode.com/problems/maximal-rectangle/">https://leetcode.com/problems/maximal-rectangle/</a>                                                                                               |
| 91 | Hard   | Binary Tree Maximum Path Sum          | <a href="https://leetcode.com/problems/binary-tree-maximum-path-sum/">https://leetcode.com/problems/binary-tree-maximum-path-sum/</a>                                                                         |
| 92 | Hard   | Serialize and Deserialize Binary Tree | <a href="https://leetcode.com/problems/serialize-and-deserialize-binary-tree/">https://leetcode.com/problems/serialize-and-deserialize-binary-tree/</a>                                                       |
| 93 | Hard   | Variadic functions in C               | <a href="https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true">https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true</a>                 |
| 94 | Hard   | Small Triangles, Large Triangles      | <a href="https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true">https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true</a> |
| 95 | Hard   | Permutations of Strings               | <a href="https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true">https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true</a>                 |

## Maya Programs

| S.N o. | Problem Name                                  | Maya Program Link                                                                                                                                                 |
|--------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Can Cross the Bridge                          | <a href="https://maya.technicalhub.io/owl-program-details/6686308df56afec5c0c8e2dd">https://maya.technicalhub.io/owl-program-details/6686308df56afec5c0c8e2dd</a> |
| 2      | Hypotenuse                                    | <a href="https://maya.technicalhub.io/owl-program-details/6686404ef56afec5c0c90135">https://maya.technicalhub.io/owl-program-details/6686404ef56afec5c0c90135</a> |
| 3      | Heron's Formula                               | <a href="https://maya.technicalhub.io/owl-program-details/66864474f56afec5c0c911f5">https://maya.technicalhub.io/owl-program-details/66864474f56afec5c0c911f5</a> |
| 4      | Loss Percentage                               | <a href="https://maya.technicalhub.io/owl-program-details/66864868f56afec5c0c91a4a">https://maya.technicalhub.io/owl-program-details/66864868f56afec5c0c91a4a</a> |
| 5      | King Tours                                    | <a href="https://maya.technicalhub.io/owl-program-details/66864c96f56afec5c0c921f1">https://maya.technicalhub.io/owl-program-details/66864c96f56afec5c0c921f1</a> |
| 6      | Profit Percentage                             | <a href="https://maya.technicalhub.io/owl-program-details/66865237f56afec5c0c92694">https://maya.technicalhub.io/owl-program-details/66865237f56afec5c0c92694</a> |
| 7      | Area and Perimeter of Square                  | <a href="https://maya.technicalhub.io/owl-program-details/6686546930bfd35127c869c">https://maya.technicalhub.io/owl-program-details/6686546930bfd35127c869c</a>   |
| 8      | Volume of Sphere                              | <a href="https://maya.technicalhub.io/owl-program-details/6686565530bfd35127c8818">https://maya.technicalhub.io/owl-program-details/6686565530bfd35127c8818</a>   |
| 9      | Required Points                               | <a href="https://maya.technicalhub.io/owl-program-details/66865b1130bfd35127c8a04">https://maya.technicalhub.io/owl-program-details/66865b1130bfd35127c8a04</a>   |
| 10     | Instant Noodles                               | <a href="https://maya.technicalhub.io/owl-program-details/66865ddb30bfd35127c8c0a">https://maya.technicalhub.io/owl-program-details/66865ddb30bfd35127c8c0a</a>   |
| 11     | Find Second Number                            | <a href="https://maya.technicalhub.io/owl-program-details/668660a530bfd35127c8cde">https://maya.technicalhub.io/owl-program-details/668660a530bfd35127c8cde</a>   |
| 12     | Kmph to Mps                                   | <a href="https://maya.technicalhub.io/owl-program-details/668663ce30bfd35127c8dfb">https://maya.technicalhub.io/owl-program-details/668663ce30bfd35127c8dfb</a>   |
| 13     | Inches to Centimeters                         | <a href="https://maya.technicalhub.io/owl-program-details/6686665e30bfd35127c8f3a">https://maya.technicalhub.io/owl-program-details/6686665e30bfd35127c8f3a</a>   |
| 14     | Capacity                                      | <a href="https://maya.technicalhub.io/owl-program-details/668678aa30bfd35127c95b9">https://maya.technicalhub.io/owl-program-details/668678aa30bfd35127c95b9</a>   |
| 15     | Average of Two Numbers                        | <a href="https://maya.technicalhub.io/owl-program-details/6687b002dfe02cea4b5389d6">https://maya.technicalhub.io/owl-program-details/6687b002dfe02cea4b5389d6</a> |
| 16     | Compound Interest                             | <a href="https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab">https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab</a> |
| 17     | Average Weight                                | <a href="https://maya.technicalhub.io/owl-program-details/6687b93edfe02cea4b54367a">https://maya.technicalhub.io/owl-program-details/6687b93edfe02cea4b54367a</a> |
| 18     | Arithmetic Operations                         | <a href="https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1">https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1</a> |
| 19     | Distance Between Two Points                   | <a href="https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a">https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a</a> |
| 20     | Days into Years, Weeks                        | <a href="https://maya.technicalhub.io/owl-program-details/6687cad1fd042085d9ec95a8">https://maya.technicalhub.io/owl-program-details/6687cad1fd042085d9ec95a8</a> |
| 21     | Convert Seconds to Hours, Minutes and Seconds | <a href="https://maya.technicalhub.io/owl-program-details/6688c926e467bfe336f8007b">https://maya.technicalhub.io/owl-program-details/6688c926e467bfe336f8007b</a> |
| 22     | Hours and Minutes                             | <a href="https://maya.technicalhub.io/owl-program-details/6688e4f0e467bfe336f89673">https://maya.technicalhub.io/owl-program-details/6688e4f0e467bfe336f89673</a> |
| 23     | Romeo and Juliet                              | <a href="https://maya.technicalhub.io/owl-program-details/6688e068e467bfe336f87a8b">https://maya.technicalhub.io/owl-program-details/6688e068e467bfe336f87a8b</a> |
| 24     | Gross Salary of an Employee                   | <a href="https://maya.technicalhub.io/owl-program-details/6688dd95e467bfe336f87682">https://maya.technicalhub.io/owl-program-details/6688dd95e467bfe336f87682</a> |
| 25     | Surface Area and Volume of a Cube             | <a href="https://maya.technicalhub.io/owl-program-details/6688d909e467bfe336f872ca">https://maya.technicalhub.io/owl-program-details/6688d909e467bfe336f872ca</a> |

|    |                                 |                                                                                                                                                                   |
|----|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26 | Area of Trapezium               | <a href="https://maya.technicalhub.io/owl-program-details/6688d637e467bfe336f86c5e">https://maya.technicalhub.io/owl-program-details/6688d637e467bfe336f86c5e</a> |
| 27 | Swap Two Numbers                | <a href="https://maya.technicalhub.io/owl-program-details/6688d2d0e467bfe336f84f55">https://maya.technicalhub.io/owl-program-details/6688d2d0e467bfe336f84f55</a> |
| 28 | Last Two Digits of a Given Year | <a href="https://maya.technicalhub.io/owl-program-details/6688ccfae467bfe336f81f90">https://maya.technicalhub.io/owl-program-details/6688ccfae467bfe336f81f90</a> |
| 29 | Arithmetic Operations           | <a href="https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1">https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1</a> |
| 30 | Uppercase Letters in a String   | <a href="https://maya.technicalhub.io/owl-program-details/669a2453c03fc56b320b215c">https://maya.technicalhub.io/owl-program-details/669a2453c03fc56b320b215c</a> |
| 31 | Factors Finding                 | <a href="https://maya.technicalhub.io/owl-program-details/66866c4a30bfd35127c90b4">https://maya.technicalhub.io/owl-program-details/66866c4a30bfd35127c90b4</a>   |
| 32 | String Copy                     | <a href="https://maya.technicalhub.io/owl-program-details/669a03ded62716a9c6d4fa9a">https://maya.technicalhub.io/owl-program-details/669a03ded62716a9c6d4fa9a</a> |
| 33 | Recursive Digit Sum             | <a href="https://www.hackerrank.com/challenges/recursive-digit-sum/problem">https://www.hackerrank.com/challenges/recursive-digit-sum/problem</a>                 |

|                            | Basic Programs | Aditya's Internal Coding Platform (Maya) | Code chef | Hacker rank | Leet code | Total      |
|----------------------------|----------------|------------------------------------------|-----------|-------------|-----------|------------|
| <b>Unit-1</b>              | 4              | 8                                        | 2         | 5           | 0         | <b>19</b>  |
| <b>Unit-2</b>              | 4              | 4                                        | 1         | 4           | 0         | <b>13</b>  |
| <b>Unit-3</b>              | 8              | 7                                        | 0         | 2           | 0         | <b>17</b>  |
| <b>Unit-4</b>              | 5              | 0                                        | 0         | 7           | 0         | <b>12</b>  |
| <b>Unit-5</b>              | 9              | 0                                        | 0         | 0           | 0         | <b>9</b>   |
| <b>Additional Practice</b> | 0              | 33                                       | 22        | 5           | 68        | <b>128</b> |
| <b>Total</b>               | <b>26</b>      | <b>52</b>                                | <b>29</b> | <b>23</b>   | <b>68</b> | <b>198</b> |

**Business Intelligence Lab**  
(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)  
(Syllabus for the batch admitted in the year 2025)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501IT01</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>0</b> | <b>0</b> | <b>2</b> | <b>2</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Utilize Excel and Power BI for data analysis, visualization, and reporting.
- CO2:** Apply various data analysis techniques in Excel and Power BI to extract meaningful insights from datasets.
- CO3:** Create clear and compelling visualizations using Excel and Power BI to communicate data-driven insights.
- CO4:** Develop data models in Power BI to organize and analyze data efficiently.
- CO5:** Design interactive dashboards in Power BI to facilitate data exploration and decision-making.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    |      |      | 2    |      |      |      | 1    | 1     | 1     |
| <b>CO2</b> | 2    | 3    |      |      | 2    |      |      |      | 1    | 1     | 2     |
| <b>CO3</b> | 2    | 2    |      |      | 2    |      |      |      | 1    | 1     | 2     |
| <b>CO4</b> | 1    | 2    | 1    |      | 2    |      |      |      | 1    | 1     | 2     |
| <b>CO5</b> | 1    | 2    | 1    |      | 2    |      |      |      | 1    | 1     | 2     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    | 2    |
| <b>CO2</b> | 2    | 1    |
| <b>CO3</b> | 2    | 2    |
| <b>CO4</b> | 1    | 2    |
| <b>CO5</b> | 2    | 2    |

**Practice:**

**1. Introduction to Excel**

- a. Overview of Excel and its capabilities for data analysis.
- b. Basics of Excel: Navigating the interface, entering data, formatting cells.
- c. Introduction to functions and formulas: SUM, AVERAGE, IF, VLOOKUP, etc.
- d. Importing data into Excel from different sources: CSV, text files.



## **2. Data Analysis with Excel**

- a. Data manipulation techniques: Sorting, filtering, and grouping data.
- b. Advanced functions and formulas: INDEX/MATCH, SUMIFS, COUNTIFS, etc.
- c. Data visualization with Excel: Creating charts and graphs.
- d. Using PivotTables for data summarization and analysis.

## **3. Advanced Excel Features**

- a. Introduction to Excel tables and structured references.
- b. Working with named ranges and dynamic ranges.
- c. Excel data validation techniques.

## **4. Introduction to Power BI**

- a. Overview of Power BI and its advantages over Excel for large datasets.
- b. Installing Power BI Desktop.
- c. Understanding the Power BI interface: Navigation, ribbons, and panes.
- d. Importing data into Power BI Desktop from various sources.

## **5. Data Preparation in Power BI**

- a. Introduction to Power Query for data transformation.
- b. Cleaning, shaping, and filtering data in Power Query Editor.

## **6. Data Preparation in Power BI**

- a. Combining data from different sources.
- b. Loading data into Power BI model.

## **7. Data Modeling in Power BI**

- a. Understanding relationships between tables.
- b. Creating calculated columns and measures using DAX.

## **8. Data Modeling in Power BI**

- a. Introduction to DAX functions: CALCULATE, FILTER, RELATED, etc.
- b. Working with date and time functions in DAX.

## **9. Visualization Basics in Power BI**

- a. Creating basic visualizations: Bar charts, line charts, pie charts, etc.
- b. Customizing visualizations: Formatting, titles, legends, etc.

## **10. Visualization Basics in Power BI**

- a. Using slicers and filters to interact with visualizations.
- b. Adding drill-down capabilities to visualizations.

## **11. Advanced Visualizations and Dashboards in Power BI**

- a. Exploring advanced visualizations: TreeMap, Waterfall chart, KPIs, etc.
- b. Creating custom visuals from the marketplace.

## **12. Advanced Visualizations and Dashboards in Power BI**

- a. Designing effective dashboards: Layout, arrangement, and organization.
- b. Adding interactivity with bookmarks and drill-through.



**Additional Practice:**

1. **Basic Data Analysis:** Import a dataset into Excel and perform basic data analysis tasks such as sorting, filtering, and creating simple charts to visualize the data.
2. **Expense Tracker:** Create a spreadsheet to track your expenses. You can have columns for date, item description, category, and amount. Use formulas to calculate totals and analyze your spending habits.
3. **Data modeling and extracting statistics from dataset:** Connecting Power BI to local data files and cloud servers (COVID19 dataset will be imported into the Power BI for visualization).

**Text Books:**

- 1 Learn Power BI - Second Edition: A comprehensive, step-by-step guide for beginners to learn real-world business intelligence 2<sup>nd</sup> Edition, ISBN: 9781801811958.
- 2 Power BI Beginner: Zero to Hero in Power BI Desktop by Philip Seamark, ISBN 1691641227.

**Reference Books:**

- 1 Power BI Quick Start Guide: Build dashboards and visualizations to make your data come to life" by Devin Knight and Siddharth Mehta.
- 2 Learn Power BI: A Beginner's Guide to Analyzing Data and Creating Reports with Power BI" by Murilo Miranda.

**Web Links:**

- 1 <https://learn.microsoft.com/en-us/power-bi/>
- 2 <https://support.microsoft.com/en-us/excel>
- 3 <https://cce.sydney.edu.au/course/MSE1>
- 4 <https://cce.sydney.edu.au/course/PBBA>

**Business Intelligence and AI Tools Lab**  
(Common to CE, EEE, ME, ECE, CSE, AIML, CSE(DS), PT & Min.E)  
(Revised Syllabus for batches admitted from 2026 onwards)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2601AI01</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>0</b> | <b>0</b> | <b>2</b> | <b>2</b> |

### Course Outcomes

At the end of the course, the student will be able to:

- CO1** Use Excel for data entry, formulas and built-in functions to perform basic data analysis.
- CO2** Apply data-analysis and visualization techniques in Excel (PivotTables, charts) to extract meaningful insights from datasets.
- CO3** Build data models and interactive dashboards in Power BI to support reporting and decision-making.
- CO4** Use generative AI tools (ChatGPT, Claude, Gemini, Perplexity) through well-structured prompts to solve everyday academic and analytical tasks.
- CO5** Apply AI tools responsibly to research, verify, summarize and create content and presentations.
- CO6** Integrate AI assistance with Excel and Power BI to accelerate data analysis and reporting.

## MODULE A — Spreadsheet Analytics with Microsoft Excel

### 1. Excel Fundamentals

- a. Navigating the Excel interface; entering and formatting data; cell referencing (relative, absolute, mixed).
- b. Core functions and formulas: SUM, AVERAGE, COUNT, IF, VLOOKUP.
- c. Importing data into Excel from CSV and text files.

### 2. Data Analysis in Excel

- a. Data manipulation: sorting, filtering and grouping data.
- b. Advanced functions: INDEX/MATCH, SUMIFS, COUNTIFS, nested IF.
- c. Creating charts and graphs to visualize data.

### 3. PivotTables and Summarization

- a. Building PivotTables and PivotCharts for data summarization.
- b. Using slicers and timelines to interact with summaries.
- c. Calculated fields and grouping within PivotTables.

### 4. Advanced Excel Features

- a. Excel tables and structured references; named and dynamic ranges.
- b. Data-validation techniques (drop-down lists, input rules).

- c. What-if analysis: Goal Seek and Data Tables.

## **MODULE B — Business Intelligence with Microsoft Power BI**

### **5. Getting Started with Power BI**

- a. Overview of Power BI and its advantages over Excel for large datasets.
- b. Installing Power BI Desktop; understanding the interface (ribbons, panes, views).
- c. Importing data from multiple sources (Excel, CSV, web).

### **6. Data Preparation with Power Query**

- a. Cleaning, shaping and filtering data in the Power Query Editor.
- b. Combining data from different sources (append and merge).
- c. Loading the prepared data into the Power BI model.

### **7. Data Modeling and DAX**

- a. Creating relationships between tables; star-schema basics.
- b. Calculated columns and measures using DAX.
- c. Key DAX functions: CALCULATE, FILTER, RELATED, and date/time functions.

### **8. Visualizations and Interactive Dashboards**

- a. Basic and advanced visuals: bar, line, pie, TreeMap, KPI cards.
- b. Slicers, filters and drill-down for interactivity.
- c. Designing an interactive dashboard with bookmarks and drill-through.

## **MODULE C — Working with AI Tools**

### **9. Exploring the AI Tool Landscape**

- a. Introduction to popular AI assistants: ChatGPT, Claude, Gemini, Perplexity.
- b. Comparing tools across tasks — summarizing, simple coding, and reasoning.
- c. Building a comparison matrix and choosing the right tool for a task.

### **10. Prompt Engineering Essentials**

- a. Anatomy of a good prompt; clarity, context and constraints.
- b. Prompt patterns: persona, few-shot, chain-of-thought, and structured (JSON) output.
- c. Iterating and refining prompts for better results.

### **11. AI for Research and Verification**

- a. Using AI for topic research, explanations and quick literature scans.
- b. Three-step verification chain: cross-check claims against primary sources.
- c. Recognizing hallucinations, bias and link-rot; the limits of AI.

### **12. Responsible and Ethical Use of AI**

- a. Academic integrity, plagiarism and proper acknowledgement of AI use.
- b. Privacy, data safety and never sharing sensitive information.
- c. Drafting a simple personal/class “AI use policy”.

### **13. AI for Content and Presentations**

- a. Summarizing documents and Q&A over your own notes (e.g., NotebookLM).
- b. Generating outlines, write-ups and email drafts with AI assistance.
- c. Auto-creating slide decks from a brief (e.g., Gamma) and refining them.

### **14. AI-Assisted Data Analysis (Capstone)**

- a. Using AI to write/explain Excel formulas and draft DAX measures.

- b. Cleaning and interpreting a dataset and explaining charts with AI help.
- c. Mini-project: clean a dataset in Excel, build a Power BI dashboard, and use AI to generate insights and a short summary report.

### **Additional Practice / Suggested Activities**

- Expense Tracker (Excel): build a spreadsheet with date, item, category and amount; use formulas to total and analyze spending.
- Sales Dashboard (Power BI): import a sample sales dataset and build an interactive dashboard with slicers and KPIs.
- COVID-19 Data Story (Power BI): connect to a public dataset and create visuals that tell a clear data story.
- AI Study Buddy: pick one subject topic and use prompt patterns to generate notes, a quiz and flashcards, then verify the facts.
- Capstone Showcase: present the Module-C mini-project — dataset → cleaned in Excel → visualized in Power BI → insights drafted with AI.

### **Text Books**

- 1 Learn Power BI – Second Edition: A comprehensive, step-by-step guide for beginners to learn real-world business intelligence, ISBN: 9781801811958.
- 2 Power BI Beginner: Zero to Hero in Power BI Desktop, Philip Seamark, ISBN: 1691641227.
- 3 Excel 2021 / Microsoft 365 – The Step-by-Step Guide to Mastering Excel, (latest edition).

### **Reference Books**

- 1 Power BI Quick Start Guide: Build dashboards and visualizations to make your data come to life, Devin Knight and Siddharth Mehta.
- 2 Learn Power BI: A Beginner's Guide to Analyzing Data and Creating Reports with Power BI, Murilo Miranda.
- 3 Co-Intelligence: Living and Working with AI, Ethan Mollick (for responsible AI use).

### **Web Links / e-Resources**

- 1 <https://learn.microsoft.com/en-us/power-bi/>
- 2 <https://support.microsoft.com/en-us/excel>
- 3 <https://aistudio.google.com/>
- 4 <https://notebooklm.google.com/>
- 5 <https://www.perplexity.ai/>

**Engineering Graphics**  
(Common to CE,EEE,ME,ECE,CSE,IT,AIIML,CSE(DS),PT&Min.E)

**Course Code: 2501ME01**

**L      T      P      C**  
**1      0      2      3**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Apply the principles of engineering drawing to construct Engineering curves
- CO2:** Construct projections of points and lines.
- CO3:** Demonstrate visualization skills of projections of planes.
- CO4:** Demonstrate visualization skills of projections of solids and development of surfaces
- CO5:** Construct isometric and orthographic views of simple solids.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    | 1    |      | 2    |      |      |      | 1    | 1     |       |
| <b>CO2</b> | 3    | 2    | 1    |      | 2    |      |      |      | 1    | 1     |       |
| <b>CO3</b> | 3    | 2    | 1    |      | 2    |      |      |      | 1    | 1     |       |
| <b>CO4</b> | 3    | 2    | 1    |      | 2    |      |      |      | 1    | 1     |       |
| <b>CO5</b> | 3    | 2    | 1    |      | 2    |      |      |      | 1    | 1     |       |

**Practice:**

- a) Introduction to Engineering Graphics**  
Introduction to AutoCAD, Dimensioning, elements of dimensioning, system of dimensioning, and Conventions in Drawing.
- b) Construction of Cycloids and Involutés**
  - a) Construction of Cycloid, Epicycloid and Hypocycloid
  - b) Involute of a pentagon and circle
- c) Introduction to Orthographic Projection**
  - a) Principles of Projection
  - b) Orthographic Projection – Four Quadrants.
  - c) First angle & Third angle Projection with examples, reference plane, importance of reference lines or Plane.
  - d) Projections of a point situated in any one of the four quadrants.
- d) Projection of straight lines-I:**
  - a) Projections of straight lines parallel to both reference planes.
  - b) Projections of straight lines perpendicular to one reference plane and parallel to other reference plane
  - c) Projections of straight line parallel to one plane & inclined to another plane

- e) **Projection of straight lines-II:**
  - a) Projections of straight line inclined to both reference planes
- f) **Projection of planes:**
  - a) Regular planes perpendicular to both reference planes, Parallel to one reference plane and inclined to the other reference plane  
Ex: Rectangle, Pentagon, Hexagon and Rhombus
- g) **Projection of planes**
  - a) Projections of Planes inclined to both reference planes Ex: Rectangle, Pentagon, Hexagon and Rhombus.
- h) **Projection of solids**
  - a) Axis Perpendicular to H.P and Axis Perpendicular to V.P, Ex: Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone
  - b) Axis Parallel to H.P and V.P, Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone
- i) **Projection of solids**
  - a) Projection of Solids with axis inclined to one reference plane and parallel to another plane. Ex: Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone
- j) **Development of Surfaces**
  - a) Development of Prisms and Cylinder simple cases
- k) **Development of Surfaces**
  - a) Development of Pyramids and Cone simple cases
- l) **Conversion of Isometric views to Orthographic views**
  - a) Practice figure - 1
  - b) Practice figure – 2

**Additional Practice:**

1. **Conversion of Isometric views to Orthographic views**
  - a) Practice figure - 3
  - b) Practice figure - 4
2. **Conversion of Orthographic views to Isometric views**
  - a) Practice figure - 1
  - b) Practice figure - 2

**Text Books:**

1. Engineering Drawing, N. D. Bhatt, Charotar Publishing House, 54<sup>th</sup> edition, 2024, ISBN : 9789385039706.
2. Engineering Drawing and Graphics , Venugopal, New Age Publications, 2<sup>nd</sup> edition, 2019, ISBN: 9788122415452.

**Reference Books:**

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2021, ISBN: 978-9385983177.
2. Computer Aided Engineering Graphics, T. Jeyapoovan, Vikas Publishing house, New Delhi, 1<sup>st</sup> Edition, 2023, ISBN : 9789356743199.

**Web Links:**

1. <https://nptel.ac.in/courses/112103019/>
2. <https://academy.autodesk.com/authenticated-home-user>
3. <https://www.sciencedirect.com/book/9780080108391/engineering-drawing-from-thebeginning>

**Differential Equations & Vector Calculus**  
(Common to CE,EEE,ME,ECE,CSE,IT,AIIML,CSE(DS),PT&Min.E)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code:</b> 2501MA02 | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>1</b> | <b>0</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the Course, Student will be able to:**

- CO1:** Solve the linear differential equations of first order and apply in various engineering problems.
- CO2:** Solve the linear differential equations of higher order and apply in various engineering problems.
- CO3:** Solve the linear partial differential equations
- CO4:** Calculate the gradient, divergence and curl.
- CO5:** Compute work done, flux using vector integration

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO2</b> | 3    | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO3</b> | 3    | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO4</b> | 3    | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO5</b> | 3    | 2    |      |      |      |      |      |      |      |       |       |

**UNIT – I**

**Ordinary Differential Equations of First Order and First Degree:**

Solution of first order linear differential equations, exact differential equations and equations reducible to exact differential equations, Orthogonal Trajectories, Modelling of RL- circuit.

**Practice(Using any computational tool):** Solving the first order initial value problems using **odesolver** and plot the solution curves.

**UNIT – II**

**Linear Differential Equations of Higher Order:**

Solution of linear differential equations with constant coefficients, method of variation of parameters, solution of simultaneous linear differential equations.

Equations reducible to Linear differential equations with constant coefficients: Cauchy's homogeneous Linear Equations, Legendre's Linear Equations. Study of oscillations arising in LCR circuit (free oscillations and forced oscillations).

**Practice(Using any computational tool):** Solving the second order initial value problems using **odesolver** and plot the solution curves



### UNIT – III

#### **Partial Differential Equations:**

Solution of linear PDE of first order by Lagrange's method, solution of homogeneous linear PDE of higher order with constant coefficients.

### UNIT – IV

#### **Vector Differentiation:**

Gradient of a scalar field, finding angle between two surfaces, directional derivative. Divergence and solenoidal fields. Curl and irrotational fields, Finding Scalar Potential.

**Practice(Using any computational tool):** Plotting of surfaces, 3D-plots, plotting vector fields.

### UNIT – V

#### **Vector Integration:**

Line integrals, work done by a force, conservative force field, surface integral, flux, volume integral. Green's theorem, Stoke's theorem and Gauss divergence theorem.

Students are advised to use any computational / AI Tool like Wolfram Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

#### **Text Books:**

- 1 Advanced Engineering Mathematics, E. Kreyszig, John Wiley & Sons, 10th Ed., 2018. ISBN 978-0470458365
- 2 Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021). ISBN 978-9383214204

#### **Reference Books:**

- 1 Advanced Engineering Mathematics, Dennis G. Zill, Jones & Bartlett Learning, 2018, 6th Edition. ISBN 978-1284105902.
- 2 Higher Engineering Mathematics, B.V. Ramana, McGraw-Hill Education, 11'th Ed., 2017. ISBN 978-9339216016.

#### **Web Links:**

- 1 <https://www.classcentral.com/course/differential-equations-engineers-13258>
- 2 <https://archive.nptel.ac.in/courses/111/106/111106100/>
- 3 <https://www.khanacademy.org/math/differential-equations>
- 4 <https://archive.nptel.ac.in/courses/111/101/111101153/>
- 5 <https://archive.nptel.ac.in/courses/111/105/111105122/>

**Data Structures**  
(Common to EEE, ECE, CSE, IT, AIML & CSE(DS))  
(Syllabus for the batch admitted in the year 2025)

|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code:</b> 2501CS03 | <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Utilize structure, union to handle heterogeneous data.
- CO2:** Illustrate Time and Space complexities for different sorting Algorithms
- CO3:** Demonstrate various operations on Linked Lists
- CO4:** Explain different operations on Stack and Queue with applications.
- CO5:** Demonstrate the importance and various operation on non-linear data structures

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 1    | 1    | 2    |      |      |      |      | 1    | 1    |       |       |
| <b>CO2</b> | 1    | 1    | 2    | 2    |      |      |      | 1    | 1    |       |       |
| <b>CO3</b> | 1    | 2    | 2    | 1    |      |      |      | 1    | 1    |       |       |
| <b>CO4</b> | 1    | 1    | 2    | 1    |      |      |      | 1    | 1    |       |       |
| <b>CO5</b> | 1    | 1    | 2    | 2    |      |      |      | 1    | 1    |       |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 3    | -    |
| <b>CO2</b> | 2    | -    |
| <b>CO3</b> | 2    | -    |
| <b>CO4</b> | 2    | -    |
| <b>CO5</b> | 2    | -    |

**UNIT – I**

**Structures and Unions:** Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type - enum variables, Using Typedef keyword, Bit Fields.

**Data Structures:** Introduction to Data Structures, Types of Data Structures.

**Practice:**

4. Write a C program to find the total, average of n students using structures
5. Copy one structure variable to another structure of the same type.
6. Read student name and marks from the command line and display the student details along with the total.

**UNIT – II**

**Introduction to Linear Data Structures:** Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Overview of time and space complexity analysis for linear data structures.

Sorting Techniques: Quick sort, Merge sort, Radix sort

**Practice:**

1. Implement Merge sort using arrays.  
<https://www.hackerrank.com/contests/hw1/challenges/merge-sort>
2. Implement Quick sort using arrays  
<https://www.hackerrank.com/challenges/quicksort1/problem>
3. Implement Radix Sort using arrays  
[https://www.hackerrank.com/contests/hw1/challenges/radix-sort?utm\\_source](https://www.hackerrank.com/contests/hw1/challenges/radix-sort?utm_source)

**UNIT – III**

**Linked Lists:** Singly linked lists: representation and operations, doubly linked lists and its operations and circular linked lists and its operations, Comparing arrays and linked lists, Applications of linked lists.

**Practice:**

1. Single Linked List: Perform different operations in single linked list.  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
2. Perform different operations in double linked list  
[https://leetcode.com/problems/design-linked-list/?utm\\_source](https://leetcode.com/problems/design-linked-list/?utm_source)
3. Circular Linked List  
[https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm\\_source](https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source)

**UNIT – IV**

**Stacks:** Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, applications of stacks.

**Queues:** Introduction to queues: properties and operations, Types of Queues, implementing queues using arrays and linked lists, applications of queues.

**Practice:**

1. Stack and its operations using arrays and Linked List  
<https://www.hackerrank.com/challenges/balanced-brackets/problem>  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
2. Implement a program to evaluate a postfix expression.  
<https://leetcode.com/problems/evaluate-reverse-polish-notation/description/>
3. Queue and its operations using arrays and Linked List  
<https://leetcode.com/problems/implement-queue-using-stacks/description/>  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
4. Implement Circular Queue using Arrays  
<https://leetcode.com/problems/design-circular-queue/description/>

**UNIT – V****Non-linear Data Structures:**

Trees: Definition of tree, Tree Terminology, types of trees, Binary tree traversals, Binary Search Tree – Insertion, Deletion.

Graphs: Definition and Terminology – Representation of Graphs-Adjacency Matrix and Linked list, Graph Traversals (BFT & DFT)

**Practice:**

1. Implement Binary search tree (BST).  
<https://leetcode.com/problems/insert-into-a-binary-search-tree/description/>  
<https://leetcode.com/problems/delete-node-in-a-bst/description/>
2. Implement Binary search Tree (BST) Traversals.  
<https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>  
<https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>  
<https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>
3. Graph Traversal using Breadth First Search (BFS)  
<https://www.hackerrank.com/challenges/bfsshortreach/problem>
4. Graph Traversal using Depth First Search (DFS)  
<https://leetcode.com/problems/number-of-islands/description/>

**Text Books:**

1. Data Structures using C, Rema Theraja, Oxford University Press, 3rd Edition. ISBN: 978-9354979453
2. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

**Reference Books:**

1. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, ISBN: 978-0716782506
3. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407
4. Data Structures Using C, Reema Thareja, Oxford University Press, 2nd Edition. ISBN: 978-0198099307

**Web Links:**

1. <https://nptel.ac.in/courses/106102064>
2. <https://archive.nptel.ac.in/courses/106/105/106105225/>
3. <https://www.udemy.com/topic/data-structures/>
4. <https://www.coursera.org/specializations/data-structures-algorithms>
5. <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>

**Additional Practice:**

| SNO | Difficulty | Problem Name          | URL                                                                                                                                                                                               |
|-----|------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Easy       | Structs and enums     | <a href="https://www.hackerrank.com/challenges/too-high-boxes/problem">https://www.hackerrank.com/challenges/too-high-boxes/problem</a>                                                           |
| 2   | Easy       | Structs and enums     | <a href="https://www.codechef.com/problems/HS08TEST?tab=statement">https://www.codechef.com/problems/HS08TEST?tab=statement</a>                                                                   |
| 3   | Medium     | Structs and enums     | <a href="https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem">https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem</a>                         |
| 4   | Easy       | Arrays and Hashtables | <a href="https://leetcode.com/problems/two-sum/description/">https://leetcode.com/problems/two-sum/description/</a>                                                                               |
| 5   | Easy       | Arrays and Pointers   | <a href="https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source">https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source</a> |
| 6   | Medium     | Arrays and Pointers   | <a href="https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source">https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source</a>       |
| 7   | Easy       | Linked List           | <a href="https://leetcode.com/problems/merge-two-sorted-lists/description/">https://leetcode.com/problems/merge-two-sorted-lists/description/</a>                                                 |
| 8   | Medium     | Arrays and Matrix     | <a href="https://leetcode.com/problems/diagonal-traverse/description/">https://leetcode.com/problems/diagonal-traverse/description/</a>                                                           |
| 9   | Easy       | Linked List           | <a href="https://www.hackerrank.com/challenges/compare-two-linked-lists/problem">https://www.hackerrank.com/challenges/compare-two-linked-lists/problem</a>                                       |
| 10  | Medium     | Stack applications    | <a href="https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm">https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm</a>                                       |
| 11  | Medium     | Binary Tree           | <a href="https://leetcode.com/problems/binary-tree-right-side-view/description/">https://leetcode.com/problems/binary-tree-right-side-view/description/</a>                                       |
| 12  | Medium     | Stack applications    | <a href="https://leetcode.com/problems/remove-k-digits/description/">https://leetcode.com/problems/remove-k-digits/description/</a>                                                               |
| 13  | Medium     | Graph Theory          | <a href="https://www.hackerrank.com/challenges/journey-to-the-moon/problem">https://www.hackerrank.com/challenges/journey-to-the-moon/problem</a>                                                 |
| 14  | Medium     | Graph Traversals      | <a href="https://leetcode.com/problems/number-of-provinces/description/">https://leetcode.com/problems/number-of-provinces/description/</a>                                                       |
| 15  | Medium     | Graph Theory          | <a href="https://www.hackerrank.com/challenges/torque-and-development/problem">https://www.hackerrank.com/challenges/torque-and-development/problem</a>                                           |

|                            | Basic Programs | Aditya's Internal coding Platform(Maya) | Code chef | Hacker rank | Leet code | Geek for Geeks |
|----------------------------|----------------|-----------------------------------------|-----------|-------------|-----------|----------------|
| <b>Unit-1</b>              | 3              | 0                                       | 0         | 0           | 0         | 0              |
| <b>Unit-2</b>              | 0              | 0                                       | 0         | 3           | 0         | 0              |
| <b>Unit-3</b>              | 0              | 0                                       | 1         | 0           | 2         | 0              |
| <b>Unit-4</b>              | 0              | 0                                       | 0         | 1           | 5         | 0              |
| <b>Unit-5</b>              | 0              | 0                                       | 0         | 4           | 3         | 0              |
| <b>Additional Practice</b> | 0              | 0                                       | 1         | 5           | 8         | 1              |
| <b>Total</b>               | <b>3</b>       | <b>0</b>                                | <b>2</b>  | <b>13</b>   | <b>18</b> | <b>1</b>       |

## Data Structures using C++

(Common to EEE, ECE, CSE, AIML & CSE (DS))  
(Revised Syllabus for batches admitted from 2026 Onwards)

|                       | L | T | P | C |
|-----------------------|---|---|---|---|
| Course Code: 2601DS02 | 2 | 0 | 2 | 4 |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Apply C++ features for problem solving.
- CO2:** Apply various sorting techniques to solve computing problems.
- CO3:** Make use of linear data structures to solve real time problems.
- CO4:** Develop applications using Tree data structures.
- CO5:** Solve problems using Graph algorithms.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 1    | 1    | 1    |      |      |      |      | 1    | 1    |       |       |
| CO2   | 1    | 1    | 2    | 2    |      |      |      | 1    | 1    |       |       |
| CO3   | 1    | 2    | 2    | 1    |      |      |      | 1    | 1    |       |       |
| CO4   | 1    | 1    | 2    | 1    |      |      |      | 1    | 1    |       |       |
| CO5   | 1    | 1    | 2    | 2    |      |      |      | 1    | 1    |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    | -    |
| CO2    | 2    | -    |
| CO3    | 2    | -    |
| CO4    | 2    | -    |
| CO5    | 2    | -    |

### UNIT – I

**An Overview of C++:** Structure of C++ program, Input and output in C++, Class, Objects, Members Functions, Access Specifiers, Introduction to Constructors and Destructor.

**Overview of Standard Template Library:** Introduction, STL Programming Model, Containers, Sequence Containers, Associative Containers, Algorithms, Iterators, Vectors, Lists, Maps.

### Practice:

- Find the roots of a quadratic equation.
- Find factorial of a given number using recursion
- Palindrome Number  
<https://leetcode.com/problems/palindrome-number/description/>
- Class and Objects  
<https://www.hackerrank.com/challenges/classes-objects/problem?isFullScreen=true>
- Program to illustrate the use of Constructors and Destructors.

6. C++ Class Templates  
<https://www.hackerrank.com/challenges/cpp-class-template-specialization/problem?isFullScreen=true>

## UNIT – II

**Data Structures:** Introduction to Data Structures, Types of Data Structures.

**Linear Data Structures:** Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation.

**Linked Lists:** Singly linked lists: Representation and operations, Doubly linked lists and its operations and Circular linked lists and its operations, applications of linked list

### Practice:

1. Single Linked List: Perform different operations in single linked list.  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
2. Perform different operations in double linked list  
[https://leetcode.com/problems/design-linked-list/?utm\\_source](https://leetcode.com/problems/design-linked-list/?utm_source)
3. Circular Linked List  
[https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm\\_source](https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source)
4. Reversing a Linked List

## UNIT – III

**Stacks:** Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, applications of stacks.

**Queues:** Introduction to queues: properties and operations, Types of Queues, implementing queues using arrays and linked lists, applications of queues.

### Practice:

1. Stack and its operations using arrays and Linked List  
<https://www.hackerrank.com/challenges/balanced-brackets/problem>  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
2. Implement a program to evaluate a postfix expression.  
<https://leetcode.com/problems/evaluate-reverse-polish-notation/description/>
3. Queue and its operations using arrays and Linked List  
<https://leetcode.com/problems/implement-queue-using-stacks/description/>  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
4. Implement Circular Queue using Arrays  
<https://leetcode.com/problems/design-circular-queue/description/>

## UNIT – IV

**Trees:** Definition of tree, Tree Terminology, Representation of tree, Types of trees-Binary Tree, BST, BST, Binary tree traversals-Inorder,Preorder,Postorder Traversals.

**Binary Search Trees** – Definition, Operations: Searching, Insertion, Deletion.

**Practice:**

5. Implement Binary search tree (BST).  
<https://leetcode.com/problems/insert-into-a-binary-search-tree/description/>  
<https://leetcode.com/problems/delete-node-in-a-bst/description/>
6. Implement Binary search Tree (BST) Traversals.  
<https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>  
<https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>  
<https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>

**UNIT – V**

**Graphs:** Definition and Terminology, Types of Graph, Representation of Graphs-Adjacency Matrix and Adjacency list, Graph Traversals (BFS & DFS), Bi-Connected Components.

**Practice:**

1. Graph Traversal using Breadth First Search (BFS)  
<https://www.hackerrank.com/challenges/bfsshortreach/problem>
2. Graph Traversal using Depth First Search (DFS)  
<https://leetcode.com/problems/number-of-islands/description/>

**Text Books:**

1. The Complete Reference C++, Herbert Schildt, TMH, Fourth Edition, ISBN-10. 0070411832.
2. Fundamentals of Data Structures in C++, Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, ISBN: 81-7515-278-8
3. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

**Reference Books:**

1. The C++ Programming Language, Bjarne Stroustrup, Pearson, Fourth Edition, ISBN : 9780133522884.
2. Object oriented programming in C++, Joyce Farrell, Cengage, ISBN : 978-1418836269
3. Data structures and algorithms in C++, 3rd edition, Adam Drozdek, Thomson, ISBN: 9788131521267
4. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
5. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407

**Web Links:**

1. <http://nptel.ac.in/courses/106105151/>
2. <https://nptel.ac.in/courses/106102064>
3. <https://archive.nptel.ac.in/courses/106/105/106105225/>



4. <https://www.udemy.com/topic/data-structures/>
5. <https://www.coursera.org/specializations/data-structures-algorithms>
6. <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>

#### Additional Practice:

| SNO | Difficulty | Problem Name          | URL                                                                                                                                                                                               |
|-----|------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Easy       | Arrays and Hashtables | <a href="https://leetcode.com/problems/two-sum/description/">https://leetcode.com/problems/two-sum/description/</a>                                                                               |
| 2   | Easy       | Arrays and Pointers   | <a href="https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source">https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source</a> |
| 3   | Medium     | Arrays and Pointers   | <a href="https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source">https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source</a>       |
| 4   | Easy       | Linked List           | <a href="https://leetcode.com/problems/merge-two-sorted-lists/description/">https://leetcode.com/problems/merge-two-sorted-lists/description/</a>                                                 |
| 5   | Medium     | Arrays and Matrix     | <a href="https://leetcode.com/problems/diagonal-traverse/description/">https://leetcode.com/problems/diagonal-traverse/description/</a>                                                           |
| 6   | Easy       | Linked List           | <a href="https://www.hackerrank.com/challenges/compare-two-linked-lists/problem">https://www.hackerrank.com/challenges/compare-two-linked-lists/problem</a>                                       |
| 7   | Medium     | Stack applications    | <a href="https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm">https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm</a>                                       |
| 8   | Medium     | Binary Tree           | <a href="https://leetcode.com/problems/binary-tree-right-side-view/description/">https://leetcode.com/problems/binary-tree-right-side-view/description/</a>                                       |
| 9   | Medium     | Stack applications    | <a href="https://leetcode.com/problems/remove-k-digits/description/">https://leetcode.com/problems/remove-k-digits/description/</a>                                                               |
| 10  | Medium     | Graph Theory          | <a href="https://www.hackerrank.com/challenges/journey-to-the-moon/problem">https://www.hackerrank.com/challenges/journey-to-the-moon/problem</a>                                                 |
| 11  | Medium     | Graph Traversals      | <a href="https://leetcode.com/problems/number-of-provinces/description/">https://leetcode.com/problems/number-of-provinces/description/</a>                                                       |
| 12  | Medium     | Graph Theory          | <a href="https://www.hackerrank.com/challenges/torque-and-development/problem">https://www.hackerrank.com/challenges/torque-and-development/problem</a>                                           |

|                     | Basic Programs | Aditya's Internal coding Platform(Maya) | Code chef | Hacker rank | Leet code | Geek for Geeks |
|---------------------|----------------|-----------------------------------------|-----------|-------------|-----------|----------------|
| Unit-1              | 3              | 0                                       | 0         | 2           | 1         | 0              |
| Unit-2              | 0              | 0                                       | 1         | 3           | 2         | 0              |
| Unit-3              | 0              | 0                                       | 0         | 1           | 5         | 0              |
| Unit-4              | 0              | 0                                       | 0         | 3           | 2         | 0              |
| Unit-5              | 0              | 0                                       | 0         | 1           | 1         | 0              |
| Additional Practice | 0              | 0                                       | 0         | 3           | 8         | 1              |
| Total               | 3              | 0                                       | 1         | 13          | 19        | 1              |

**Programming with Python**  
(Common to CSE, IT, AI&ML and DS)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501IT42</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes: At the end of the Course, Student will be able to:**

- CO1:** Develop Python programs using basic programming constructs, control statements, loops.
- CO2:** Implement data processing solutions using Python's string methods and core data structures.
- CO3:** Develop real time applications using functions and packages.
- CO4:** Apply Object Oriented Programming concepts and files.
- CO5:** Build various applications using GUI and exceptions.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | 3    | -    | 2    | -    | -    | 1    | -    | -     | 1     |
| <b>CO2</b> | 2    | 2    | 3    | -    | 2    | -    | -    | 1    | -    | -     | 1     |
| <b>CO3</b> | 3    | -    | 2    | -    | 2    | -    | -    | 2    | 1    | 1     | 1     |
| <b>CO4</b> | 2    | 1    | 2    | -    | 2    | -    | -    | 1    | 1    | 1     | 1     |
| <b>CO5</b> | 1    | 1    | 2    | -    | 2    | -    | -    | 2    | 1    | 1     | 1     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    | 2    |
| <b>CO2</b> | 3    | 2    |
| <b>CO3</b> | 2    | 2    |
| <b>CO4</b> | 2    | 2    |
| <b>CO5</b> | 1    | 2    |

**UNIT – I**

**Programming:**

Introduction to Programming, Introduction to Python, Program Development Cycle, Input–Processing–Output, Print Function, Comments, Variables, Keyboard Input, Basic Calculations, Operators, Type Conversions, Expressions, Data Types, Strings, Using Functions, Using Modules. Decision Making: if, if-else, if-elif-else, Nested Decisions, Logical Operators, Boolean Expressions. Loops: while, for, Running Totals, Input Validation, Nested Loops.

**Practice:**

1. Basic Programs.
  - a. Adding two numbers  
<https://www.codechef.com/problems/FLOW001>
  - b. Perfect Square root or not  
<https://maya.technicalhub.io/owl-program-details/668d0b25aa293a75dcf2dda4>
  - c. Perfect Number

<https://maya.technicalhub.io/owl-program-details/668b717fd24b0e6bee89ce97>

- d. Even Number or Odd number

<https://www.hackerrank.com/challenges/py-if-else/problem?isFullScreen=true>

## 2. Decision Structures and Loops.

- a. Python Loops – Printing Squares of Numbers

<https://www.hackerrank.com/challenges/python-loops/problem?isFullScreen=true>

- b. Check for Armstrong number, Palindrome.

<https://www.hackerrank.com/contests/iiitdm-contest1/challenges/armstrong-number-2?utm>

- c. Spy Number

<https://maya.technicalhub.io/owl-program-details/6688e610e467bfe336f89d72>

- d. Compound Interest

<https://maya.technicalhub.io/owl-program-details/6694bce1d5d1d7533859f1d8>

- e. Count vowels, consonants, digits in a string.

<https://www.codechef.com/problems/CV>

- f. Print a number pyramid.

<https://www.codechef.com/problems/PATT01>

## UNIT – II

### Python Data Types:

Working with Strings: Basic String Operations, String Formatting, String Methods. Lists and Tuples: Sequence Operations, Lists, Tuples, Tuple Function. Dictionaries: Creating and Using Dictionaries, Basic Dictionary Operations, Dictionary Methods. Sets: Creating Sets, Basic Set Operations, Set Methods, Simple Set Comprehensions.

### Practice:

- a. String Matching in an Array

<https://leetcode.com/problems/string-matching-in-an-array/>

- b. Product-of-Three-Numbers

<https://leetcode.com/problems/maximum-product-of-three-numbers>

- c. Write a program to check if the substring is present in a given string or not.

<https://www.hackerrank.com/challenges/find-a-string/problem?utm>

- d. Reverse-vowels-of-a-String

<https://leetcode.com/problems/reverse-vowels-of-a-string>

### Lists, Tuples, Dictionary

- a. Generate 20 random numbers; print min, max, avg, even count.

<https://www.codechef.com/problems/FLOW002>

- b. **Longest Consecutive Sequence**

<https://leetcode.com/problems/longest-consecutive-sequence/>

- c. **Subarray Sum Equals K**

<https://leetcode.com/problems/subarray-sum-equals-k/>

## UNIT – III

**Functions and Packages:** Function Definition, Parameters, Local vs Global Variables, Default Arguments, Keyword Arguments, Return Statement, Lambda Functions. Modules: import, from–import, Creating Simple Modules, Standard Modules, Packages. Basic Problem Solving: Top-Down Design, Simple Recursion Concepts.

### Practice:

#### 1. Working with Functions

- Write a Python program to define a function that takes parameters and returns the sum of two numbers.  
<https://www.geeksforgeeks.org/python-program-to-find-factorial-of-number-using-recursion/>
- Two Sum** — a classic easy problem that's often solved using a function.  
<https://leetcode.com/problems/two-sum/>
- Valid Anagram** — good practice for string/dictionary manipulations inside a function.  
<https://leetcode.com/problems/valid-anagram/>
- FLOW001** — “Add Two Numbers”: simplest problem, good for writing a function to sum two numbers. <https://www.codechef.com/problems/FLOW001>
- FLOW002** — “Compute the Average”: practice writing a function to compute averages.  
<https://www.codechef.com/problems/FLOW002>

## UNIT – IV

**Object Oriented Programming:** Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance , overlapping and overloading operators, Structuring Classes with Inheritance and Polymorphism File Operations: Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations.

### Practice:

#### 1. OOP – Classes and Methods

- Create a Product class with dynamic pricing and stock update.  
<https://www.codechef.com/problems/STFOOD>
- Define Converter class for unit conversions (e.g., inches → feet).  
<https://www.codechef.com/problems/CONV01>
- Create a Time class to convert seconds → minutes, hours.  
<https://www.codechef.com/problems/TIMEMNG>

#### 2. File Handling

- Say "Hello, World!" from a file** (read input from file, print output):  
<https://www.hackerrank.com/challenges/write-a-function/problem>
- Reading from STDIN / file and processing lines:**  
<https://www.hackerrank.com/challenges/whats-your-name/problem>
- FLOW001 – Add Two Numbers:** <https://www.codechef.com/problems/FLOW001>

## UNIT – V

**Errors and Exceptions:** Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions, Redefined Clean up Actions. Graphical User Interfaces: The Behaviour of Terminal Based Programs and GUI - Based, Programs, Coding Simple GUI-Based Programs.

### Practice:

1. GUI and Exceptions
  - a. Build a file-open dialog and display content in a text box.  
<https://www.codechef.com/problems/ERROR404>
  - b. **Python Try/Except** — basic problem to handle division by zero and other exceptions:  
<https://www.hackerrank.com/challenges/py-exceptions/problem>
  - c. **Handling Multiple Exceptions** — practise catching multiple exception types in one block:  
<https://www.hackerrank.com/challenges/handling-multiple-exceptions/problem>
  - d. Show file handling using try/finally and with statements.  
<https://www.codechef.com/problems/VALIDMIN>
2. Integrated Problem Solving
  - a. Implement the Hangman game using string logic and loops.  
<https://www.codechef.com/problems/STRPALIN>

### Text Books:

- 1 Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage, 2018.
- 2 Beginning Python: from Novice to Professional, Lie Hetland, Magnus, 2nd Edition, 2005.

### Reference Books:

1. Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press.
2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson, 2017.
3. Think Python, Allen Downey, Green Tea Press, 2012.
4. Python for Everybody Exploring Data in Python 3, Charles Russell Severance, Sue Blumenberg.

### Web Links:

- 1 <https://www.python.org/>
- 2 <https://www.coursera.org/courses?query=Python%20programming>
- 3 <https://www.learnpython.org/>
- 4 [https://onlinecourses.nptel.ac.in/noc21\\_cs32/preview/](https://onlinecourses.nptel.ac.in/noc21_cs32/preview/)

### Additional Practice:

|                                                |                                                                                                                                                                   |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LPYAS10</b> –<br><i>Print the Pattern</i>   | <a href="https://www.codechef.com/practice/course/python/LPPYAS01/problems/LPYAS10">https://www.codechef.com/practice/course/python/LPPYAS01/problems/LPYAS10</a> |
| <b>LPYAS09</b> –<br><i>Simple Input Output</i> | <a href="https://www.codechef.com/practice/course/python/LPPYAS01/problems/LPYAS09">https://www.codechef.com/practice/course/python/LPPYAS01/problems/LPYAS09</a> |
| <b>LPYAS11</b> –<br><i>Check Even or Odd</i>   | <a href="https://www.codechef.com/practice/course/python/LPPYAS02/problems/LPYAS11">https://www.codechef.com/practice/course/python/LPPYAS02/problems/LPYAS11</a> |

|                                                             |                                                                                                                                                                                     |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LPYAS19</b> –<br><i>Sum of Digits</i>                    | <a href="https://www.codechef.com/practice/course/python/LPPYAS02/problems/LPYAS19">https://www.codechef.com/practice/course/python/LPPYAS02/problems/LPYAS19</a>                   |
| <b>REMMON</b> –<br><i>Remaining Monsters</i>                | <a href="https://www.codechef.com/problems/REMMON">https://www.codechef.com/problems/REMMON</a>                                                                                     |
| <b>EPISODES</b> –<br><i>Episodes</i>                        | <a href="https://www.codechef.com/problems/EPISODES">https://www.codechef.com/problems/EPISODES</a>                                                                                 |
| <b>TRIANGLE7</b> –<br><i>Triangle Type</i>                  | <a href="https://www.codechef.com/problems/TRIANGLE7">https://www.codechef.com/problems/TRIANGLE7</a>                                                                               |
| <b>COLORB</b> –<br><i>Color Blindness</i>                   | <a href="https://www.codechef.com/problems/COLORB">https://www.codechef.com/problems/COLORB</a>                                                                                     |
| <b>CABRIDE</b> –<br><i>Cab Ride</i>                         | <a href="https://www.codechef.com/problems/CABRIDE">https://www.codechef.com/problems/CABRIDE</a>                                                                                   |
| <b>SKONG</b> –<br><i>Strong Language</i>                    | <a href="https://www.codechef.com/problems/SKONG">https://www.codechef.com/problems/SKONG</a>                                                                                       |
| <b>SELLCOIN</b> –<br><i>Sell Coins</i>                      | <a href="https://www.codechef.com/problems/SELLCOIN">https://www.codechef.com/problems/SELLCOIN</a>                                                                                 |
| <b>MIXINGLIQ</b> –<br><i>Mixing Liquids</i>                 | <a href="https://www.codechef.com/problems/MIXINGLIQ">https://www.codechef.com/problems/MIXINGLIQ</a>                                                                               |
| <b>GAMBLING</b> –<br><i>Gambling</i>                        | <a href="https://www.codechef.com/problems/GAMBLING">https://www.codechef.com/problems/GAMBLING</a>                                                                                 |
| <b>INCAT</b> –<br><i>Increase the Number</i>                | <a href="https://www.codechef.com/problems/INCAT">https://www.codechef.com/problems/INCAT</a>                                                                                       |
| <b>INDDAY</b> –<br><i>Independence Day Offer</i>            | <a href="https://www.codechef.com/problems/INDDAY">https://www.codechef.com/problems/INDDAY</a>                                                                                     |
| <b>CWCTH</b> –<br><i>Count the Holidays</i>                 | <a href="https://www.codechef.com/problems/CWCTH">https://www.codechef.com/problems/CWCTH</a>                                                                                       |
| <b>Palindrome Number</b>                                    | <a href="https://leetcode.com/problems/palindrome-number">https://leetcode.com/problems/palindrome-number</a>                                                                       |
| <b>Valid Perfect Square</b>                                 | <a href="https://leetcode.com/problems/valid-perfect-square">https://leetcode.com/problems/valid-perfect-square</a>                                                                 |
| <b>Count the Digits That Divide a Number</b>                | <a href="https://leetcode.com/problems/count-the-digits-that-divide-a-number">https://leetcode.com/problems/count-the-digits-that-divide-a-number</a>                               |
| <b>Subtract the Product and Sum of Digits of an Integer</b> | <a href="https://leetcode.com/problems/subtract-the-product-and-sum-of-digits-of-an-integer">https://leetcode.com/problems/subtract-the-product-and-sum-of-digits-of-an-integer</a> |
| <b>Three Divisors</b>                                       | <a href="https://leetcode.com/problems/three-divisors">https://leetcode.com/problems/three-divisors</a>                                                                             |
| <b>Smallest Even Multiple</b>                               | <a href="https://leetcode.com/problems/smallest-even-multiple">https://leetcode.com/problems/smallest-even-multiple</a>                                                             |
| <b>Happy Number</b>                                         | <a href="https://leetcode.com/problems/happy-number">https://leetcode.com/problems/happy-number</a>                                                                                 |
| <b>Ugly Number</b>                                          | <a href="https://leetcode.com/problems/ugly-number">https://leetcode.com/problems/ugly-number</a>                                                                                   |
| <b>Power of Two</b>                                         | <a href="https://leetcode.com/problems/power-of-two">https://leetcode.com/problems/power-of-two</a>                                                                                 |

|                                            |                                                                                                                                                                   |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Power of Three</b>                      | <a href="https://leetcode.com/problems/power-of-three">https://leetcode.com/problems/power-of-three</a>                                                           |
| <b>Power of Four</b>                       | <a href="https://leetcode.com/problems/power-of-four">https://leetcode.com/problems/power-of-four</a>                                                             |
| <b>Arranging Coins</b>                     | <a href="https://leetcode.com/problems/arranging-coins">https://leetcode.com/problems/arranging-coins</a>                                                         |
| <b>Excel Sheet Column Title</b>            | <a href="https://leetcode.com/problems/excel-sheet-column-title">https://leetcode.com/problems/excel-sheet-column-title</a>                                       |
| <b>Excel Sheet Column Number</b>           | <a href="https://leetcode.com/problems/excel-sheet-column-number">https://leetcode.com/problems/excel-sheet-column-number</a>                                     |
| <b>Maya</b>                                |                                                                                                                                                                   |
| <b>Integer Division</b>                    | <a href="https://maya.technicalhub.io/owl-program-details/6694b1ef519a4355f15c590f">https://maya.technicalhub.io/owl-program-details/6694b1ef519a4355f15c590f</a> |
| <b>Area of a Circle</b>                    | <a href="https://maya.technicalhub.io/owl-program-details/6694b694519a4355f15ca75f">https://maya.technicalhub.io/owl-program-details/6694b694519a4355f15ca75f</a> |
| <b>Compound interest</b>                   | <a href="https://maya.technicalhub.io/owl-program-details/6694bce1d5d1d7533859f1d8">https://maya.technicalhub.io/owl-program-details/6694bce1d5d1d7533859f1d8</a> |
| <b>Simple Interest</b>                     | <a href="https://maya.technicalhub.io/owl-program-details/6694bfb7d5d1d7533859f3ae">https://maya.technicalhub.io/owl-program-details/6694bfb7d5d1d7533859f3ae</a> |
| <b>Neon Number</b>                         | <a href="https://maya.technicalhub.io/owl-program-details/668b6b34d24b0e6bee8982b0">https://maya.technicalhub.io/owl-program-details/668b6b34d24b0e6bee8982b0</a> |
| <b>Nearest Fibonacci</b>                   | <a href="https://maya.technicalhub.io/owl-program-details/668b7ce1126457fcee5c8de6">https://maya.technicalhub.io/owl-program-details/668b7ce1126457fcee5c8de6</a> |
| <b>Reverse Integer</b>                     | <a href="https://maya.technicalhub.io/owl-program-details/668b6e86d24b0e6bee89a871">https://maya.technicalhub.io/owl-program-details/668b6e86d24b0e6bee89a871</a> |
| <b>Amicable Numbers</b>                    | <a href="https://maya.technicalhub.io/owl-program-details/668b7461126457fcee5c4679">https://maya.technicalhub.io/owl-program-details/668b7461126457fcee5c4679</a> |
| <b>Automorphic Number</b>                  | <a href="https://maya.technicalhub.io/owl-program-details/668cff57aa293a75dcf28f92">https://maya.technicalhub.io/owl-program-details/668cff57aa293a75dcf28f92</a> |
| <b>Unique Number</b>                       | <a href="https://maya.technicalhub.io/owl-program-details/668d0275aa293a75dcf2c620">https://maya.technicalhub.io/owl-program-details/668d0275aa293a75dcf2c620</a> |
| <b>Pronic Number or Heteromecic Number</b> | <a href="https://maya.technicalhub.io/owl-program-details/6694fe34e0258d3db2167aa9">https://maya.technicalhub.io/owl-program-details/6694fe34e0258d3db2167aa9</a> |

|                            | <b>Maya</b> | <b>Code chef</b> | <b>Hacker rank</b> | <b>Leet code</b> | <b>Geeksfor Geeks</b> | <b>Total</b> |
|----------------------------|-------------|------------------|--------------------|------------------|-----------------------|--------------|
| <b>Unit-1</b>              | 4           | 3                | 3                  | 0                | 0                     | 10           |
| <b>Unit-2</b>              | 0           | 1                | 1                  | 5                | 0                     | 7            |
| <b>Unit-3</b>              | 0           | 2                | 0                  | 2                | 1                     | 5            |
| <b>Unit-4</b>              | 0           | 4                | 2                  | 0                | 0                     | 6            |
| <b>Unit-5</b>              | 0           | 3                | 2                  | 0                | 0                     | 5            |
| <b>Additional Programs</b> | 11          | 16               | 0                  | 16               | 0                     | 43           |
| <b>Total</b>               | <b>16</b>   | <b>29</b>        | <b>8</b>           | <b>23</b>        | <b>1</b>              | <b>76</b>    |



**Computer Organization & Architecture**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Semester:</b>             | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501CS71</b> | <b>2</b> | <b>1</b> | <b>0</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Describe the basic structure of a computer system, various number systems and arithmetic operations.
- CO2:** Explain the Operation of CPUs including RTL, ALU, Instruction Cycle and Buses
- CO3:** Demonstrate the architecture and functionality of central processing unit
- CO4:** Illustrate the I/O and memory organization in an efficient way.
- CO5:** Make use of multi processors and pipelining to improve the efficiency of computer system.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 1    | -    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO2</b> | 2    | 1    | -    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO3</b> | 3    | 1    | -    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO4</b> | 2    | 1    | -    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO5</b> | 3    | 2    | -    | -    | 3    | -    | -    | -    | -    | -     | -     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO / PSO   | PSO | PSO 2 |
|------------|-----|-------|
| <b>CO1</b> | 2   |       |
| <b>CO2</b> | 2   |       |
| <b>CO3</b> | 2   |       |
| <b>CO4</b> | 2   |       |
| <b>CO5</b> | 3   |       |

**UNIT – I**

**Basic Structure of Computers:** Basic Organization of Computers, Historical Perspective, Bus Structures. Data Representation: Data types, Complements, Fixed Point Representation. Floating – Point Representation. Other Binary Codes, Error Detection Codes. Computer **Arithmetic:** Addition and Subtraction, Multiplication Algorithms, Division Algorithms.

**UNIT – II**

**Register Transfer Language and Microoperations:** Register Transfer language. Register Transfer Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit

**Basic Computer Organization and Design:** Instruction Codes, Computer Register, Computer Instructions, Instruction Cycle, Memory – Reference Instructions. Input – Output and Interrupt, Complete Computer Description.

### UNIT – III

**Central Processing Unit:** General Register Organization, STACK Organization. Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.  
**Microprogrammed Control:** Control Memory, Address Sequencing, Micro Program example, Design of Control Unit.

### UNIT – IV

**Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.  
**Input-Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupts, Direct Memory Access.

### UNIT – V

**Multi Processors:** Introduction, Characteristics of Multiprocessors, Interconnection Structures, Inter Processor Arbitration.  
**Pipeline:** Parallel Processing, Pipelining, Instruction Pipeline, RISC Pipeline, Array Processor.

#### Text Books:

- 1 Computer System Architecture, M. Morris Mano, Third Edition, Pearson, 2008.
- 2 Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 5/e, McGraw Hill, 2002.

#### Reference Books:

- 1 Computer Organization and Architecture, William Stallings, 6/e, Pearson, 2006.
- 2 Structured Computer Organization, Andrew S. Tanenbaum, 4/e, Pearson, 2005.
- 3 Fundamentals of Computer Organization and Design, Sivarama P. Dandamudi, Springer, 2006

#### Web Links:

- 1 <https://nptel.ac.in/courses/106/105/106105163/>
- 2 <https://nptel.ac.in/courses/106/106/106106092/>
- 3 <https://www.udemy.com/course/computer-architecture-computer-organization-course/>
- 4 <http://www.cuc.ucc.ie/CS1101/David%20Tarnoff.pdf>

**Discrete Mathematics**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501MA08</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>1</b> | <b>0</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Apply the principles of mathematical logic to statement calculus and predicate calculus.
- CO2:** Compute transitive closure, equivalence classes of binary relations.
- CO3:** Apply basic counting techniques to solve the combinatorial problems.
- CO4:** Solve recurrence relations by various methods.
- CO5:** Apply the concepts of Graph theory to find Euler paths, Hamiltonian paths and demonstrate different traversal methods for trees.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 3    | 2    |      |      |      |      |      |      |      |       |       |
| CO2   | 3    | 2    |      |      |      |      |      |      |      |       |       |
| CO3   | 2    | 3    |      |      |      |      |      |      |      |       |       |
| CO4   | 3    | 2    |      |      |      |      |      |      |      |       |       |
| CO5   | 3    | 2    |      |      |      |      |      |      |      |       |       |

**UNIT – I**

**Logic:** Propositional Logic: Statements and logical connectives, Well-Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus. Predicate Logic: Statement Functions, Variables, and Quantifiers; Inference Theory for Predicate Calculus.

**Practice(Using any computational tool):** Construct the truth table calculator taking two inputs, P and Q, and calculate AND, OR and NOT.

**UNIT – II**

**Relations:** Properties of Binary Relations, Relation Matrix, Digraph, Operations on Relations, Partition and Covering, Transitive, Closure, Warshall Algorithm, Equivalence Relation, R-Equivalence Class, partially ordered sets, Hasse Diagrams.

**UNIT – III**

**Combinatorics:** Basis of Counting, Permutations, Permutations with Repetitions, Circular and Restricted Permutations, Combinations, Restricted Combinations, Binomial and Multinomial Coefficients and Theorems.

## UNIT – IV

**Recurrence Relations:** Formation of Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots.

**Practice(Using any computational tool:** Compute the nth Fibonacci number.

## UNIT – V

**Graph Theory:** Basic Concepts of Graphs, Matrix Representation of Graphs: Adjacency Matrix, Incidence Matrix, Isomorphic Graphs, Paths and Circuits, Euler and Hamilton Graphs, Planar Graphs, and Euler's Formula. **Trees:** Tree Properties, Spanning Trees, BFS Algorithm, DFS Algorithm, Minimal Spanning Trees, and Kruskal's Algorithm, Graph coloring, chromatic number.

**Practice(Using any computational tool):** BFS and DFS algorithms.

### Text Books:

- Discrete Mathematics and its Applications with Combinatorics and Graph Theory,  
1 Kenneth H. Rosen, McGraw Hill Education (India) Private Limited, ISBN : 9780070681880.
- 2 Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay and R. Manohar, Tata Mc Graw Hill, ISBN 978-0074631133

### Reference Books:

- 1 Discrete Mathematical Structures, Bernard Kolman, Robert C. Busby and Sharon Cutler Ross, PHI. ISBN 978-9332549593.
- 2 Mathematical Foundations of Computer Science, S. Santha, E. V. Prasad, Cengage Publishers, ISBN 978-8131515938.

### Web Links:

- 1 <http://nptel.ac.in/courses/106106094/>
- 2 <http://mathworld.wolfram.com/classroom/classes/DiscreteMathematics.html>
- 3 <http://mathworld.wolfram.com/topics/GeneralLogic.html>
- 4 <https://ggc-discrete-math.github.io/>

## Object Oriented Programming through C++ (Common to CSE, IT, AIML & CSE(DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501CS08</b> | <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Make use of C and C++ programming constructs to demonstrate OOP concepts
- CO2:** Develop applications using constructor and destructor.
- CO3:** Apply C++ features for problem solving.
- CO4:** Apply inheritance concepts and file I/O to solve a given problem.
- CO5:** Design C++ classes using templates and STL.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 1    | 2    |      |      |      |      | 1    | 1    |       |       |
| CO2   | 1    | 2    | 2    |      |      |      |      | 1    | 1    |       |       |
| CO3   | 1    | 1    | 1    |      |      |      |      | 1    | 1    |       |       |
| CO4   | 1    | 1    | 2    |      |      |      |      | 1    | 1    |       |       |
| CO5   | 2    | 1    | 2    |      |      |      |      | 1    | 1    |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    |      |
| CO2    | 2    |      |
| CO3    | 2    |      |
| CO4    | 2    |      |
| CO5    | 2    |      |

### UNIT – I

**Introduction to C++:** Differences between C and C++, Disadvantages of Conventional Programming, Evolution of C++, Key Concepts of Object Oriented Programming, Structure of C++ program, Advantages of OOP, scope resolution Operator, Namespace

#### Practice:

7. Find the roots of a quadratic equation.
8. Find factorial of a given number using recursion
9. Implement scope resolution and namespaces.
10. Illustrate the use of default arguments and access specifiers

#### Coding Practice:

1. Palindrome Number  
Link: <https://leetcode.com/problems/palindrome-number/description/>
2. First n Fibonacci

Link: <https://www.geeksforgeeks.org/problems/print-first-n-fibonacci-numbers1002/1?page=1&category=Dynamic%20Programming&sortBy=submissions>

## UNIT – II

**Classes and Objects:** Declaring Objects- Access Specifiers and their Scope, Defining Member Function, Rules for Inline Functions, static Member Variable, static Member Function, Friend functions, overloading Member Function, Array of Objects, Object as Parameter, Object as return type, Nested class. Introduction to Constructors and Destructor, Characteristics of Constructor and Destructor, Application with Constructor, Constructor with Arguments, Copy Constructor, Destructors, Anonymous Objects.

### Practice:

1. Program to illustrate inline functions and function overloading.
2. Program to illustrate friend function
3. Program to illustrate the use of Constructors and Destructors.
4. Program illustrating Constructor overloading.
5. Program illustrating Copy Constructor.

### Coding Practice

1. Function With No Argument

Link: <https://www.geeksforgeeks.org/problems/function-with-no-arguments-1605703188/1?page=3&category=CPP&sortBy=submissions>

2. Sum of all array elements

Link: <https://www.geeksforgeeks.org/problems/sum-all-array-elements/1?page=4&category=CPP&sortBy=submissions>

3. Class

Link: <https://www.hackerrank.com/challenges/c-tutorial-class/problem?isFullScreen=true>

4. Class and Objects

Link: <https://www.hackerrank.com/challenges/classes-objects/problem?isFullScreen=true>

## UNIT – III

**Operator Overloading:** Introduction, The Keyword Operator, Rules for Overloading Operators, Overloading Unary Operator, Overloading Binary Operator, Overloading using friend function.

**Inheritance:** Introduction, Reusability, Types of Inheritance, Virtual Base Classes, Object as a Class Member, Abstract Classes, Advantages and Disadvantages of Inheritance. Pointer to Class- Pointer Object, this Pointer, Pointer to Derived Classes and Base Class.

**Binding Polymorphisms and Virtual Functions:** Introduction, Binding in C++, Virtual Functions, Rules for Virtual Function, Abstract classes, Virtual Destructor

### Practice:

1. Overload Unary, and Binary Operators using member function.

2. Overload Unary, and Binary Operators using friend function.
3. Incorporate various forms of Inheritance i. Single Inheritance ii. Multiple Inheritances  
iii. Multi-level inheritance iv. Hierarchical Inheritance v. Hybrid inheritance
4. Order of execution of constructors and destructors in inheritance.
5. Illustrate the use of object as a class member, pointer to a class, this pointer and Virtual Base Class.
6. Illustrate virtual functions.
7. Implement pure virtual function and calculate the area of different shapes by using abstract class.

### Coding Practice:

1. Inheritance  
Link: <https://www.hackerrank.com/challenges/inheritance-introduction/problem?isFullScreen=true>
2. Pointer  
Link: <https://www.hackerrank.com/challenges/c-tutorial-pointer/problem?isFullScreen=true>
3. Virtual Functions  
Link: <https://www.hackerrank.com/challenges/virtual-functions/problem?isFullScreen=true>
4. Operator Overloading

Link: <https://www.hackerrank.com/challenges/operator-overloading/problem?isFullScreen=true>

## UNIT – IV

**Generic Programming with Templates:** Introduction, Need for Templates, Definition of class Templates, Normal Function Templates, Overloading of Template Function, Bubble Sort Using Function Templates, Difference between Templates and Macros, Linked list with templates

### Practice:

1. Illustrate the use of function template.
2. Implement template class.
3. Implement class templates with multiple parameters.

### Coding Practice:

1. C++ Class Templates  
Link: <https://www.hackerrank.com/challenges/cpp-class-template-specialization/problem?isFullScreen=true>

## UNIT – V

**Exception Handling:** Introduction, Principles of Exception Handling, The Keywords try throw and catch, Multiple Catch Statements.

Files: Stream I/O ,Reading and writing to Files.

Overview of Standard Template Library: Introduction, STL Programming Model, Containers, Sequence Containers, Associative Containers, Algorithms, Iterators, Vectors, Lists, Maps

Practice:

1. Implement Exceptions handling.
2. Illustrate the use of multiple catch statements.
3. Implement List, Vector and its Operations.
4. Implement Deque and its Operations.
5. Implement Map and its Operations.

### Coding Practice:

#### 1. Exception Handling

Link: <https://www.hackerrank.com/challenges/cpp-exception-handling/problem?isFullScreen=true>

#### 2. C++ STL(Vector)

Link: <https://www.geeksforgeeks.org/problems/c-stl-set-1-vector/1?page=5&category=CPP&sortBy=submissions>

#### 3. Binary Search Tree Iterator

Link: <https://leetcode.com/problems/binary-search-tree-iterator/?envType=problem-list-v2&envId=iterator>

### Text Books:

- 1 The Complete Reference C++, Herbert Schildt, TMH, Fourth Edition, ISBN-10. 0070411832.
- 2 The C++ Programming Language, Bjarne Stroustrup, Pearson, Fourth Edition, ISBN · 9780133522884.

### Reference Books:

- 1 A First Book Of C++, Gary Bronson, Cengage Learning, Fourth Edition. ISBN-13. 978-8131532713
- 2 C++ Primer Plus By Stephen Prata, Pearson, Sixth Edition. ISBN: 978-0321776402
- 3 C++ Programming:From Problem Analysis To Program Design, Ds Malik , Cengage Learning, Eighth Edition. ISBN: 9781337102087

### Web Links:

- 1 <http://nptel.ac.in/courses/106105151/>
- 2 <http://www.geeksforgeeks.org/c-plus-plus/>
- 3 [https://infyspringboard.onwingspan.com/web/en/viewer/html/lex\\_auth\\_01350157284861542410101](https://infyspringboard.onwingspan.com/web/en/viewer/html/lex_auth_01350157284861542410101)
- 4 <https://www.udemy.com/course/beginning-c-plus-plus-programming/>



**Additional Practice:**

|    | <b>Problem Name</b>       | <b>Link</b>                                                                                                                                                                       |
|----|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Hello World               | <a href="https://www.hackerrank.com/challenges/cpp-hello-world/problem">https://www.hackerrank.com/challenges/cpp-hello-world/problem</a>                                         |
| 2  | Input & Output            | <a href="https://www.hackerrank.com/challenges/cpp-input-and-output/problem">https://www.hackerrank.com/challenges/cpp-input-and-output/problem</a>                               |
| 3  | If-Else                   | <a href="https://www.hackerrank.com/challenges/c-tutorial-conditional-if-else/problem">https://www.hackerrank.com/challenges/c-tutorial-conditional-if-else/problem</a>           |
| 4  | For Loop                  | <a href="https://www.hackerrank.com/challenges/c-tutorial-for-loop/problem">https://www.hackerrank.com/challenges/c-tutorial-for-loop/problem</a>                                 |
| 5  | Functions                 | <a href="https://www.hackerrank.com/challenges/c-tutorial-functions/problem">https://www.hackerrank.com/challenges/c-tutorial-functions/problem</a>                               |
| 6  | String Basics             | <a href="https://www.hackerrank.com/challenges/c-tutorial-strings/problem">https://www.hackerrank.com/challenges/c-tutorial-strings/problem</a>                                   |
| 7  | CamelCase                 | <a href="https://www.hackerrank.com/challenges/camelcase/problem">https://www.hackerrank.com/challenges/camelcase/problem</a>                                                     |
| 8  | StringStream              | <a href="https://www.hackerrank.com/challenges/c-tutorial-stringstream/problem">https://www.hackerrank.com/challenges/c-tutorial-stringstream/problem</a>                         |
| 9  | Array Introduction        | <a href="https://www.hackerrank.com/challenges/arrays-introduction/problem">https://www.hackerrank.com/challenges/arrays-introduction/problem</a>                                 |
| 10 | Vector Sort               | <a href="https://www.hackerrank.com/challenges/vector-sort/problem">https://www.hackerrank.com/challenges/vector-sort/problem</a>                                                 |
| 11 | Vector Erase              | <a href="https://www.hackerrank.com/challenges/vector-erase/problem">https://www.hackerrank.com/challenges/vector-erase/problem</a>                                               |
| 12 | Sets                      | <a href="https://www.hackerrank.com/challenges/cpp-sets/problem">https://www.hackerrank.com/challenges/cpp-sets/problem</a>                                                       |
| 13 | Maps                      | <a href="https://www.hackerrank.com/challenges/cpp-maps/problem">https://www.hackerrank.com/challenges/cpp-maps/problem</a>                                                       |
| 14 | Deque                     | <a href="https://www.hackerrank.com/challenges/deque-stl/problem">https://www.hackerrank.com/challenges/deque-stl/problem</a>                                                     |
| 15 | Lower Bound               | <a href="https://www.hackerrank.com/challenges/cpp-lower-bound/problem">https://www.hackerrank.com/challenges/cpp-lower-bound/problem</a>                                         |
| 16 | Classes                   | <a href="https://www.hackerrank.com/challenges/c-tutorial-class/problem">https://www.hackerrank.com/challenges/c-tutorial-class/problem</a>                                       |
| 17 | Structs                   | <a href="https://www.hackerrank.com/challenges/c-tutorial-struct/problem">https://www.hackerrank.com/challenges/c-tutorial-struct/problem</a>                                     |
| 18 | Virtual Functions         | <a href="https://www.hackerrank.com/challenges/virtual-functions/problem">https://www.hackerrank.com/challenges/virtual-functions/problem</a>                                     |
| 19 | Inheritance Introduction  | <a href="https://www.hackerrank.com/challenges/inheritance-introduction/problem">https://www.hackerrank.com/challenges/inheritance-introduction/problem</a>                       |
| 20 | Pointer Basics            | <a href="https://www.hackerrank.com/challenges/c-tutorial-pointer/problem">https://www.hackerrank.com/challenges/c-tutorial-pointer/problem</a>                                   |
| 21 | Intro to Sorting          | <a href="https://www.hackerrank.com/challenges/tutorial-intro/problem">https://www.hackerrank.com/challenges/tutorial-intro/problem</a>                                           |
| 22 | Mark and Toys             | <a href="https://www.hackerrank.com/challenges/mark-and-toys/problem">https://www.hackerrank.com/challenges/mark-and-toys/problem</a>                                             |
| 23 | Time Conversion           | <a href="https://www.hackerrank.com/challenges/time-conversion/problem">https://www.hackerrank.com/challenges/time-conversion/problem</a>                                         |
| 24 | Linked List Basics        | <a href="https://www.hackerrank.com/challenges/print-the-elements-of-a-linked-list/problem">https://www.hackerrank.com/challenges/print-the-elements-of-a-linked-list/problem</a> |
| 25 | Tree Height               | <a href="https://www.hackerrank.com/challenges/tree-height-of-a-binary-tree/problem">https://www.hackerrank.com/challenges/tree-height-of-a-binary-tree/problem</a>               |
| 26 | Interview Kit             | <a href="https://www.hackerrank.com/interview/interview-preparation-kit">https://www.hackerrank.com/interview/interview-preparation-kit</a>                                       |
| 27 | FLOW001 - Add Two Numbers | <a href="https://www.codechef.com/problems/FLOW001">https://www.codechef.com/problems/FLOW001</a>                                                                                 |
| 28 | FLOW002 - Find Remainder  | <a href="https://www.codechef.com/problems/FLOW002">https://www.codechef.com/problems/FLOW002</a>                                                                                 |
| 29 | HS08TEST - ATM            | <a href="https://www.codechef.com/problems/HS08TEST">https://www.codechef.com/problems/HS08TEST</a>                                                                               |
| 30 | INTEST - Input Test       | <a href="https://www.codechef.com/problems/INTEST">https://www.codechef.com/problems/INTEST</a>                                                                                   |
| 31 | FSQRT - Square Root       | <a href="https://www.codechef.com/problems/FSQRT">https://www.codechef.com/problems/FSQRT</a>                                                                                     |
| 32 | AMR15A - Mahasena         | <a href="https://www.codechef.com/problems/AMR15A">https://www.codechef.com/problems/AMR15A</a>                                                                                   |

|    |                                 |                                                                                                                                             |
|----|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 33 | FLOW004 - Reverse Number        | <a href="https://www.codechef.com/problems/FLOW004">https://www.codechef.com/problems/FLOW004</a>                                           |
| 34 | LAPIN - Lapindrome              | <a href="https://www.codechef.com/problems/LAPIN">https://www.codechef.com/problems/LAPIN</a>                                               |
| 35 | MUFFINS3 - Muffins              | <a href="https://www.codechef.com/problems/MUFFINS3">https://www.codechef.com/problems/MUFFINS3</a>                                         |
| 36 | RECIPE - Recipe                 | <a href="https://www.codechef.com/problems/RECIPE">https://www.codechef.com/problems/RECIPE</a>                                             |
| 37 | Two Sum                         | <a href="https://leetcode.com/problems/two-sum/">https://leetcode.com/problems/two-sum/</a>                                                 |
| 38 | Palindrome Number               | <a href="https://leetcode.com/problems/palindrome-number/">https://leetcode.com/problems/palindrome-number/</a>                             |
| 39 | Roman to Integer                | <a href="https://leetcode.com/problems/roman-to-integer/">https://leetcode.com/problems/roman-to-integer/</a>                               |
| 40 | Valid Parentheses               | <a href="https://leetcode.com/problems/valid-parentheses/">https://leetcode.com/problems/valid-parentheses/</a>                             |
| 41 | Merge Two Sorted Lists          | <a href="https://leetcode.com/problems/merge-two-sorted-lists/">https://leetcode.com/problems/merge-two-sorted-lists/</a>                   |
| 42 | Maximum Subarray                | <a href="https://leetcode.com/problems/maximum-subarray/">https://leetcode.com/problems/maximum-subarray/</a>                               |
| 43 | Plus One                        | <a href="https://leetcode.com/problems/plus-one/">https://leetcode.com/problems/plus-one/</a>                                               |
| 44 | Climbing Stairs                 | <a href="https://leetcode.com/problems/climbing-stairs/">https://leetcode.com/problems/climbing-stairs/</a>                                 |
| 45 | Best Time to Buy and Sell Stock | <a href="https://leetcode.com/problems/best-time-to-buy-and-sell-stock/">https://leetcode.com/problems/best-time-to-buy-and-sell-stock/</a> |
| 46 | Binary Tree Inorder Traversal   | <a href="https://leetcode.com/problems/binary-tree-inorder-traversal/">https://leetcode.com/problems/binary-tree-inorder-traversal/</a>     |

|                            | Aditya's Internal Coding Platform (Maya) | Code chef/greek for greeks | Hacker rank | Leet code | Total     |
|----------------------------|------------------------------------------|----------------------------|-------------|-----------|-----------|
| <b>Unit-1</b>              | 0                                        | 1                          | 0           | 1         | <b>2</b>  |
| <b>Unit-2</b>              | 0                                        | 2                          | 2           | 0         | <b>4</b>  |
| <b>Unit-3</b>              | 0                                        | 0                          | 4           | 0         | <b>4</b>  |
| <b>Unit-4</b>              | 0                                        | 0                          | 1           | 0         | <b>1</b>  |
| <b>Unit-5</b>              | 0                                        | 1                          | 1           | 1         | <b>3</b>  |
| <b>Additional Practice</b> | 0                                        | 10                         | 26          | 10        | <b>46</b> |
| <b>Total</b>               | <b>0</b>                                 | <b>14</b>                  | <b>34</b>   | <b>12</b> | <b>60</b> |

## Theory of Computation (Common to CSE&IT)

**Course Code: 2501CS11**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>1</b> | <b>0</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Apply the properties of languages and automata to solve a given problem.
- CO2:** Construct an automata for a given language.
- CO3:** Design grammars for a given language.
- CO4:** Apply interconversion on automata, grammar and regular expressions.
- CO5:** Analyze decidability and undecidability problems.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    |      | 1    |      |      |      |      |      |      |       |       |
| <b>CO2</b> | 1    | 2    | 1    |      |      |      |      |      |      |       |       |
| <b>CO3</b> | 1    | 2    | 1    |      |      |      |      |      |      |       |       |
| <b>CO4</b> | 3    |      |      |      |      |      |      |      |      |       |       |
| <b>CO5</b> | 2    | 2    |      | 2    |      |      |      |      |      |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 2    |      |

## UNIT – I

**Finite Automata:** Need of Automata theory, Central Concepts of Automata Theory, Automation, Finite Automata, Transition Systems, Acceptance of a String, DFA, Design of DFAs, NFA, Design of NFA, Equivalence of DFA and NFA, Conversion of NFA into DFA, Finite Automata with  $\epsilon$ -Transitions, Minimization of Finite Automata, Finite Automata with output-Mealy and Moore Machines, Applications and Limitation of Finite Automata.

## UNIT – II

Regular Expressions, Regular Sets, Identity Rules, Equivalence of two RE, Manipulations of REs, Finite Automata and Regular Expressions, Inter Conversion, Equivalence between FA and RE, Pumping Lemma of Regular Sets, Closure Properties of Regular Sets, Grammars, Classification of Grammars, Chomsky Hierarchy Theorem, Right and Left Linear Regular Grammars, Equivalence between RG and FA, Inter Conversion.

### UNIT – III

Formal Languages, Context Free Grammar, Leftmost and Rightmost Derivations, Parse Trees, Ambiguous Grammars, Simplification of Context Free Grammars-Elimination of Useless Symbols,  $\epsilon$ -Productions and Unit Productions, Normal Forms-Chomsky Normal form and Greibach Normal Form, Pumping Lemma, Closure Properties, Applications of Context Free Grammars.

### UNIT – IV

Pushdown Automata, Definition, Model, Graphical Notation, Instantaneous Description, Language Acceptance of Pushdown Automata, Design of Pushdown Automata, Deterministic and Non – Deterministic Pushdown Automata, Equivalence of Pushdown Automata and Context Free Grammars, Conversion, Two Stack Pushdown Automata, Application of Pushdown Automata.

### UNIT – V

**Turing Machine:** Definition, Model, Representation of TMs-Instantaneous Descriptions, Transition Tables and Transition Diagrams, Language of a TM, Design of TMs, Types of TMs, Church's Thesis, Universal and Restricted TM, Decidable and Un-decidable Problems, Halting Problem of TMs, Post's Correspondence Problem, Modified PCP, Classes of P and NP, NP-Hard and NP-Complete Problems.

#### Text Books:

- 1 Introduction to Automata Theory, Languages and Computation, J. E. Hopcroft, R. Motwani and J. D. Ullman, 3rd Edition, Pearson, 2008 ISBN: 978-8131720479
- 2 Theory of Computer Science-Automata, Languages and Computation, K. L. P. Mishra and N. Chandrasekharan, 3rd Edition, PHI, 2007 ISBN: 978-8120329683

#### Reference Books:

- 1 Elements of Theory of Computation, Lewis H.P. & Papadimitriou C.H., Pearson /PHI ISBN: 978-0132624787
- 2 Theory of Automata, Languages and Computation, Rajendra Kumar, McGraw Hill, 2014 ISBN: 978-0070702042

#### Web Links:

- 1 <http://nptel.ac.in/courses/111103016>
- 2 <https://archive.nptel.ac.in/courses/106/104/106104148/>
- 3 <https://www.iitg.ac.in/dgoswami/Flat-Notes.pdf>
- 4 <https://www.ics.uci.edu/~goodrich/teach/cs162/notes/>
- 5 <https://www.geeksforgeeks.org/introduction-of-finite-automata/>

## Database Management Systems

(Common to CSE, IT, AIML & CSE (DS))

**Course Code:** 2501IT05

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Describe the Fundamental concepts of DBMS.
- CO2:** Interpret relational database using SQL.
- CO3:** Make use of normalization techniques for database design.
- CO4:** Illustrate the mechanisms of transaction management.
- CO5:** Optimize database performance with advanced indexing, query optimization, and robust backup and recovery strategies.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO2</b> | 2    | 3    | 2    |      |      |      |      |      |      |       |       |
| <b>CO3</b> | 3    |      | 2    |      |      |      |      |      |      |       |       |
| <b>CO4</b> |      | 2    | 3    |      |      |      |      |      |      |       |       |
| <b>CO5</b> |      |      | 3    | 3    | 2    |      |      |      |      |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> |      | 3    |
| <b>CO3</b> | 3    |      |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> | 3    |      |

### UNIT – I

**Introduction to DBMS:** History and Architecture, Need and Purpose of DBMS, Applications of DBMS, Data and Metadata, Levels of abstraction, Three-Schema Architecture, structure of DBMS, Database Users & Roles of DBA, Basics of Parallel and Distributed Databases, Specialty Databases – Spatial, Temporal, Multimedia, NoSQL.

**View of Data :** Concepts of Schema, Data Models (Relational, ER, Object-based, Semi-structured), Steps in Database Design, Database system environment, Centralized and Client Server architecture for the database.

#### Practice

1. Familiarization with installation of DBMS (Oracle 10g).
2. Draw the schema model for a University Database System by identifying the main entities using draw.io/diagrams.net or any similar tool.

### UNIT – II

**Introduction to the Relational Model:** Structure of Relational Model, concepts of domain, attribute, tuple, relation, Database Schema and Schema Diagrams, Keys in Relational Model: Primary, Candidate, Alternate, Foreign, Importance and Handling of NULL Values, Relational Algebra: Fundamental Operations.

**Basic SQL:** Data types, table definitions (create, alter), DML operations (insert, delete, update), basic SQL querying (select, where clause, projection), arithmetic&logical operations, SQL functions, Introduction to GROUP BY and HAVING clauses.

#### Practice

1. Querying and modifying the database using Data Manipulation Language commands - select, insert, update, delete.
2. Implementation of SQL Functions –Use group-by and having clause.
  - Find Customer Referee using DML Operations
    - <https://leetcode.com/problems/find-customer-referee/description/?envType=study-plan-v2&envId=top-sql-50>
  - Average Time of Process per Machine using aggregate functions.
    - <https://leetcode.com/problems/average-time-of-process-per-machine/description/?envType=study-plan-v2&envId=top-sql-50>
  - DML Operations on given schema
    - <https://www.hackerrank.com/challenges/revising-the-select-query-2/problem?isFullScreen=true>
  - Aggregate Operators
    - <https://www.hackerrank.com/challenges/earnings-of-employees/problem?isFullScreen=true>
  - Basic Queries for salaries of employees
    - <https://www.hackerrank.com/challenges/salary-of-employees/problem?isFullScreen=true>

### UNIT – III

**ER Model** – Introduction to entities, attributes, entity sets, relationships, relationship sets, constraints. Specialization, generalization, inheritance, subclasses and super classes using ER diagrams.

**Advanced SQL** – Creating tables with relationships, implementing key and integrity constraints, nested and correlated subqueries, grouping, aggregation, ordering, different types of joins (natural, equi, outer, left, right, inner), views (updatable and non-updatable), relational set operations.

#### Practice:

1. Perform join operations: natural, equi-join, outer join, left, right, inner; assess query performance.
2. Perform set operations: union, intersection, difference.
3. Implement nested and correlated subqueries.
4. Creating and querying views and materialized views.
- Queries using join operations Ex: Product Sales Analysis I
  - <https://leetcode.com/problems/product-sales-analysis-i/description/?envType=study-plan-v2&envId=top-sql-50>
- Queries using Nested queries. Ex: Employees Whose Manager Left the Company
  - <https://leetcode.com/problems/employees-whose-manager-left-the-company/description/?envType=study-plan-v2&envId=top-sql-50>
- Queries using join operations
  - <https://leetcode.com/problems/primary-department-for-each-employee/description/?envType=study-plan-v2&envId=top-sql-50>
- Queries challenge the pads problem
  - <https://www.hackerrank.com/challenges/the-pads/problem?isFullScreen=true>
- Queries type of triangle problem

- <https://www.hackerrank.com/challenges/what-type-of-triangle/problem?isFullScreen=true>
- Joins
  - <https://www.hackerrank.com/challenges/the-report/problem?isFullScreen=true>

## UNIT – IV

**Normalization:** Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form (BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF), Fifth Normal Form (5NF).

**Transaction Concept:** Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Storage, Recovery and Atomicity, Recovery algorithm.

### Practice

1. **Implement SQL queries on a normalized database schema** using the given university database structure. The schema consists of the following tables:
  - **Students** (StudentID, StudentName, Major)
  - **Courses** (CourseID, CourseName, Credits)
  - **Enrollments** (StudentID, CourseID, EnrollmentDate)
  - **Instructors** (InstructorID, InstructorName, Phone)
  - **Course\_Instructors** (CourseID, InstructorID)
2. (a) Implementation of Data Control Language commands – grant and revoke.  
 (b) Implementation of Transaction Control Language commands - commit, savepoint, and rollback.
  - Understanding Transaction, Commit and Rollback
    - <https://www.codechef.com/learn/course/sql/SQ00LS10A/problems/TRA01>
  - Queries on normalized database.
    - <https://www.hackerrank.com/challenges/symmetric-pairs/problem?isFullScreen=true>
  - Queries on occupations
    - <https://www.hackerrank.com/challenges/occupations/problem?isFullScreen=true>

## UNIT – V

**Indexing Techniques:** Introduction, B+ Trees: Search, Insert, delete algorithms, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing: Tree base Indexing, Comparison of File Organizations.

**Database Tuning:** Introduction, Database Performance Tuning, Query Optimization: Introduction, Query Optimization algorithms, Backup and Recovery.

### Practice

1. Create a Primary, Secondary Index on a Column.
2. Retrieve Data Using an Index.
3. Insert Data and Update Indexes.
4. Delete Data and Impact on Indexes.

\* **Note:** The student must Complete & Submit a Database Foundations Certificate Course offered by Oracle Academy at the end of the Practice Session.

### Textbooks:

- 1 Database System Concepts ,Abraham Silberschatz, Henry Korth, and S. Sudarshan, McGraw-Hill , 8<sup>th</sup> Edition, ISBN-13: 978-1260230508.
- 2 Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Mc Graw-Hill, 4<sup>th</sup> Edition, ISBN: 978-1260091195.

### Reference Books:

- 1 Database Systems, Ramez Elmasri, Shamkant B. Navathe, 7<sup>th</sup> Edition, Pearson, ISBN: 978-0137504277.
- 2 Database Systems, Carlos Coronel, Steven Morris, Peter Rob, 10<sup>th</sup> Edition, Cengage, ISBN: 978-0357517864.
- 3 Introduction to Database Systems, C J Date, Pearson, 9<sup>th</sup> Edition, ISBN: 978-0133970777.

### Web Links:

- 1 <https://academy.oracle.com/pages/coursedescription/Oracle%20Academy%20Database%20Foundations%20Course%20Description.pdf>
- 2 <https://www.w3schools.com/sql/>
- 3 [https://onlinecourses.nptel.ac.in/noc22\\_cs91/](https://onlinecourses.nptel.ac.in/noc22_cs91/)

### Additional Practice:

| S.No | Difficulty | Problem Name         | Link                                                                                                                                                                                              |
|------|------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.   | Easy       | Select               | <a href="https://www.codechef.com/learn/course/sql/SQ00LS04/problems/GSQ17">https://www.codechef.com/learn/course/sql/SQ00LS04/problems/GSQ17</a>                                                 |
| 2.   | Easy       | DML queries          | <a href="https://leetcode.com/problems/second-highest-salary/description/">https://leetcode.com/problems/second-highest-salary/description/</a>                                                   |
| 3.   | Easy       | Select All           | <a href="https://www.hackerrank.com/challenges/select-all-sql/problem?isFullScreen=true">https://www.hackerrank.com/challenges/select-all-sql/problem?isFullScreen=true</a>                       |
| 4.   | Easy       | Basic employee names | <a href="https://www.hackerrank.com/challenges/name-of-employees/problem?isFullScreen=true">https://www.hackerrank.com/challenges/name-of-employees/problem?isFullScreen=true</a>                 |
| 5.   | Easy       | Aggregate functions  | <a href="https://www.hackerrank.com/challenges/revising-aggregations-sum/problem?isFullScreen=true">https://www.hackerrank.com/challenges/revising-aggregations-sum/problem?isFullScreen=true</a> |
| 6.   | Easy       | Basic SQL Querying   | <a href="https://www.codechef.com/learn/course/sql/SQ00LS04/problems/GSQ21">https://www.codechef.com/learn/course/sql/SQ00LS04/problems/GSQ21</a>                                                 |
| 7.   | Easy       | Basic Join           | <a href="https://www.hackerrank.com/challenges/the-report/problem?isFullScreen=true">https://www.hackerrank.com/challenges/the-report/problem?isFullScreen=true</a>                               |



|    |        |                        |                                                                                                                                                                                                                         |
|----|--------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8. | Easy   | Basic Join             | <a href="https://www.hackerrank.com/challenges/average-population-of-each-continent/problem?isFullScreen=true">https://www.hackerrank.com/challenges/average-population-of-each-continent/problem?isFullScreen=true</a> |
| 9. | Easy   | Views                  | <a href="https://leetcode.com/problems/article-views-i/">https://leetcode.com/problems/article-views-i/</a>                                                                                                             |
| 10 | Easy   | Database Normalization | <a href="https://www.hackerrank.com/challenges/placements/problem?isFullScreen=true">https://www.hackerrank.com/challenges/placements/problem?isFullScreen=true</a>                                                     |
| 11 | Easy   | 1NF                    | <a href="https://www.hackerrank.com/challenges/database-normalization-1-1nf/problem?isFullScreen=true">https://www.hackerrank.com/challenges/database-normalization-1-1nf/problem?isFullScreen=true</a>                 |
| 12 | Easy   | 1NF/2NF/3NF            | <a href="https://www.hackerrank.com/challenges/database-normalization-123nf/problem?isFullScreen=true">https://www.hackerrank.com/challenges/database-normalization-123nf/problem?isFullScreen=true</a>                 |
| 13 | Easy   | 2NF/3NF                | <a href="https://www.hackerrank.com/challenges/database-normalization-4/problem?isFullScreen=true">https://www.hackerrank.com/challenges/database-normalization-4/problem?isFullScreen=true</a>                         |
| 14 | Easy   | Select                 | <a href="https://www.hackerrank.com/challenges/average-population-of-each-continent/problem?isFullScreen=true">https://www.hackerrank.com/challenges/average-population-of-each-continent/problem?isFullScreen=true</a> |
| 15 | Easy   | Select ID              | <a href="https://www.hackerrank.com/challenges/select-by-id/problem?isFullScreen=true">https://www.hackerrank.com/challenges/select-by-id/problem?isFullScreen=true</a>                                                 |
| 16 | Easy   | attributes             | <a href="https://www.hackerrank.com/challenges/japanese-cities-attributes/problem?isFullScreen=true">https://www.hackerrank.com/challenges/japanese-cities-attributes/problem?isFullScreen=true</a>                     |
| 17 | Easy   | Select                 | <a href="https://www.hackerrank.com/challenges/select-by-id/problem?isFullScreen=true">https://www.hackerrank.com/challenges/select-by-id/problem?isFullScreen=true</a>                                                 |
| 18 | Easy   | Select                 | <a href="https://www.hackerrank.com/challenges/weather-observation-station-3/problem?isFullScreen=true">https://www.hackerrank.com/challenges/weather-observation-station-3/problem?isFullScreen=true</a>               |
| 19 | Easy   | Select                 | <a href="https://www.hackerrank.com/challenges/weather-observation-station-1/problem?isFullScreen=true">https://www.hackerrank.com/challenges/weather-observation-station-1/problem?isFullScreen=true</a>               |
| 20 | Easy   | Select                 | <a href="https://www.hackerrank.com/challenges/more-than-75-marks/problem?isFullScreen=true">https://www.hackerrank.com/challenges/more-than-75-marks/problem?isFullScreen=true</a>                                     |
| 21 | Easy   | Indexing               | <a href="https://leetcode.com/problems/create-a-new-column/description/">https://leetcode.com/problems/create-a-new-column/description/</a>                                                                             |
| 22 | Medium | BCNF                   | <a href="https://www.hackerrank.com/challenges/database-normalization-5/problem?isFullScreen=true">https://www.hackerrank.com/challenges/database-normalization-5/problem?isFullScreen=true</a>                         |
| 23 | Medium | 4NF                    | <a href="https://www.hackerrank.com/challenges/database-normalization-10/problem?isFullScreen=true">https://www.hackerrank.com/challenges/database-normalization-10/problem?isFullScreen=true</a>                       |
| 24 | Medium | select                 | <a href="https://www.hackerrank.com/challenges/the-company/problem?isFullScreen=true">https://www.hackerrank.com/challenges/the-company/problem?isFullScreen=true</a>                                                   |
| 25 | Medium | joins                  | <a href="https://www.hackerrank.com/challenges/harry-potter-and-wands/problem?isFullScreen=true">https://www.hackerrank.com/challenges/harry-potter-and-wands/problem?isFullScreen=true</a>                             |
| 26 | medium | Indexing               | <a href="https://leetcode.com/problems/primary-department-for-each-employee/description/">https://leetcode.com/problems/primary-department-for-each-employee/description/</a>                                           |
| 27 | Medium | Group BY               | <a href="https://leetcode.com/problems/product-price-at-a-given-date/description/">https://leetcode.com/problems/product-price-at-a-given-date/description/</a>                                                         |
| 28 | Medium | Group BY               | <a href="https://leetcode.com/problems/group-sold-products-by-the-date/description/">https://leetcode.com/problems/group-sold-products-by-the-date/description/</a>                                                     |
| 29 | Hard   | Delete index           | <a href="https://leetcode.com/problems/delete-duplicate-emails/description/">https://leetcode.com/problems/delete-duplicate-emails/description/</a>                                                                     |
| 30 | Hard   | Insert and update      | <a href="https://leetcode.com/problems/trips-and-users/description/">https://leetcode.com/problems/trips-and-users/description/</a>                                                                                     |
| 31 | Hard   | Insert and update      | <a href="https://leetcode.com/problems/students-and-examinations/description/">https://leetcode.com/problems/students-and-examinations/description/</a>                                                                 |
| 32 | Hard   | Delete index           | <a href="https://leetcode.com/problems/immediate-food-delivery-ii/description/">https://leetcode.com/problems/immediate-food-delivery-ii/description/</a>                                                               |

|    |      |       |                                                                                                                                                                                               |
|----|------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 33 | Hard | Views | <a href="https://www.hackerrank.com/challenges/interviews/problem?isFullScreen=true">https://www.hackerrank.com/challenges/interviews/problem?isFullScreen=true</a>                           |
| 34 | Hard | joins | <a href="https://www.hackerrank.com/challenges/15-days-of-learning-sql/problem?isFullScreen=true">https://www.hackerrank.com/challenges/15-days-of-learning-sql/problem?isFullScreen=true</a> |

|                            | <b>Aditya's Internal Coding Platform (Maya)</b> | <b>Code chef</b> | <b>Hacker rank</b> | <b>Leet code</b> | <b>Total</b> |
|----------------------------|-------------------------------------------------|------------------|--------------------|------------------|--------------|
| <b>Unit-1</b>              | 0                                               | 0                | 0                  | 0                | <b>0</b>     |
| <b>Unit-2</b>              | 0                                               | 0                | 3                  | 2                | <b>5</b>     |
| <b>Unit-3</b>              | 0                                               | 0                | 3                  | 3                | <b>6</b>     |
| <b>Unit-4</b>              | 0                                               | 1                | 2                  | 0                | <b>0</b>     |
| <b>Unit-5</b>              | 0                                               | 0                | 0                  | 0                | <b>0</b>     |
| <b>Additional Practice</b> | 0                                               | 2                | 22                 | 10               | <b>34</b>    |
| <b>Total</b>               | <b>0</b>                                        | <b>3</b>         | <b>30</b>          | <b>15</b>        | <b>45</b>    |

**Engineering Workshop**  
(Common to CE,EEE,ME,ECE,CSE,IT,AIIML,CSE(DS),PT&Min.E)

**Course Code:** 2501ME03

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>1</b> | <b>1</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Prepare various wooden joints.
- CO2:** Demonstrate various sheet metal models.
- CO3:** Develop the basic knowledge of house wiring.
- CO4:** Develop the basic knowledge of plumbing.
- CO5:** Practice various welded joints.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 1    | 1    |      |      |      | 1    | 1    | 2    | 1    |       | 1     |
| CO2   | 1    | 1    |      |      |      | 1    | 1    | 2    | 1    |       | 1     |
| CO3   | 2    | 2    |      |      |      | 1    | 1    | 2    | 1    |       | 1     |
| CO4   | 1    | 2    |      |      |      | 1    | 1    | 2    | 1    |       | 1     |
| CO5   | 2    | 2    |      |      |      | 1    | 1    | 2    | 1    |       | 1     |

**Practice:**

- To make a T-Lap joint from the given wooden workpieces.
- To make a dovetail lap joint from the given wooden workpieces.
- To make a taper tray using the given sheet metal.
- To make a funnel using the given sheet metal.
- To make a square tin using the given sheet metal.
- To connect three bulbs by using series and parallel connections.
- To give connection to a bulb by using staircase wiring.
- To prepare wiring for a tube light with switch control.
- To prepare a PVC pipe joint by using the given circuit1.
- To prepare a PVC pipe joint by using the given circuit2.
- To make a butt joint using the given M.S pieces by arc welding.
- To make a lap joint using given M.S pieces by arc welding

**Additional Practice:**

- To make a cross-lap joint from the given wooden workpieces.
- To make an open scoop using the given sheet metal.
- To make a T-joint using given M.S pieces by arc welding.

**Text Books:**

1. Work shop Manual , P.Kannaiah & K.L.Narayana/ SciTech Publishers, 2<sup>nd</sup> edition, ISBN: 978-8183711302.
2. Elements of Workshop Technology, Vol I by S.K. Hajra Choudhury, S.K. Hajra Choudhury & Nirjhar Roy, Media Promoters and Publishers Pvt. Limited, 14<sup>th</sup> edition ISBN: 8185099146.

**Reference Books:**

1. Workshop Technology, Part 1, W.A.J. Chapman, 5<sup>th</sup> edition, ISBN 9780415503020.
2. Engineering Practices Lab Manual, T. Jeyapoovan & M. Saravanapandian, Vikas Publishing House Pvt. Limited, 4<sup>th</sup> edition, ISBN: .8125929037
3. Engineering Practices Laboratory Manual, Ramesh Babu.V., VRB Publishers Private Limited, Chennai, Revised edition, 2019-20, ISBN: 978-81-935993-8.

**Web Links:**

1. <https://bharatskills.gov.in>
2. <https://www.gopracticals.com/basic-engineering/workshop/>

**Agile Software Engineering**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501IT07**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> |          | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the Course, Student will be able to:**

- CO1:** Apply software engineering practices and evaluate different software development models to design and manage the life cycle of a Student Management System (SMS).
- CO2:** Analyze the principles of Agile methodologies and compare them with traditional models by transitioning a retail software company from Waterfall to Agile.
- CO3:** Evaluate the impact of Agile processes on requirements engineering and manage unstable requirements for a social media platform project.
- CO4:** Design and implement a comprehensive testing strategy using TDD and test automation tools in an Agile project.
- CO5:** Apply Agile design principles and execute refactoring techniques to develop maintainable and scalable software systems.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 1    |      |      | 2    |      |      |      |      |       |       |
| <b>CO2</b> | 3    | 2    | 1    | 1    |      |      |      | 2    | 2    | 2     | 1     |
| <b>CO3</b> | 2    | 1    | 1    |      |      |      |      |      |      | 2     | 1     |
| <b>CO4</b> | 3    | 2    | 2    | 1    |      |      |      | 2    | 2    | 2     | 1     |
| <b>CO5</b> | 1    | 2    |      |      |      |      |      |      |      |       |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 1    | 1    |
| <b>CO4</b> | 2    | 2    |
| <b>CO5</b> | 1    | 1    |

**UNIT – I**

**Introduction to Software Engineering:** Define Software Engineering, The Software Process, Software Engineering Practice, Software Myths

**Software Life Cycle models and Processes:** Software Process, Process Classification, Phased Development Life Cycle, Software Development Process Models – The Waterfall, Spiral and Evolutionary Models, Software Project Management Process, Project Planning and Estimation, Gathering Requirements, Software Design, Software Testing, Software Quality and Reliability.

**Case Study:** Developing a Student Management System (SMS)

## UNIT – II

**Fundamentals of Agile Methodology:** Theories for Agile Management, Agile Software Development, Traditional Model Vs. Agile Model, Classification of Agile Methods, Agile Manifesto and Principles, Agile Project Management, Agile Team Interactions, Ethics in Agile Teams, Agility in Design, Testing, Agile Documentations, Agile Drivers, Capabilities and Values.

**Case Study:** Implementing Agile Methodology in a Software Development Project

## UNIT – III

**Agile Processes:** Lean production - SCRUM, Crystal, Feature Driven Development, Adaptive Software Development, and Extreme Programming: Method overview – lifecycle – work products, roles and practices.

**Agility And Requirements Engineering:** Impact of Agile Processes in RE, Current Agile Practices, Overview of RE Using Agile, Managing Unstable Requirements, Requirements Elicitation

**Case Study:** Agile Processes and Requirements Engineering in a Healthcare Software Project

## UNIT – IV

**Agile Testing:** The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester.

**Case Study:** Implementing Test-Driven Development (TDD) for a Healthcare Application

## UNIT – V

**Agile Software Design and Development:** Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control.

**Case Study:** Refactoring an E-Commerce Backend Using Agile Design Principles.

### Capstone Project:

Students shall choose a real-time software application (e.g., e-commerce backend, SMS, food delivery app) and apply Agile design principles, perform refactoring, implement TDD, and use version control and CI tools. This project should be implemented as a mini project and submitted at the end of the course.

**Text Books:**

- 1 Software Engineering – Concepts and Practices: Ugrasen Suman, Cengage Learning, ISBN: 9789390555475.
- 2 Agile Software Development, Current Research and Future Directions, Springer-Verlag Berlin Heidelberg, Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), ISBN-10. 3642125743.

**Reference Books:**

- 1 Software Engineering, Lan Sommerville, Ninth Edition, Pearson
- 2 Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, David J. Anderson; Eli Schragenheim,

**Web Links:**

- 1 [https://www.tutorialspoint.com/software\\_engineering/](https://www.tutorialspoint.com/software_engineering/)
- 2 <https://www.sciencedirect.com/science/article/pii/S0950584916303329>

**Probability & Statistics**  
(Common to CSE, IT AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501MA09</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>1</b> | <b>0</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Apply Baye's theorem
- CO2:** Apply various Probability distributions for both discrete and continuous random variables
- CO3:** Compute mean and variance of sample means with replacement and without replacement and maximum errors.
- CO4:** Apply various tests to test the hypothesis concerning mean, Proportion, variance and attributes.
- CO5:** Apply the concepts of correlation and regression to the given statistical data.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 3    |      |      |      |      |      |      |      |       |       |
| <b>CO2</b> | 3    | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO3</b> | 2    | 3    |      |      |      |      |      |      |      |       |       |
| <b>CO4</b> | 3    | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO5</b> | 3    | 2    |      |      |      |      |      |      |      |       |       |

**UNIT – I**

**Probability and Random Variables:**

Probability – Conditional probability and Baye's Theorem-Random variables – Discrete and Continuous random variables-Mathematical Expectation, Variance and Moment generating function.

**Practice(Using any computational tool):**

Calculation of Mean and Variance.

**UNIT – II**

**Probability Distributions:**

Distribution function –Binomial, Poisson, Normal and Exponential distributions.

**Practice(Using any computational tool):**

Discrete and continuous probability distributions (Binomial, Poisson, normal and exponential distributions)

**UNIT – III**

**Data Analytics and Sampling Theory:**

Data science –Collection of data – primary and secondary data – Types of variables: dependent and independent Categorical and Continuous variables – Data visualization – Measures of Central tendency(Mean,mode and median) – Measures of Variability (spread or variance).



**Sampling Theory:** Introduction – Population and samples – Sampling distribution of Means and Variance – Central limit theorem (without proof)-Point and Interval estimations – Maximum error of estimate.

**Practice(Using any computational tool):**

1. Finding measures of variability and central tendency (mean, median, mode, arithmetic mean, geometric mean, Variance)
2. Data visualization (Construction of bar charts, pie charts).
3. Construction of confidence intervals

**UNIT – IV**

**Tests of Hypothesis:**

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions, Chi-Square and F test.

**Practice(Using any computational tool):**

1. Z-test, t-test and Chi-square test

**UNIT – V**

**Correlation and Regression:**

Method of least squares – Straight line - nonlinear curves– parabola -Exponential – Power curves-Correlation – Karl Pearson's correlation coefficient – rank correlation – regression– regression coefficients and properties (without proof) – regression lines

**Practice(Using any computational tool):**

1. Finding correlation coefficient and regression lines

\*Students are advised to use any Programming language/computational tool/AI tool like Python, Excel, PowerBI, Wolfram Alpha, Symbolab, Mathway, etc., for the practice

**Text Books:**

1. Miller and Freund's, Probability and Statistics for Engineers, 9/e, Pearson, 2020. ISBN: 978-9353945237
2. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, 12th edition, Sultan Chand & Sons Publications, 2020, ISBN: 978-9351611738

**Reference Books:**

1. Probability, Statistics and Random processes, T.Veerarajan, Tata McGraw-Hill, ISBN: 978-0070669253
2. Probability and statistics by T.K.V. Iyengar, S. Chand publishers, 2022, ISBN: 9789355010643
3. Modern Statistics: Intuition, Math, Python, R by Mike X Cohen, ISBN: 9798867723736

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc21\\_ma74/preview](https://onlinecourses.nptel.ac.in/noc21_ma74/preview)
- 2 <http://mathworld.wolfram.com/topics/ProbabilityandStatistics.html>
- 3 <https://www.khanacademy.org/math/statistics-probability>
- 4 <https://www.geeksforgeeks.org/statistics-with-python/>
- 5 <https://www.coursera.org/learn/inferential-statistical-analysis-python?specialization=statistics-with-python>

**Java Programming**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501IT06</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

**CO1:** Apply Java features for problem solving.

**CO2:** Build applications using principles of OOPs, interfaces and Packages.

**CO3:** Develop programs using Exception Handling to handle run-time errors.

**CO4:** Develop applications using multithreading for inter thread communication.

**CO5:** Build JDBC applications for performing CRUD operations using MySQL.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| <b>CO1</b> | 2   | 1   | 1   |     | 1   |     |     |     | 1   | 2    | 1    |
| <b>CO2</b> | 2   | 1   | 3   |     | 1   |     |     |     | 1   | 2    | 1    |
| <b>CO3</b> | 2   | 3   | 2   |     | 1   |     |     |     | 1   | 2    | 1    |
| <b>CO4</b> | 2   | 2   | 2   |     | 1   |     |     |     | 1   | 2    | 1    |
| <b>CO5</b> | 2   | 2   | 3   |     | 1   |     |     |     | 1   | 2    | 1    |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 1    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 3    |      |

**UNIT – I**

**Introduction to Java:** History of Java, Features of Java Language, JVM Architecture, Java source file structure. Building Blocks of Java, Control Statements, Operators, Type Conversion, Command Line Arguments, Arrays.

**Practice:**

**1. Control Statements**

- a. Select all the prime numbers within the range of 1 to 100.

[https://leetcode.com/problems/count-primes/description/?utm\\_source=](https://leetcode.com/problems/count-primes/description/?utm_source=)

- b. Find the sum of all even terms in the Fibonacci sequence up to the given range N.

<https://leetcode.com/problems/fibonacci-number/description/>

- c. Check whether a given number is Armstrong or not.

<https://www.hackerrank.com/contests/iiitdm-contest1/challenges/armstrong-number-2>

**2. Arrays**

- a. Sort an array of integers in ascending order.

- b. Find the maximum and minimum element in an array.

- c. Remove duplicate elements from an array.

## UNIT – II

**Concepts of Class:** Class, Object, Method, Constructor, Overloading- Method and Constructor Keywords: this, static and final, String Class and its Methods, StringTokenizer, StringBuffer and StringBuilder.

### Practice:

#### 1. Class Mechanism

- Display the details of a person. Personal details should be given in one method and the qualification details in another method.
- Implement constructor and constructor overloading.
- Implement method overloading.

#### 2. Strings

- Check if a given string is a pangram (contains every letter of the alphabet at least once).
- Find the most frequently occurring character in a string.
- Find all permutations of a given string.
- Check if a given string is an anagram (Ex: CAT and ACT).

<https://leetcode.com/problems/valid-anagram/description/>

## UNIT – III

**Inheritance:** Inheritance, Types of Inheritance, super and super( ), Method Overriding, Using final with inheritance, abstract with Class and Method, Dynamic Method Dispatch. Interfaces: Introduction to interface, Multiple inheritance.

### Practice:

#### 1. Inheritance & interface

<https://www.hackerrank.com/challenges/java-inheritance-1/problem>

<https://www.hackerrank.com/challenges/java-interface/problem>

- Implement multi level Inheritance.
- Implement multiple Inheritance.

<https://www.hackerrank.com/challenges/java-interface/problem>

- Find the areas of different shapes using abstract classes.

<https://www.hackerrank.com/challenges/java-abstract-class/problem>

## UNIT – IV

**Packages:** Introduction, Importing Packages and Classes, path and classpath, Access Specifiers, java.util: Collection Framework (related interfaces and classes), java.io: FileReader, FileWriter, FileInputStream, FileOutputStream, BufferedReader and BufferedWriter, Wrapper Classes.

### Practice:

#### 1. Packages & java.io

- Import and use user defined package.

<https://www.geeksforgeeks.org/java/packages-in-java/>

- Illustrate the use of protected members in a package.

- Copy Even numbers into Even.txt file and Odd Numbers into Odd.txt file.

## 2. Collection Framework

- a. ArrayList and LinkedList
- b. Iterator and Iterable
- c. Comparator and Comparable
- d. HashMap and TreeMap
- e. HashSet and TreeSet
- f. HashTable

## UNIT – V

**Exception Handling:** Introduction, Keywords: try, catch, throw, throws and finally, Multiple Catch Clauses, Checked and Unchecked Exceptions, User Defined Exceptions.

**Multithreading:** Introduction, Thread Life Cycle, Creation, Priorities, Synchronization, ITC.

**Java Database Connectivity:** Introduction, JDBC Architecture, Types of Drivers, JDBC Environment Setup, JDBC Steps, CRUD Operations.

### Practice:

#### 1. Exception Handling

- a. Illustrate exception handling mechanism using multiple catch clauses.
- b. Make use of Built-in and user-defined Exceptions in handling a run time exception.

#### 2. Multithreading

- a. Creates threads by extending Thread class. First thread display “Good Morning “every 1 sec, the second thread displays “Hello “every 2 seconds and the third display “Welcome” every 3 seconds, (Repeat the same by implementing Runnable).
- b. Solve Producer-Consumer problem using synchronization.

#### 3. JDBC

- a. CRUD operations.

### Cornerstone Project:

#### PROJECT 1: Student Attendance Management System

##### Project Implementation, Documentation and Viva Voce

- **Implementation mainly focuses on**
  - Adding student details, marking and viewing attendance.
  - JDBC operations: insert, update, search by roll number.
  - Input validation (no duplicate roll numbers, days  $\leq$  total days).
  - Attendance percentage calculation.
  - Menu-driven console workflow with exception handling.
- **Documentation must contain**
  - Objective & problem definition
  - Attendance table structure
  - ER diagram (Student  $\rightarrow$  Attendance)
  - Module explanations: Add, Mark, View, Search
  - JDBC connection flow
  - Screenshots of sample input/output
  - Enhancements added (login, validation, normalization)

## **PROJECT 2: Library Management System**

- **Implementation mainly focuses on**
  - Adding, searching, updating, deleting book records.
  - JDBC CRUD operations on books table.
  - Validation of price, quantity.
  - Implementing search by ID, title, and author.
- **Documentation must contain**
  - Objective of library automation
  - Books table schema
  - Flowchart for Add → View → Delete operations
  - Module descriptions
  - Exception handling (invalid ID)
  - Screenshots
  - Enhancements (issue records, author search)

## **PROJECT 3: Student Course Registration System**

### **Implementation Mainly Focuses On**

- Course registration, view, update, delete operations.
- Database design with student, course, registration tables.
- Validation for duplicate registration.
- JDBC connectivity and table relationships.

### **Documentation Must Contain**

- Objective
- Table design (student, course, registration)
- ER diagram
- Module explanation: Register, Display, Edit
- SQL constraints used
- Screenshots of registration process

## **PROJECT 4: Online Student Result Management System**

### **Implementation Mainly Focuses On**

- Marks entry and validation.
- Automatic total, percentage, grade calculation.
- Result storage and retrieval using JDBC.
- Web-based form input using HTML.

### **Documentation Must Contain**

- Objective
- Marks table schema
- Grade calculation logic
- HTML form screenshots
- JDBC code explanation
- Enhancements (validation, grade generation)

## **PROJECT 5: Employee Leave Management System**

### **Implementation Mainly Focuses On**

- Leave application submission.
- Balance update logic.

- Validations on leave days and employee ID.
- JDBC-based leave approval or rejection.

**Documentation Must Contain**

- Objective
- Employee & leave tables
- Flowchart: Apply → Validate → Approve
- Module explanation
- Screenshots of leave form and output

**PROJECT 6: Online Shopping Cart Simulation****Implementation Mainly Focuses On**

- Displaying products and adding items to cart.
- Stock validation before adding to cart.
- Bill calculation with discounts/coupons.
- JDBC for storing cart and order history.

**Documentation Must Contain**

- Objective
- Product, cart, order tables
- Module flow: Add → Update → Bill
- Billing logic with formulas
- Screenshots of cart process

**PROJECT 7: Bus Ticket Booking System****Implementation Mainly Focuses On**

- Booking, cancelling, viewing seat availability.
- Preventing double booking of same seat.
- Route table and seat allocation logic.
- JDBC insert/update operations.

**Documentation Must Contain**

- Objective
- Route and seat tables
- Seat allocation flowchart
- Module descriptions
- SQL queries
- Screenshots of booking/cancel pages

**Text Books:**

- 1 The Complete Reference Java, Herbert Schildt, TMH ,8<sup>th</sup> Edition, ISBN 978-1260440232.
- 2 Java one step ahead, Anita seth, B.L.Juneja, Oxford, First Edition. ISBN: 9780199459643.

**Reference Books:**

- 1 Introduction to java programming, by Y Daniel Liang, Seventh Edition, Pearson. ISBN: 978-8131729588
- 2 Core Java: An Integrated Approach, R.Nageswara Rao, Dream tech press. ISBN: 978-9351199250

**Web Links:**

- 1 <https://nptel.ac.in/courses/106105191/>
- 2 <http://java.sun.com/docs/books/tutorial/>

**Note:**

- Students must submit the Certificate of Completion offered by any Industry.
- The cornerstone project team size shall be four (4) students.
- Students may select any one of the above prescribed projects or a project of their own choice with the prior permission of the Course instructor.
- The SEE – Lab shall be evaluated for 50 marks based on project implementation, oral presentation, 10-minute video presentation, report and viva voce.
- The video presentation should consist of the working procedure of the project along with contribution of each student for a minimum of 2 minutes.
- Finally, the Source code of the cornerstone Project has to be pushed into the Students GitHub repository.

**Additional Practice:**

| UNIT-I |                                                     |                                                                                                                                                                                                            |
|--------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | <u>Finding 3-Digit Even Numbers</u>                 | <u>Link: <a href="https://leetcode.com/problems/finding-3-digit-even-numbers/description/">https://leetcode.com/problems/finding-3-digit-even-numbers/description/</a></u>                                 |
| 2      | Loops                                               | <u>Link: <a href="https://www.hackerrank.com/challenges/30-loops/problem">https://www.hackerrank.com/challenges/30-loops/problem</a></u>                                                                   |
| 3      | <u>Unique 3-Digit Even Numbers</u>                  | <u>Link: <a href="https://leetcode.com/problems/unique-3-digit-even-numbers/description/">https://leetcode.com/problems/unique-3-digit-even-numbers/description/</a></u>                                   |
| 4      | <u>Best Time to Buy and Sell Stock</u>              | <u>Link: <a href="https://leetcode.com/problems/best-time-to-buy-and-sell-stock/description/">https://leetcode.com/problems/best-time-to-buy-and-sell-stock/description/</a></u>                           |
| 5      | <u>Single Number</u>                                | <u>Link: <a href="https://leetcode.com/problems/single-number/description/">https://leetcode.com/problems/single-number/description/</a></u>                                                               |
| 6      | Majority Element                                    | <u>Link: <a href="https://leetcode.com/problems/majority-element/description/">https://leetcode.com/problems/majority-element/description/</a></u>                                                         |
| 7      | Contains Duplicate                                  | <u>Link: <a href="https://leetcode.com/problems/contains-duplicate/description/">https://leetcode.com/problems/contains-duplicate/description/</a></u>                                                     |
| 8      | Missing Number                                      | <u>Link: <a href="https://leetcode.com/problems/missing-number/description/">https://leetcode.com/problems/missing-number/description/</a></u>                                                             |
| 9      | Second Largest Number                               | <u>Link: <a href="https://www.naukri.com/code360/problem-details/second-largest-number_13762781">https://www.naukri.com/code360/problem-details/second-largest-number_13762781</a></u>                     |
| 10     | Java Program to Find if a Given Year is a Leap Year | <u>Link: <a href="https://www.geeksforgeeks.org/java/java-program-to-find-if-a-given-year-is-a-leap-year/">https://www.geeksforgeeks.org/java/java-program-to-find-if-a-given-year-is-a-leap-year/</a></u> |
| 11     | Bitwise Operators                                   | <u>Link: <a href="https://www.geeksforgeeks.org/problems/bitwise-operators-1597314674/0">https://www.geeksforgeeks.org/problems/bitwise-operators-1597314674/0</a></u>                                     |
| 12     | Program to Convert Octal Number to Binary Number    | <u>Link: <a href="https://www.geeksforgeeks.org/dsa/program-to-convert-octal-number-to-binary-number/">https://www.geeksforgeeks.org/dsa/program-to-convert-octal-number-to-binary-number/</a></u>         |
| 13     | Neon Number                                         | <u>Link: <a href="https://www.geeksforgeeks.org/dsa/neon-number/">https://www.geeksforgeeks.org/dsa/neon-number/</a></u>                                                                                   |



|                 |                                                    |                                                                                                                                                                                                                     |
|-----------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14              | Automorphic Number                                 | Link: <a href="https://www.geeksforgeeks.org/dsa/automorphic-number/">https://www.geeksforgeeks.org/dsa/automorphic-number/</a>                                                                                     |
| 15              | Harshad (Or Niven) Number                          | Link: <a href="https://www.geeksforgeeks.org/dsa/harshad-or-niven-number/">https://www.geeksforgeeks.org/dsa/harshad-or-niven-number/</a>                                                                           |
| <b>UNIT-II</b>  |                                                    |                                                                                                                                                                                                                     |
| 16              | Longest Common Prefix                              | Link: <a href="https://leetcode.com/problems/longest-common-prefix/description/">https://leetcode.com/problems/longest-common-prefix/description/</a>                                                               |
| 17              | Find the index of the first occurrence in a string | Link: <a href="https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/description/">https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/description/</a>     |
| 18              | Valid-Parentheses                                  | Link: <a href="https://leetcode.com/problems/valid-parentheses/description/">https://leetcode.com/problems/valid-parentheses/description/</a>                                                                       |
| 19              | Length of last word                                | Link: <a href="https://leetcode.com/problems/length-of-last-word/description/">https://leetcode.com/problems/length-of-last-word/description/</a>                                                                   |
| 20              | Add Binary                                         | Link: <a href="https://leetcode.com/problems/add-binary/description/">https://leetcode.com/problems/add-binary/description/</a>                                                                                     |
| 21              | Isomorphic Strings                                 | Link: <a href="https://leetcode.com/problems/isomorphic-strings/description/">https://leetcode.com/problems/isomorphic-strings/description/</a>                                                                     |
| 22              | Jewels and Stones                                  | Link: <a href="https://leetcode.com/problems/jewels-and-stones/description/">https://leetcode.com/problems/jewels-and-stones/description/</a>                                                                       |
| 23              | Buddy Strings                                      | Link: <a href="https://leetcode.com/problems/buddy-strings/description/">https://leetcode.com/problems/buddy-strings/description/</a>                                                                               |
| 24              | Reverse Only Letters                               | Link: <a href="https://leetcode.com/problems/reverse-only-letters/description/">https://leetcode.com/problems/reverse-only-letters/description/</a>                                                                 |
| 25              | Find Common Characters                             | Link: <a href="https://leetcode.com/problems/find-common-characters/description/">https://leetcode.com/problems/find-common-characters/description/</a>                                                             |
| 26              | Find Pattern                                       | Link: <a href="https://www.geeksforgeeks.org/problems/find-pattern/0">https://www.geeksforgeeks.org/problems/find-pattern/0</a>                                                                                     |
| 27              | Largest Substring Between Two Equal Characters     | Link: <a href="https://leetcode.com/problems/largest-substring-between-two-equal-characters/description/">https://leetcode.com/problems/largest-substring-between-two-equal-characters/description/</a>             |
| 28              | Remove All Adjacent Duplicates In String           | Link: <a href="https://leetcode.com/problems/remove-all-adjacent-duplicates-in-string/description/">https://leetcode.com/problems/remove-all-adjacent-duplicates-in-string/description/</a>                         |
| 29              | Permutations of given string                       | Link: <a href="https://www.geeksforgeeks.org/dsa/write-a-c-program-to-print-all-permutations-of-a-given-string">https://www.geeksforgeeks.org/dsa/write-a-c-program-to-print-all-permutations-of-a-given-string</a> |
| 30              | Longest Repeating Subsequence                      | Link: <a href="https://www.geeksforgeeks.org/dsa/longest-repeating-subsequence/">https://www.geeksforgeeks.org/dsa/longest-repeating-subsequence/</a>                                                               |
| <b>UNIT-III</b> |                                                    |                                                                                                                                                                                                                     |
| 31              | Java Inheritance-1                                 | Link: <a href="https://www.hackerrank.com/challenges/java-inheritance-1/problem">https://www.hackerrank.com/challenges/java-inheritance-1/problem</a>                                                               |
| 32              | Java Inheritance-2                                 | Link: <a href="https://www.hackerrank.com/challenges/java-inheritance-2/problem">https://www.hackerrank.com/challenges/java-inheritance-2/problem</a>                                                               |
| 33              | Java Abstract Class                                | Link: <a href="https://www.hackerrank.com/challenges/java-abstract-class/problem">https://www.hackerrank.com/challenges/java-abstract-class/problem</a>                                                             |
| 34              | Java Interface                                     | Link: <a href="https://www.hackerrank.com/challenges/java-interface/problem">https://www.hackerrank.com/challenges/java-interface/problem</a>                                                                       |

|                |                                                     |                                                                                                                                                                                                     |
|----------------|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 35             | Java Method Overriding                              | Link: <a href="https://www.hackerrank.com/challenges/java-method-overriding/problem">https://www.hackerrank.com/challenges/java-method-overriding/problem</a>                                       |
| 36             | Java Method Overriding-2 (super keyword)            | Link: <a href="https://www.hackerrank.com/challenges/java-method-overriding-2-super-keyword/problem">https://www.hackerrank.com/challenges/java-method-overriding-2-super-keyword/problem</a>       |
| <b>UNIT-IV</b> |                                                     |                                                                                                                                                                                                     |
| 37             | Java program to append a string in an existing file | Link: <a href="https://www.geeksforgeeks.org/java/java-program-to-append-a-string-in-an-existing-file/">https://www.geeksforgeeks.org/java/java-program-to-append-a-string-in-an-existing-file/</a> |
| 38             | Java End-of-file                                    | Link: <a href="https://www.hackerrank.com/challenges/java-end-of-file/problem">https://www.hackerrank.com/challenges/java-end-of-file/problem</a>                                                   |
| 39             | Java Stdin and Stdout II                            | Link: <a href="https://www.hackerrank.com/challenges/java-stdin-stdout/problem">https://www.hackerrank.com/challenges/java-stdin-stdout/problem</a>                                                 |
| 40             | Java Output Formatting                              | Link: <a href="https://www.hackerrank.com/challenges/java-output-formatting/problem">https://www.hackerrank.com/challenges/java-output-formatting/problem</a>                                       |
| 41             | Find Duplicate File in System                       | Link: <a href="https://leetcode.com/problems/find-duplicate-file-in-system/description/">https://leetcode.com/problems/find-duplicate-file-in-system/description/</a>                               |
| <b>UNIT-V</b>  |                                                     |                                                                                                                                                                                                     |
| 42             | Java Exception Handling (Try-catch)                 | Link: <a href="https://www.hackerrank.com/challenges/java-exception-handling-try-catch">https://www.hackerrank.com/challenges/java-exception-handling-try-catch</a>                                 |
| 43             | Java Exception Handling                             | Link: <a href="https://www.hackerrank.com/challenges/java-exception-handling">https://www.hackerrank.com/challenges/java-exception-handling</a>                                                     |
| 44             | Java Factory Pattern                                | Link: <a href="https://www.hackerrank.com/challenges/java-factory">https://www.hackerrank.com/challenges/java-factory</a>                                                                           |
| 45             | Print in Order                                      | Link: <a href="https://leetcode.com/problems/print-in-order/description/">https://leetcode.com/problems/print-in-order/description/</a>                                                             |
| 46             | Print Zero Even Odd                                 | Link: <a href="https://leetcode.com/problems/print-zero-even-odd/description/">https://leetcode.com/problems/print-zero-even-odd/description/</a>                                                   |

|                            | Aditya's Internal Coding Platform (Maya) | Code chef/greek for greeks | Hacker rank | Leet code | Total     |
|----------------------------|------------------------------------------|----------------------------|-------------|-----------|-----------|
| <b>Unit-1</b>              | 0                                        | 0                          | 1           | 2         | <b>3</b>  |
| <b>Unit-2</b>              | 0                                        | 0                          | 0           | 1         | <b>1</b>  |
| <b>Unit-3</b>              | 0                                        | 0                          | 4           | 0         | <b>4</b>  |
| <b>Unit-4</b>              | 0                                        | 1                          | 0           | 0         | <b>1</b>  |
| <b>Unit-5</b>              | 0                                        | 0                          | 0           | 0         | <b>0</b>  |
| <b>Additional Practice</b> | 0                                        | 10                         | 13          | 23        | <b>46</b> |
| <b>Total</b>               | <b>0</b>                                 | <b>11</b>                  | <b>18</b>   | <b>26</b> | <b>55</b> |

**Full Stack Application Development using MERN**  
**(Common to CSE, AIML & DS)**  
(Syllabus for the batch admitted in the year 2026)

|                              |   |   |   |   |
|------------------------------|---|---|---|---|
| VI Semester                  | L | T | P | C |
| <b>Course Code: 2601AI02</b> | 2 | 0 | 2 | 4 |

Course Outcomes:

At the end of the Course, Student will be able to:

**CO1:** Develop static web pages using HTML and CSS.

**CO2:** Apply JavaScript for Client side validations and XML for data transportation.

**CO3:** Make use of Node.JS and Angular JS for developing a web server and dynamic webpages.

**CO4:** Utilize React JS for developing responsive web pages.

**CO5:** Develop web applications using using PHP and MySQL/MongoDB.

Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 2   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    |
| <b>CO2</b> | 3   | 2   | 2   | -   | 2   | -   | -   | -   | -   | -    | -    | -    |
| <b>CO3</b> | 3   | 2   | 2   | -   | 2   | -   | -   | -   | -   | -    | -    | 2    |
| <b>CO4</b> | 2   | 3   | 2   | -   | 2   | -   | -   | -   | -   | -    | -    | 2    |
| <b>CO5</b> | 3   | 2   | 2   | -   | 2   | -   | -   | -   | -   | -    | -    | -    |

Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    | -    |
| <b>CO2</b> | 2    | -    |
| <b>CO3</b> | 2    | -    |
| <b>CO4</b> | 2    | -    |
| <b>CO5</b> | 2    | -    |

### Unit – I: HTML and CSS

**HTML 5:** Introduction to Web, Overview of Web Technologies, HTML - Introduction, HTML - Need, Case-insensitivity, Platform-independency, DOCTYPE Declaration, Types of Elements, HTML Elements - Attributes, Metadata Element, Sectioning Elements, Paragraph Element, Division and Span Elements, List Element, Link Element, Character Entities, HTML5 Global Attributes, Creating Table Elements, Table Elements : Colspan/Rowspan Attributes, border, cellpadding and cellspacing attributes, Creating Form Elements, Input Elements - Attributes, Color and Date Pickers, Select and Datalist Elements, Editing Elements, Media, Iframe, Dynamic HTML.

**CSS:** Cascading style sheets, Levels of Style Sheets, Style Specification Formats, Selector Forms, Box Model, Conflict Resolution, CSS3.

## Practice:

### HTML:

1. Write a HTML program, that makes use of basic tags like <html> ,<head> ,<title> ,<body> ,<p> ,<hr> ,<br> ,<h1> to <h6> ,<!-- --> tags and their attributes.
2. Write a HTML program, that makes use of formatting tags like <b> ,<i> ,<u> ,<strong> ,<sub> ,<sup> ,<tt> ,<pre> ,<font> tags and their attributes.
3. Write a HTML program, to explain the working of lists.  
Note: It should have an ordered list, unordered list, nested lists and ordered list in an unordered list and definition lists.
4. Write a HTML program, to explain the working of hyperlinks using <a> tag and href, target Attributes.
5. Note: Use text to link →<https://www.aec.edu.in/>
6. Use image to link →<https://www.aec.edu.in/?p=Gallery>
7. Write a HTML program, to explain the working of tables by preparing a timetable.  
(Note: Use <caption> tag to set the caption to the table & also use cell spacing, cell padding, table border etc.).
8. Write a HTML program, to explain the working of frames, such that page is to be divided into 3 parts on either direction. (Note: first frame → image, second frame → paragraph, third frame → hyperlink. And make sure of using “no frame” attribute such that frames to be fixed).
9. Write a HTML program, to explain the working of forms by designing Registration form. (Note: Include text field, password field, number field, date of birth field, checkboxes, radio buttons, list boxes using <select> & <option> tags, <text area> and two buttons ie: submit and reset. Use tables to provide a better view).
10. Write a HTML program, that makes use of <article> ,<aside> ,<figure> ,<figcaption> ,<footer> ,<header> ,<main> ,<nav> ,<section> ,<div> ,<span> tags.

### CSS

1. Write a program to apply different types (or levels of styles or style specification formats) - inline, internal, external styles to HTML elements.
2. Write a program to apply different types of selector forms
  - i. Simple selector (element, id, class, group, universal)
  - ii. Combinator selector (descendant, child, adjacent sibling, general sibling)
  - iii. Pseudo-class selector
  - iv. Pseudo-element selector
  - v. Attribute selector
3. Write a program to apply Box model.
4. Write a CSS rule that places a background image halfway down the page, tilting it horizontally. The image should remain in place when the user scrolls up or down.
5. Write a program using the following terms related to CSS:
  - i. font-size ii. font-weight iii. Font-stretch
  - iv. text-decoration v. text-transformation vi. Text-alignment

### Unit – II: Javascript and XML

**JavaScript:** Why we need JavaScript, What is JavaScript, Environment Setup, Working with Identifiers, Type of Identifiers, Primitive and Non Primitive Data Types, Variables – var, let, const, Operators and Types of Operators, Types of Statements, Non - Conditional

Statements, Types of Conditional Statements, If and Switch Statements, Types of Loops, Types of Functions, Declaring and Invoking Function, Arrow Function, Function Parameters, Nested Function, Built-in Functions, Variable Scope in Functions, Working With Classes, Creating and Inheriting Classes, In-built Events and Handlers, Working with Objects, Types of Objects, Predefined - String, Number, Array, Date, Math, Random, RegExp, User-defined objects - Creating Objects, Combining and cloning Objects using Spread operator, Destructuring Objects, Browser and Document Object Model, Introduction to Asynchronous Programming, Callbacks, Promises, Async and Await, Executing Network Requests using Fetch API, Creating and consuming Modules.

**Working with XML:** Document Type Definition (DTD), XML schemas, XSLT, XML and CSS, Document Object Model, Parsers - DOM and SAX.

### Practice:

1. Write a JavaScript program, that makes use of different objects (predefined – Array, String, Math, Date, RegExp and User-defined). Note: Use atleast 5 properties and methods from each object.
2. Write a javascript to display the denomination of the amount deposited in the bank in terms of 100's, 50's, 20's, 10's, 5's, 2's & 1's. (Eg: If deposited amount is Rs.163, the output should be 1-100's, 1-50's, 1- 10's, 1-2's & 1-1's)
3. Write a JavaScript that takes a number from one text field in the range of 0-999 and display it in other text field in words. If the number is out of range, it should show “out of range” and if it is not a number, it should show “not a number” message in the result box.
4. Write a JavaScript program, that makes use of class, object, method, constructor for student information system.
5. Design a HTML having a text box and four buttons named Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate java script function should be called to display
  - i. Factorial of that number
  - ii. Fibonacci series up to that number
  - iii. Prime numbers up to that number
  - iv. Is it palindrome or not?
6. Write JavaScript programs on Event Handling
  - i. Open a Window from the current window
  - ii. Change color of background at each click of button or refresh of a page
  - iii. Display calendar for the month and year selected from combo box
  - iv. On Mouse over event
7. Write a JavaScript to validate the following fields in a registration page created in Experiment 2
  - i. Name (start with alphabet and followed by alphanumeric and the length should not be less than 6 characters)
  - ii. Password (it allows alphanumeric, special symbols and should not be less than 6 characters)
  - iii. E-mail (should not contain invalid email addresses)
8. Write an XML file which will display the Book information which includes the following: Title of the book, Author Name, ISBN number, Publisher name, Edition, Price.
  - i. Write a Document Type Definition (DTD) to validate the above XML

- file.
- ii. Write an XML Schema Definition (XSD) to validate the above XML file.
  - iii. Write an Extensible Stylesheet Language Transformations (XSLT) to display data in table format.

### Unit – III: Node.js and MongoDB

**Node.js: Why and What Node.js, How to use Node.js, Create a web server in Node.js, Process Model, NPM, Modules - HTTP, File system, URL, Modular programming in Node.js, Restarting Node Application, Events.**

**MongoDB:** Introduction Module Overview, Document Database Overview, Understanding JSON, MongoDB Structure and Architecture, MongoDB Remote Management, Installing MongoDB on the local computer (Mac or Windows), Introduction to MongoDB Cloud, Create MongoDB Atlas Cluster, GUI tools Overview, Install and Configure MongoDB Compass, Introduction to the MongoDB Shell, MongoDB Shell JavaScript Engine, MongoDB Shell JavaScript Syntax, Introduction to the MongoDB Data Types, CRUD Operations on documents, Create and Delete Databases and Collections, MongoDB Queries.

#### **Practice:**

##### **Node.js**

1. How to execute different functions successfully in the Node.js platform.
2. Write a program to show the workflow of JavaScript code executable by creating web server in Node.js
3. Write a Node.js module to show the workflow of modularization of Node application.
4. Write a program to show the workflow of restarting a Node application.
5. Create a text file src.txt and add the following data to it. Mongo, Express, Angular, Node.

##### **MongoDB**

Install MongoDB and configure ATLAS.

1. Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove().
2. Write MongoDB queries to create and drop databases and collections.

### Unit – IV: Express.js and Typescript

**Express.js: Express Development Environment, Defining a route, Handling Routes, Route and Query Parameters, How Middleware works, Chaining of Middlewares, Types of Middlewares, Connecting to MongoDB with Mongoose, Validation Types and Defaults, Models, CRUD Operations, API Development, Session management - Cookies, Sessions.**

**Typescript:** Installation, Introduction, Function, Parameter Types and Return Types, Arrow Function, Function Types, Optional and Default Parameters, Rest Parameter, Creating an Interface, Duck Typing, Function Types, Extending Interfaces, Classes, Constructor, Access Modifiers, Properties and Methods, Creating and using Namespaces, Creating and using Modules, Module Formats and Loaders, Module Vs Namespace, What is Generics, What are Type Parameters, Generic Functions, Generic Constraints.ice:

### Express.js

1. Implement routing using routes/route.js file.
2. Handle POST submissions, display customized error messages, perform logging
3. Write a Mongoose schema to connect with MongoDB.
4. Write a program to wrap the Schema into a Model object
5. Write a program to perform various CRUD (Create-Read-Update-Delete) operations using Mongoose library functions.
6. Include APIs based on the requirements provided - Fetch the details which is provided in the URL, Update the details based on the name which is provided in the URL and the data in the request body, Delete the details based on the name which is provided in the URL.
7. Write a program to explain session management using cookies.
8. Write a program to explain session management using sessions.

### Typescript

1. Basics of TypeScript.
2. Define an arrow function inside the event handler to filter the product array with the selected product object using the productId received by the function. Pass the selected product object to the next screen.
3. Consider that developer needs to declare a function - getMobileByVendor which accepts string as input parameter and returns the list of mobiles.
4. Arrow Function.
5. Optional, Default, Rest parameters in a function.
6. Declare an interface named - Product with two properties like productId and productName with a number and string datatype and need to implement logic to populate the Product details.
7. Declare an interface named - Product with two properties like productId and productName with the number and string datatype and need to implement logic to populate the Product details.
8. Declare an interface with function type and access its value.
9. Declare a productList interface which extends properties from two other declared interfaces like Category, Product as well as implementation to create a variable of this interface type.
10. Consider the Mobile Cart application, Create objects of the Product class and place them into the productList array.
11. Declare a class named - Product with the below-mentioned declarations: (i) productId as number property (ii) Constructor to initialize this value (iii) getProductId method to return the message "Product id is <<id value>>".
12. Create a Product class with 4 properties namely productId, productName, productPrice, productCategory with private, public, static, and protected access modifiers and accessing them through Gadget class and its methods.



- 13. Create a Product class with 4 properties namely productId and methods to setProductId() and getProductId().**
- 14. Create a namespace called ProductUtility and place the Product class definition in it.**
- 15. Import the Product class inside productlist file and use it.**
- 16. Consider the Mobile Cart application which is designed as part of the functions in a module to calculate the total price of the product using the quantity and price values and assign it to a totalPrice variable.**
- 17. Create a generic array and function to sort numbers as well as string values.**

#### Unit – V: React JS

React JS – Introduction, Displaying “Welcome React”, Introducing JSX, Rendering Elements, Components and Props, State and Lifecycle, Handling Events, Conditional Rendering, Lists and Keys, Forms, Lifting State Up, Composition vs Inheritance, Thinking in React, Hooks, API Integration

#### **Practice:**

1. Create a simple React application that displays the message "Welcome React" on the webpage.
2. Develop a React component that uses JSX syntax to display static and dynamic content.
3. Create and render elements dynamically.
4. Design a component that receives and displays student information through props and states.
5. Implement simple component and stateful component.
6. Implement form validation using events.
7. Implement conditional rendering.
8. Implement rendering lists and keys.
9. Implement routing to different pages using react router.
10. Implement hooks.
11. Implement sharing data between components
12. Implement to-do list application.
13. Implement API integration – CRUD operations using MySQL

#### **Capstone Projects:**

Project 1: Student Management System

Implementation mainly focuses on CRUD operations using MongoDB, Express, React, Node.js

Project 2: Online Food Ordering System

Implementation mainly focuses on menu display, cart, orders, user login, admin panel.

Project 3: Personal Portfolio with Admin Dashboard

Implementation mainly focuses on Edit portfolio sections via a protected admin panel.

Project 4: To-Do List Application

Implementation mainly focuses on add, edit, update and delete tasks.



**Project 5: Event Registration Portal**

Implementation mainly focuses on users register for events; admin can view/manage registrations.

**Project 6: E-Commerce Product Catalog**

Implementation mainly focuses on Product listings, categories, product details, cart basics.

**Project 7: College Information & Admission Portal**

Implementation mainly focuses on Forms, tables, student admission data, admin management.

**Project 8: Blog Posting Platform**

Implementation mainly focuses on users create posts, add images, edit, comment, delete.

**Project 9: Movie Review and Rating System**

Implementation mainly focuses on users can review movies, give ratings, view reviews list.

**Project 10: Employee Record Management**

Implementation mainly focuses on Employee details, salary, department, search filters.

**Project 11: Notes Application**

Implementation mainly focuses on Create/edit notes, categorize them, private notes per user.

**Project 12: Online Quiz Application**

Implementation mainly focuses on admin adding questions, users take quiz, store scores.

**Project 13: Library Book Management System**

Implementation mainly focuses on add books, issue/return system, student records, dashboards.

**Project 14: Hospital Appointment Booking System**

Implementation mainly focuses on users book appointments, doctors manage schedules.

Note: Documentation must contain Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement.

**Text Books:**

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson
2. Pro Mean Stack Development, 1st Edition, ELadElrom, Apress O'Reilly.
3. React Explained, 2020 Edition, Zac Gordon, OStraining.
4. MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly.

**Reference Books:**

1. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech.
2. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda S Katila, Cengage Learning.

**Web Links:**

1. <https://www.reactjs.org/docs/getting-started.html>
2. <https://www.university.mongodb.com/>

## Operating Systems

(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501CS13</b> | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Describe basic concepts of Operating Systems and its structure.
- CO2:** Analyse various issues related to inter process communication like process scheduling, resource management and deadlocks.
- CO3:** Interpret the issues and challenges of memory management.
- CO4:** Illustrate concepts of Disk management and file system implementation.
- CO5:** Explain issues related to protection and security mechanisms.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    |      |      |      |      |      |      |      | 1    |       |       |
| <b>CO2</b> | 1    | 3    |      | 1    |      |      |      |      | 2    |       | 1     |
| <b>CO3</b> | 1    | 3    |      | 1    |      |      |      |      | 2    |       | 1     |
| <b>CO4</b> | 1    | 3    |      | 1    |      |      |      |      | 1    |       | 1     |
| <b>CO5</b> | 2    | 2    |      |      |      |      |      |      | 1    |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1     | PSO2 |
|------------|----------|------|
| <b>CO1</b> | <b>1</b> |      |
| <b>CO2</b> | <b>2</b> |      |
| <b>CO3</b> | <b>2</b> |      |
| <b>CO4</b> | <b>2</b> |      |
| <b>CO5</b> | <b>2</b> |      |

## UNIT – I

**Operating Systems Overview:** Operating system functions, Operating system structure, Operating systems operations, Computing environments, Open-Source Operating Systems. System Structures: Operating System Services, User and Operating-System Interface, systems calls, Types of System Calls, system programs, operating system structure, System Boot.

**Case Study:** The above topics are discussed as case study in Windows/ Unix OS

### Practice:

- Basic Linux commands
- Implementation of System calls
- Multiprogramming-Memory management-Implementation of fork (), wait (), exec() and exit (), System calls

## UNIT – II

**Process Concept:** Process scheduling, Operations on processes, Inter-process communication.

**Process Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling.

**Multithreaded Programming:** Multithreading models, Thread libraries, Threading issues

**Case Study:** The above topics are discussed as case study in Windows/ Unix OS

### Practice:

1. Simulate the following CPU scheduling algorithms: FCFS and SJF
2. Simulate the following CPU scheduling algorithms: Priority and Round Robin

## UNIT – III

**Inter-process Communication:** Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Classical IPC Problems - Dining philosophers problem, Readers and writers problem.

**Deadlocks:** Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection and recovery, Deadlock avoidance, Deadlock prevention.

**Case Study:** The above topics are discussed as case study in Windows/ Unix OS

### Practice:

1. Simulate Bankers Algorithm for Dead Lock Avoidance
2. Write a C program that illustrates two processes communicating using shared memory.
3. Write C program to create a thread using pthreads library and let it run its function.
4. Write a C program to illustrate concurrent execution of threads using pthreads library

## UNIT – IV

**Memory-Management Strategies:** Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation.

**Virtual Memory Management:** Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation.

**File Systems:** Files, Directories, File system implementation, management and optimization.

**Case Study:** The above topics are discussed as case study in Windows/ Unix OS

### Practice:

1. Simulate the Multiprogramming with a fixed number of tasks (MFT)
2. Simulate the Multiprogramming with a variable number of tasks (MVT)
3. Simulate the FIFO page replacement algorithm
4. Simulate the LRU page replacement algorithm
5. Simulate the following File allocation strategies: Sequenced, Indexed and Linked

## UNIT – V

**Secondary-Storage Structure:** Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.

**System Protection:** Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights.

**System Security:** Introduction, Program threats, System and network threats.

### Practice:

1. The above topics are discussed as case study in Windows/ Unix OS

### Text Books:

- 1 Operating System Concepts, Abraham Silberschatz, Peter B Galvin and Greg Gagne, John Wiley and Sons Inc., 12<sup>th</sup> Edition. ISBN: 978-0470128725
- 2 William Stallings, Operating Systems: Internals and Design Principles. Prentice-Hall, 7<sup>th</sup> Edition. ISBN: 978-9332518803

### Reference Books:

- 1 Modern Operating Systems, Tanenbaum A S, Pearson Education, 3<sup>rd</sup> Edition. ISBN: 978-0136006633
- 2 Operating Systems A Concept Based Approach, Dhamdhare D M, Tata McGraw-Hill, 3<sup>rd</sup> Edition. ISBN: 978-1259005589
- 3 Operating Systems, Nutt G, Pearson Education, 3<sup>rd</sup> Edition,. ISBN: 978-8131723593

### Web Links:

- 1 <https://archive.nptel.ac.in/courses/106/106/106106144/>
- 2 <https://archive.nptel.ac.in/courses/106/105/106105214/>
- 3 <https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems>
- 4 <https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923>

**Artificial Intelligence**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501AI02**

**L      T      P      C**  
**2      0      1      3**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Illustrate the historical development of AI, key milestones and contributors.
- CO2:** Apply the basic principles of AI in problem solving
- CO3:** Apply Local Search Algorithms and Optimization Techniques.
- CO4:** Choose the appropriate representation of Knowledge.
- CO5:** Summarise the expert systems and real time applications

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    |      |      | 1    |      |      |      | 1    | 1    |       | 1     |
| <b>CO2</b> | 3    | 2    |      | 2    |      |      |      | 1    | 1    |       | 1     |
| <b>CO3</b> | 3    | 2    | 1    | 2    | 1    |      |      | 1    | 1    |       | 1     |
| <b>CO4</b> | 2    |      | 1    |      |      |      |      | 1    | 1    |       |       |
| <b>CO5</b> | 2    | 2    | 1    | 1    | 1    |      |      | 1    | 1    |       | 1     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 2    | 1    |
| <b>CO3</b> | 1    | 1    |
| <b>CO4</b> | 1    |      |
| <b>CO5</b> | 1    | 1    |

**UNIT – I**

**Introduction:**

What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

**Practice :**

1. Introduction to LISP : To demonstrate simple recursive functions and list manipulation in LISP
2. Introduction to Prolog : Provide a brief introduction to Prolog syntax, including facts, rules, and queries.

## UNIT – II

### **Problem formulation:**

Problem Definition Production systems, Control strategies, Search strategies. Problem characteristics, Problem Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies

### **Practice :**

1. Implementation of DFS for water jug problem using LISP/PROLOG
2. Implementation of BFS for tic-tac-toe problem using LISP/PROLOG

## UNIT – III

### **Problem solving methods**

Problem graphs, Matching, Indexing and Heuristic functions Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions, , Constraints satisfaction – Measure of performance and analysis of search algorithms. Game playing.

### **Practice :**

1. Implementation of TSP using heuristic approach using LISP/Prolog
2. Implementation of Hillclimbing to solve 8 Puzzle Problem

## UNIT – IV

### **Knowledge representation**

Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic Structured representation of knowledge Basic plan generation systems – Strips Advanced plan generation systems – K strips Strategic explanations Why, why not and how explanations.

### **Practice :**

1. Design a semantic network to represent knowledge about a specific domain, such as animals or transportation systems. Experiment with different node types, relationships, and attributes to encode information effectively. Implement a Python / LISP code for this program.
2. Create a frame-based representation for a simple domain like a restaurant. Define frame templates for entities like menu items, customers, and orders, along with slots for attributes such as price, ingredients, and customer preferences.

## UNIT – V

### **Expert Learning**

Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.

### **Practice :**

1. Using PYTHON / LISP , develop an expert system to help users plan travel itineraries, including transportation, accommodation, and activities. Utilize knowledge about travel destinations, transportation options, and user preferences to generate personalized travel plans.

2. Using PYTHON / LISP , create an expert system to assist students in selecting courses, majors, or career paths based on their interests, skills, and academic performance. Use knowledge about educational programs, career prospects, and academic requirements to make personalized recommendations.

**Text Books:**

- 1 Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig , Pearson, 3rd Edition, ISBN: 978-9332543515
- 2 Artificial Intelligence: Structures and Strategies for Complex Problem Solving by George F. Luger, 2<sup>nd</sup> Edition, ISBN: 978-0805347807

**Reference Books:**

- 1 Artificial Intelligence, Saroj Kaushik, Cengage Learning India, ISBN: 978-8131510995
- 2 Artificial Intelligence, Elaine Rich and Kevin Knight, Tata McGraw Hill, ISBN: 978-0-07-052263-3
- 3 Artificial Intelligence: Foundations for Computational Agents, David Poole and Alan Mackworth, Cambridge University Press, ISBN: 978-1107195394

**Web Links:**

- 1 <https://nptel.ac.in/courses/106105077>
- 2 <https://nptel.ac.in/courses/106106126>
- 3 <https://aima.cs.berkeley.edu>

**Computer Networks**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code:** 2501CS07

**L      T      P      C**  
**2      0      1      3**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Describe network topologies, reference models and media for data transmission
- CO2:** Analyze error and flow control issues in data link layer
- CO3:** Classify MAC protocols and channelization techniques
- CO4:** Apply routing algorithms and congestion control techniques for effective data transmission
- CO5:** Analyze protocols Transport and Application Layers

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 1    |      |      |      |      |      |      |      |       |       |
| <b>CO2</b> |      | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO3</b> |      | 2    |      |      |      |      |      |      | 1    | 1     |       |
| <b>CO4</b> | 1    | 2    | 2    |      |      |      |      |      | 2    |       | 1     |
| <b>CO5</b> |      | 1    |      |      | 1    |      |      |      |      |       | 1     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PO      | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 2    |      |

**UNIT – I**

**Network Overview:** interfaces, protocols and services, connection-oriented and connectionless services, OSI & TCP/IP Reference Models. Local Area Networks: Topologies - star, bus, ring, media access control - deterministic and probabilistic, IEEE 802.x. wireless networking.

**Practice:**

1. Study of Network devices in detail and connect the computers in Local Area Network

**UNIT – II**

**Data Link Protocols:** Framing and Data Transparency, Error Detection & Correction, Flow control.



**Practice:**

1. Write a Program to implement the data link layer framing methods such as i) Character stuffing ii) bit stuffing.

**UNIT – III**

**Media Access Control:** Random Access: ALOHA, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance, Controlled Access: Reservation, Polling, Token Passing, Channelization: frequency division multiple Access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA).

**Practice:**

1. Write a Program to implement Sliding window protocols

**UNIT – IV**

**Routing Algorithms:** The Optimality principle, Shortest path, Flooding, Distance vector, Link state, Hierarchical, Congestion Control algorithms: General principles of congestion control, Congestion prevention policies, Approaches to Congestion Control, Traffic Aware Routing, Admission Control, Traffic Throttling, Load Shedding, Traffic Control Algorithm: Leaky bucket & Token bucket.

**Practice:**

1. Programs to implement routing protocols like shortest path.

**UNIT – V**

**IP Protocols:** IP Addressing, IP & ICMP.

Transmission Control Protocol: UDP & TCP.

Application Layer: World Wide Web, HTTP, Electronic mail, Architecture, web based mail, email security, TELENET, local versus remote Logging, Domain Name System: Name Space, DNS, SNMP.

**Practice:**

1. NS2 Simulator i. NS2 Simulator-Introduction ii. Simulate to Find the Number of Packets Dropped iii. Simulate to Find the Number of Packets Dropped by TCP/UDP

**Capstone Project:**

Simulate and implement data link layer protocols and network routing strategies using NS2 (Network Simulator 2). It includes configuring network topologies, setting up routing protocols like AODV, DSDV, and OLSR, and analyzing their performance through metrics such as throughput, delay, and packet delivery ratio. Additionally, explore the simulation of data link layer functionalities, including MAC addressing and error detection. You may use NS2's capabilities, that insights into the behaviour of network protocols, aiding in the design and optimization of efficient communication systems.

**Text Books:**

- 1 Computer Networks — Andrew S Tanenbaum and David J Wetherall, Pearson Education, 5th Edition. ISBN: 978-0132126953
- 2 Data Communications and Networking – Behrouz A.Forouzan, McGraw Hill Education, 5th Edition ISBN: 978-1259064753

**Reference Books:**

- 1 Data Communications and Networks- Achut S Godbole, AtulKahate, McGraw-Hill Education (India) Pvt Limited, 2<sup>nd</sup> Edition. ISBN: 978-0-07-123110-7
- 2 Computer Networks, Mayank Dave, CENGAGE India, 6<sup>th</sup> Edition ISBN: 978-8131509869

**Web Links:**

- 1 <https://nptel.ac.in/courses/106105081>
- 2 <https://www.coursera.org/learn/fundamentals-network-communications>

**Data Mining**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501AI03**

**L      T      P      C**  
**1      0      2      3**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Illustrate data warehousing architectures and mining concepts for knowledge discovery.
- CO2:** Apply preprocessing techniques to prepare data for mining algorithms.
- CO3:** Build classification model using Decision tree induction.
- CO4:** Analyze association rule generation using Apriori and FP growth algorithms.
- CO5:** Apply Clustering algorithms on given data to find similarity between classes.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 2    | 2    |      | 1    |      |      | 1    | 1    |       | 2     |
| CO2   | 2    | 2    | 2    |      | 2    |      |      | 1    | 1    |       | 2     |
| CO3   | 2    | 2    | 3    |      | 1    |      |      | 1    | 1    |       | 2     |
| CO4   | 2    | 2    | 3    |      | 1    |      |      | 1    | 1    |       | 2     |
| CO5   | 2    | 2    | 3    |      | 1    |      |      | 1    | 1    |       | 2     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    |      | 1    |
| CO2    |      | 2    |
| CO3    |      | 2    |
| CO4    |      | 2    |
| CO5    |      | 2    |

**UNIT-I**

**Data Warehousing and Online Analytical Processing:**

**Data Warehouse:** Basic Concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute Oriented Induction.

**Data Mining:** What Is Data Mining, Why Data Mining, Data Mining Functionalities, Technologies Are Used, Major Issues in Data Mining, Architecture Of Data Mining Systems Classification Of Data Mining Systems.

**Practice:**

1. Illustrate KDD process and explore the Data Mining tool WEKA/KNIME for Data Preprocessing, Classification and Clustering.
2. Explain ETL process important for moving data in the data warehouse.

## UNIT-II

**Know Your Data :** Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity.

**Data Preprocessing :** An Overview, Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.

### Practice:

1. Apply Statistical Descriptions and Measures of Similarity and Dissimilarity on given data
2. Apply Preprocessing for training data set related to Weather data

## UNIT-III

**Classification and Prediction:** Classification: Basic Concepts, General Approach to Solving a Classification Problem, Decision Tree Induction, Model Overfitting, Evaluating the Performance of a Classifier, Issues Regarding Classification and Prediction

### Practice:

1. Demonstrate classification rule process on given data set using id3 algorithm.
2. Demonstrate classification rule process on Student's Academic Performance Data using j48 algorithm.

## UNIT-IV

**Mining Frequent Patterns, Associations and Correlations:** Basic Concepts and Methods, Frequent Itemset Mining Methods, Which Patterns Are Interesting?—Pattern Evaluation Methods, Association Mining to Correlation Analysis.

### Practice:

1. Demonstrate Association rule generation on credit card data using apriori algorithm.
2. Demonstrate Association rule process on contact lenses. arff using FPGrowth Algorithm

## UNIT – V

**Cluster Analysis:** Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Evaluation of Clustering, Mining Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

### Practice

1. Demonstrate clustering process on given dataset using simple k-means
2. Apply Hierarchical clustering process on dataset.

## Advanced Data Structures & Algorithm Analysis (Common to AIML, CSE, CSE-DS & IT)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501CS10</b> | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

At the end of the Course, Student will be able to:

**CO1:** Analyze the algorithms efficiency and hashing techniques for searching.

**CO2:** Illustrate the concepts of search trees and operations of Priority Queues.

**CO3:** Analyze the algorithms of Divide & Conquer and Greedy paradigms.

**CO4:** Analyze the algorithms of Dynamic Programming paradigm.

**CO5:** Design the algorithms of Backtracking and Brach & Bound paradigms.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    |
| <b>CO2</b> | 2   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    |
| <b>CO3</b> | 1   | 2   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    |
| <b>CO4</b> | 2   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    |
| <b>CO5</b> | 2   | 1   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    | -    |
| <b>CO2</b> | 2    | -    |
| <b>CO3</b> | 2    | -    |
| <b>CO4</b> | 2    | -    |
| <b>CO5</b> | 2    | -    |

### UNIT – I

**Introduction to Algorithm Analysis,** Space and Time Complexity analysis, Asymptotic Notations.

**Hashing:** Introduction to Static Hashing, Hash Tables, Hash Functions, Different Hash Functions, Collision Resolution Techniques, Dynamic Hashing.

#### Practice:

1. Write a program to implement collision resolution techniques of Hash data structure.

### UNIT – II

**AVL Trees** – Creation, Insertion, Deletion operations and Applications.

**B-Trees** – Creation, Insertion, Deletion operations and Applications

**Priority Queues (Heaps):** Introduction, Binary Heaps-Model and Simple Implementation, Basic Heap Operations, Other Heap Operations, Applications of Priority Queues

**Practice:**

1. Write a program to implement AVL tree operations
2. Write a program to implement Max heap and min heap operations

**UNIT – III**

**Divide and Conquer:** The General Method, Binary Search, Merge Sort, Quick Sort.

**Greedy Method:** The General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths.

**Practice:**

1. Write a program to sort the given list of elements using Merge sort technique using divide and conquer approach.
2. Write a program to implement Single Source Shortest Paths using greedy approach.

**UNIT – IV**

**Dynamic Programming:** The General Method, Single Source Shortest Paths– General Weights (Bellman Ford Algorithm), All-pairs shortest paths, Optimal Binary Search Trees, 0/1 Knapsack, Travelling Salesperson problem

**Practice:**

1. Write a program to implement 0/1 Knapsack problem using Dynamic Programming approach.
2. Write a program to implement all pairs shortest path problem using Dynamic Programming approach.

**UNIT – V**

**Backtracking:** The General Method, N-Queens Problem, Sum of Subsets problem, Graph Coloring, Hamiltonian cycles.

**Branch and Bound:** The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem.

**Practice:**

1. Write a program to implement N-Queens problem using backtracking algorithm.
2. Write a program to implement Travelling Salesperson problem using branch and bound approach.

**Text Books:**

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh, 2<sup>nd</sup> Edition Universities Press.
2. Computer Algorithms in C++, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, 2<sup>nd</sup> Edition University Press.

**Reference Books:**

1. Data Structures and program design in C, Robert Kruse, 2nd Edition Pearson Education Asia.
2. An introduction to Data Structures with applications, Trembley& Sorenson, McGraw Hill
3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison - Wesley.
4. Data Structures using C & C++: Langsam, Augenstein & Tanenbaum, Pearson

**Web Links:**

1. <https://archive.nptel.ac.in/courses/106/102/106102064/>
2. <https://archive.nptel.ac.in/courses/106/106/106106131/>
3. <http://peterindia.net/Algorithms.html>

## Compiler Design

(Common to CSE&IT)

**Course Code: 2501IT04**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Analyze the phases in compilation process.
- CO2:** Apply different parsing algorithms to develop parsers for a given grammar
- CO3:** Construct various forms of intermediate code.
- CO4:** Compare the storage allocation strategies.
- CO5:** Apply techniques to generate optimized and target code.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 3    |      |      |      |      |      |      | 1    | 1     |       |
| <b>CO2</b> | 2    | 3    | 1    |      | 1    |      |      |      | 1    | 1     |       |
| <b>CO3</b> | 3    | 2    |      |      |      |      |      |      | 1    | 1     |       |
| <b>CO4</b> | 2    | 2    |      |      |      |      |      |      | 1    | 1     |       |
| <b>CO5</b> | 2    | 2    | 1    |      |      |      |      |      | 1    | 1     |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 1    |      |
| <b>CO4</b> | 1    |      |
| <b>CO5</b> | 1    |      |

## UNIT – I

**Overview of Language Processing:** Language Processors, Structure of a Compiler.

**Lexical Analysis:** The Role of the Lexical Analyzer - Lexical Analysis Vs. Parsing, Tokens, Patterns and Lexemes, Lexical Errors, Regular Expressions, Regular Definitions, Recognition of Tokens, The Lexical-Analyzer Generator Lex.

### Practice:

- 1 a) Write a lex program which removes white spaces from its input file.
- b) Write a program to implement the lexical analyzer using JLex, flex, lex or other lexical analyzer generating tools.

## UNIT – II

### Syntax Analysis:

The Role of the Parser, Context Free Grammars- Derivations, Parse Trees, Ambiguity, Left Recursion, Left Factoring, Classification of Parsing Techniques.

### Top-Down Parsing:



Brute-Force Parsing, Recursive-Descent Parsing, First and Follow, LL(1) Grammars, Nonrecursive Predictive Parsing, Error Recovery in Predictive Parsing.

**Practice:**

1. Write a C program to implement Recursive Descent Parser for an expression.

### UNIT – III

**Bottom-Up Parsing:**

Reductions, Handle Pruning, Shift-Reduce Parsing, Why LR Parsers, The LR-Parsing Algorithm, Constructing SLR-Parsing Tables, More Powerful LR Parses - Construction of CLR(1), LALR Parsing Tables, Using Ambiguous Grammars.

**Practice:**

1. Write a C program to implement LALR bottom up parser for the given language.

### UNIT – IV

**Semantic Analysis:**

Syntax-Directed Definitions, Evaluation Orders for SDD's, Syntax Directed Translation.

**Intermediate Code Generation:** Three Address Code, Quadruples, Triples, Abstract Syntax Trees, Type Checker - Type Expressions, Type Conversion.

**Runtime Environments:**

Activation Record, Storage Organization, Storage Allocation Strategies – Static Allocation, Stack Allocation and Heap Allocation.

**Practice:**

1. Write a C program to implement intermediate code generation for simple expression.

### UNIT – V

**Code Optimization:** Basic Blocks & Flow Graphs, Machine-Independent Optimizations – The Principal Sources of Optimization: Common Subexpression Elimination, Copy Propagation, Dead Code Elimination, Code Motion, Induction Variables and Reduction in Strength, DAG Representation, Machine-dependent Optimization: Peephole Optimization.

**Code Generation:** Issues in the Design of a Code Generator, Object Code Forms, A Simple Code Generator, Register Allocation and Assignment.

**Practice:**

- 1 a) Write a C program to perform Loop Unrolling.  
b) Write a C program for constant propagation

**TextBooks:**

- 1 Compilers: Principles, Techniques and Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Second Edition, Pearson, 2007. ISBN: 978-1-29202-434-9
- 2 Modern compiler implementation in C, Andrew W Appel, Revised edition, Cambridge University Press ISBN: 978-0521607650

**Reference Books:**

- 1 Compiler Construction-Principles and Practice, Kenneth C Louden, Cengage Learning.  
ISBN: 978-0534939724
- 2 The Compiler Design Handbook, Y.N. Srikant and Priti Shankar, 2<sup>nd</sup> ed., CRC Press  
ISBN: 978-1420043822.

**Web Links:**

- 1 <https://nptel.ac.in/courses/106/108/106108113/>
- 2 <https://nptel.ac.in/courses/106/104/106104123/>

(Common to CSE, IT, AIML & CSE(DS))

**Course Code: 2501AI05**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Outline the Concepts of Machine Learning and Statistical Learning
- CO2:** Build Regression and Classification models for given data.
- CO3:** Apply Instance based Learning techniques and SVM techniques linear and nonlinear data.
- CO4:** Apply clustering techniques on high dimensional data to group the similar entities.
- CO5:** Make use of ensemble learning techniques to improve the performance of a model.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|-----|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    |     |      | 2    | 2    |      | 1    | 1    |       |       |
| <b>CO2</b> | 2    | 2    | 3   |      | 2    | 2    |      | 1    | 1    |       |       |
| <b>CO3</b> | 3    | 2    | 3   |      | 2    |      |      | 1    | 1    |       | 2     |
| <b>CO4</b> | 3    | 2    | 3   |      | 2    |      |      | 1    | 1    |       |       |
| <b>CO5</b> | 2    | 2    | 2   |      | 2    |      |      | 1    | 1    |       | 2     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 1    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

**UNIT – I**

**Introduction:**

Machine Learning, Types of Machine Learning Systems, Main Challenges of Machine Learning. Statistical Learning: Introduction, Supervised and Unsupervised Learning, Learning Problem, Feasibility of Learning.

**Practice :**

1. Installation of Jupyter/Spider notebook and working on basic commands.
2. Loading and apply key preprocessing techniques on the dataset and also analyse dataset.

**UNIT – II**

**Supervised Learning(Regression/Classification):Basic Methods:**

**Concept Learning:** General-to-Specific Hypotheses Ordering, Find-S and Candidate Elimination Algorithm, Version Space, and Inductive Bias.

**Bayesian Learning:** Probability Overview, MLE and MAP Estimates, Gaussian Naive Bayes Classifier, Bayesian Networks.

**Instance-based Learning:** k-Nearest Neighbour (kNN) Classifier, Voronoi Diagram and Distance-Weighted kNN, Distance Metrics and Curse of Dimensionality.

**Practice :**

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Exercises to solve the real-world problems using Binary Classifier
4. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.

**UNIT – III**

**Linear Models and Regression:** Linear Classification, Linear Regression, Non-linear Transformation, Logistic Regression.

**Support Vector Machines:** Decision Boundary and Support Vector: Optimization and Primal-Dual Problem, Soft Margin and Non-linear Decision Boundary, Kernel Functions and Radial Basis Functions introduction.

**Practice :**

1. Exercises to solve the real-world problems using Linear Regression
2. Exercises to solve the real-world problems using Logistic Regression
3. Consider Patient Dataset. Apply linear classification technique(SVM) to identify the rate of heart patients.

**UNIT – IV**

**Classifier / Hypothesis Evaluation:** Accuracy, Precision, Recall and F-Measures, Scores, Sampling, Bootstrapping and ROC, Hypotheses Testing and Cross-validation.

**Unsupervised Learning:**

**Clustering :** Partitional Clustering and Hierarchical Clustering, Cluster Types, Attributes and Salient Features, Hierarchical and Density-based Clustering Algorithms, Inter and Intra Clustering Similarity, Cohesion and Separation. MST and DBSCAN Clustering Algorithms.

**Practice :**

1. Develop a program for Bias, Variance, Remove duplicates , Cross Validation
2. Write a program to implement One-hot Encoding.
3. Write a program to implement Categorical Encoding.

## UNIT – V

### Ensemble Learning :

Bagging and Boosting, Adaboost and Random Forest ,

**Computational Learning Theory :** Error and Noise Formalisms, Training vs. Testing, Theory of Generalization, PAC Learnability and VC Dimensions , Overfitting, Regularization and Validation.

### Practice :

1. Write a program to demonstrate the working of Random Forest classifier. Use appropriate dataset for Random Forest Classifier.
2. Use a sentiment analysis dataset from Twitter or other social media platforms, available on platforms like Kaggle and apply bagging and boosting techniques for prediction.

### Additional Practice:

1. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
2. Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using kMeans algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

### Capstone Project:

#### Student Performance Prediction System

**Objective:** Predict a student's performance (pass/fail or score range) based on input features like study time, attendance, past grades, family background, etc.

**Domain:** Education

#### Techniques & Concepts Used:

- Supervised learning (Classification – Logistic Regression, SVM)
- Data preprocessing (handling nulls, encoding categorical variables)
- Evaluation metrics (accuracy, precision, recall)

### Text Books:

- 1 Hands On Machine Learning with ScikitLearn, Keras, and TensorFlow, 2nd Edition, O'Reilly Publications, 2019, ISBN: 978-1492032649
- 2 Data Science and Machine Learning Mathematical and Statistical Methods, Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, 2019, ISBN: 978-1138492530

### Reference Books:

- 1 Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, ISBN: 9780262018029
- 2 Machine Learning Tools, Dr Muddafa Maruli Krishna, Dr A Vanathi, Final Thawaksr, Dr Lokesh P. Gangani, publisher: Book Rivers, ISBN: 978-93-5515-730-0

### Web Links:

- 1 <https://www.deeplearning.ai/machinelearningyearning/>
- 2 <https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html>

## Big Data Analytics

(Common to CSE, IT, AIML & CSE(DS))

**Course Code:** 2501AI04

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Illustrate big data challenges in different domains
- CO2:** Use various techniques for mining data stream.
- CO3:** Demonstrate building blocks of Hadoop
- CO4:** Make use of Pig and Hive to structure big Data
- CO5:** Apply Spark tool to analyze big data.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    |      | 1    | 2    |      |      | 1    | 2    |       | 1     |
| <b>CO2</b> | 2    | 3    |      | 1    | 2    |      |      | 1    | 2    |       | 1     |
| <b>CO3</b> | 2    | 1    |      | 3    | 2    |      |      | 1    | 2    |       | 2     |
| <b>CO4</b> | 2    | 3    |      | 2    | 2    |      |      | 1    | 2    |       | 2     |
| <b>CO5</b> | 2    | 2    |      | 1    | 3    |      |      | 1    | 2    |       | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

### UNIT – I

**Introduction to big data:** Introduction to Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting.

#### Practice:

1. Hadoop File System Operations: Implement the following file management tasks in Hadoop: a.) Adding files and directories b.) Retrieving files c.) Deleting files

### UNIT – II

#### Stream Processing:

**Mining data streams:** Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform (RTAP) Applications.

#### Practice:

1. Loading DataSet in to HDFS for Spark Analysis.

## UNIT – III

**Introduction to Hadoop:** History of Hadoop, the Hadoop Distributed File System, Components of Hadoop Analyzing the Data with Hadoop, Scaling Out, Hadoop Streaming, Design of HDFS, Java interfaces to HDFS Basics, Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling, Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features Hadoop environment.

**Practice:**

1. Map Reduce Word Count Hadoop Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

## UNIT – IV

**Pig: Hadoop Programming Made Easier:** Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Checking out the Pig Script Interfaces, Scripting with Pig Latin. Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works with examples, Querying and Analyzing Data.

**Practice:**

1. Hive Queries a) Install Hive Framework b) Implement Hive to create, alter, and drop databases, tables
2. Hive Queries Implement hive queries and joins to perform display and retrieve the data

## UNIT – V

**Spark:** Installing Spark, Spark applications, Jobs, stages and Tasks, Resilient Distributed data sets, Shared Variables, Anatomy of a Spark job run.

**Practice:**

1. Demonstrate Spark SQL on Hive
  - a) Create a SQLContext object and load the Parquet file into DataFrame
  - b) Load the Dataframe into Hive table.
  - c) Verify the created Hive table in Hive environment
  - d) Execute Spark SQL query

**Text Books:**

1. Hadoop: The Definitive Guide, Tom White, O'reilly, 4<sup>th</sup> Edition, ISBN: 978-1491901632
2. Hadoop for Dummies, Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk, Bruce Brown, Rafael Coss, John Wiley & Sons, ISBN: 978-1118727128

**Reference Books:**

- 1 Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Bill Franks, John Wiley& sons, ISBN: 978-1118224912
- 2 Harness the Power of Big Data:The IBM Big Data Platform, Paul Zikopoulos, DirkdeRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, Tata McGraw Hill Publications, ISBN: 9780071808187

- 3 Big Data Science & Analytics: A Hands On Approach , Arshdeep Bahga and Vijay Madisetti, VPT, ISBN: 978-0996025577
- 4 Learning Spark: Lightning Fast Big Data Analysis Paperback, Holden Karau, ISBN: 978-1449358624

**Web Links:**

- 1 Hadoop: <http://hadoop.apache.org/>
- 2 Hive: <https://cwiki.apache.org/confluence/display/Hive/Home>
- 3 <https://nptel.ac.in/courses/106106142>
- 4 <https://www.cloudera.com/servicesandsupport/tutorials.html>
- 5 <https://www.databricks.com/spark/gettingstartedwithapachespark>



## Cryptography & Network Security

(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501IT03</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Explain Security Threats and Mathematical Foundations of Cryptography
- CO2:** Classify the basic principles of symmetric key algorithms.
- CO3:** Revise the basic principles of public key algorithms and Asymmetric key algorithms
- CO4:** Design applications of hash algorithms, digital signatures, and key management techniques
- CO5:** Determine the knowledge of Network layer security Protocols.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| <b>CO1</b> | 3   | 2   |     | 1   |     |     |     |     |     | 2    | 1    |
| <b>CO2</b> | 2   | 3   |     |     | 2   |     |     |     |     | 1    | 1    |
| <b>CO3</b> | 1   | 3   |     |     | 2   |     |     |     |     | 1    | 1    |
| <b>CO4</b> | 2   | 2   | 3   | 2   |     |     |     |     |     | 2    | 2    |
| <b>CO5</b> | 3   | 2   |     |     |     |     |     |     |     | 2    | 2    |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 1    |      |

### UNIT – I

**Basic Principles:** Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography (Integer Arithmetic, Modular Arithmetic, Matrices, Linear Congruence).

### Practice:

- Write a program to obtain GCD of two numbers using Euclidean Algorithm
- Write a c program to implement elliptical curve cryptography algorithm

## UNIT – II

**Symmetric Encryption:** Traditional Symmetric Key Ciphers (Introduction, Substitution ciphers, Transposition ciphers, Stream and block ciphers), Data Encryption Standard, Advanced Encryption Standard.

**Practice:**

1. Write a C program to implement Mono alphabetic substitution cipher
2. Write a C program to implement Vernam Cipher

## UNIT – III

**Asymmetric Encryption:** Mathematics of Asymmetric Key Cryptography ( Euler's Phi Function, Fermat's Little Theorem, Euler's Theorem, Chinese Remainder Theorem), Asymmetric Key Cryptography( Introduction, RSA Cryptography, Diffie Hellman key exchange, Rabin Cryptosystem, Elgamal Cryptosystem)

**Practice:**

1. Write a C program to implement Rabin Cryptosystem

## UNIT – IV

**Digital Signature Schemes & Key Management:** Message Integrity and Message Authentication, Cryptographic Hash Functions (SHA-512), Digital Signatures(Process, Services, Attacks), Key Management (Kerberos, X.509).

**Practice:**

1. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.

## UNIT – V

**Network Security:** PGP and S/MIME, SSL and TLS, IPsec ( Modes, Security Protocols), IPC.

**Practice:**

1. Implement the following forms of IPC
  - a. Pipes
  - b. FIFO

### Capstone Project:

1. Design and implement a Secure Messaging Application that ensures confidentiality and integrity of messages using Hybrid Cryptography (combination of symmetric and asymmetric encryption). Use RSA or ElGamal for secure key exchange and AES for encrypting the actual message content. Implement SHA-512 to generate message digests for integrity verification. The application should support basic message exchange between two users with proper key management. Demonstrate the working of encryption, decryption, key generation, and integrity verification through a user-friendly interface or command-line tool.

### Text Books:

1. Cryptography and Network Security: Principles and Practice, William Stallings, Pearson, 9<sup>th</sup> Edition , ISBN-13: 9781292742366, 2023.
2. Introduction to Modern Cryptography: Principles and Protocols, Jonathan Katz, Yehuda Lindell, CRC Press, 4<sup>th</sup> Edition , ISBN 13: 9781584885511, 2023.

### Reference Books:

1. Understanding Cryptography: A Textbook for Students and Practitioners, Christof Paar, Jan Pelzl, Springer, 2nd Edition, 2020, ISBN: 978-3642041006.  
Network Security Essentials: Applications and Standards, William Stallings, Pearson,
2. 7th Edition, 2023, ISBN: 978-8131761755

**Web Links:**

- 1 <https://nptel.ac.in/courses/106105031>
- 2 <https://users.cs.northwestern.edu/~ychen/classes/cs395-w05/lectures.html>

## Software Architecture (Common to CSE&IT)

**Course Code: 2501CS15**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Explain architectural styles of software
- CO2:** Illustrate software architectural models
- CO3:** Analyze quality attributes of software architecture
- CO4:** Explain architectural and design process.
- CO5:** Explain user interface architecture design for real time applications

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 1    |      | 3    | 2    |      |      |      |      |       | 2     |
| <b>CO2</b> | 2    | 2    | 3    | 2    | 2    |      |      |      |      |       | 1     |
| <b>CO3</b> | 2    | 1    | 1    | 1    | 3    |      |      |      |      |       | 1     |
| <b>CO4</b> | 2    | 3    |      | 2    | 2    |      |      |      |      |       | 2     |
| <b>CO5</b> | 2    | 3    | 1    | 1    | 2    |      |      |      |      |       | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 1    |      |
| <b>CO4</b> | 1    |      |
| <b>CO5</b> | 1    |      |

### UNIT – I

Introduction- Software Architecture- Definition Prospects- State of Art-Architectural Styles-Pipes and Filters-Layered Systems-Repositories-Process Control, Other familiar Architecture-Heterogeneous Architectures

#### Practice:

1. Study case tools such as rational rose or equivalent tools

### UNIT – II

The Architecture Business Cycle, what is Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures and views.

#### Practice:

1. Requirements implementation of requirements engineering activities such as elicitation, validation management using case tools

### UNIT – III

Creating and Architecture Quality Attributes, achieving qualities, Architectural styles and patterns, designing the Architecture, Documenting software architectures, Reconstructing Software Architecture.

**Practice:**

1. Study and usage of software project management tools such cost estimates and scheduling

### UNIT – IV

Architecture Evaluation, Architecture design decision making, Building systems from off the shelf components, Software architecture in future.

**Practice:**

1. Exposure towards test plan generators, test case generators, test coverage and software metrics

### UNIT – V

Architecture design- Introduction Shared Information System, Architecture Structures for Shared Information Systems. Architecture design guidance-User Interface Architecture. Case study: Design of User Interface Design.

**Practice:**

1. Case study: Design of User Interface Design

**Text Books:**

- 1 Software Architecture in **Practice**, second edition, Len Bass, Paul Clements & Rick Kazman, Pearson Education. ISBN :9788177589962
- 2 Designing Software Architectures: A Practical Approach" by Humberto Cervantes and Rick Kazman ISBN: 978-0134390789

**Reference Books:**

- 1 Beyond Software architecture, Luke Hohmann, Addison wesley. ISBN:9780201775945
- 2 Software architecture, David M. Dikel, David Kane and James R. Wilson, Prentice Hall PTR. ISBN: 9780130290328

**Web Links:**

- 1 <https://nptel.ac.in/courses/106105224>
- 2 <https://www.geeksforgeeks.org/fundamentals-of-software-architecture/>
- 3 <https://core.ac.uk/download/pdf/36753454.pdf>

### Multidisciplinary Courses (MDC)

| Course Code  | Course Name                                | Level | L        | T        | P        | C        | CIE | SEE | Total | Pre-requisite |
|--------------|--------------------------------------------|-------|----------|----------|----------|----------|-----|-----|-------|---------------|
| 2501EC95     | Digital Logic Design                       | FC    | 2        | 1        |          | 3        | 50  | 50  | 100   | -             |
| 2501EE01     | Basic Electrical & Electronics Engineering | FC    | 2        |          | 2        | 4        | 50  | 50  | 100   | -             |
| 2501MB01     | Engineering Economics & Management         | FC    | 2        |          |          | 2        | 50  | 50  | 100   | -             |
| <b>Total</b> |                                            |       | <b>6</b> | <b>1</b> | <b>2</b> | <b>9</b> |     |     |       |               |

**Digital Logic Design**  
(Common for CSE, AIML, DS and IT)

**Course Code: 2501EC95**

**L      T      P      C**  
**2      1      0      3**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO 1:** Understand various number systems, perform conversions between them, and apply binary codes in digital representations. (BTL: 2)
- CO 2:** Understand basic Boolean algebra rules and simplify Boolean expressions using Karnaugh maps. (BTL:
- CO 3:** Design and implement basic combinational logic circuits such as adders, decoders, and multiplexers.
- CO 4:** Apply the concepts of flip-flops to implement basic sequential circuits like registers, and counters.
- CO 5:** Develop logic circuits using PLDs such as PROM, PAL, and PLA by utilizing programming tables.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    |      |      |      |      |      | 2    | 1    |       | 1     |
| <b>CO2</b> | 2    | 2    |      |      |      |      |      | 2    | 1    |       | 1     |
| <b>CO3</b> | 2    | 2    | 3    | 1    |      |      |      | 2    | 1    |       | 1     |
| <b>CO4</b> | 2    | 2    | 3    | 1    |      |      |      | 2    | 1    |       | 1     |
| <b>CO5</b> | 2    | 2    | 3    | 1    |      |      |      | 2    | 1    |       | 1     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 3    |
| <b>CO4</b> |      | 3    |
| <b>CO5</b> |      | 3    |

**UNIT-I:**

**Digital Systems and Binary Numbers**

Digital Systems, Binary Numbers, Number based Conversions, Octal & Hexadecimal Numbers, Complements – r's complement, (r-1)'s complement, Signed binary Numbers, Arithmetic addition and subtraction, Binary Codes: BCD, 2421, 8421, Excess-3, Gray codes.

**UNIT-II:**

**Concept of Boolean algebra and Gate Level Minimization**

Basic Definitions, Axioms and laws, Basic Theorems & Properties of Boolean algebra, Boolean Functions, Canonical and Standard Forms, Digital logic gates, The Map Method –

Two-Variable, Three-Variable, Four-Variable K-Maps. Product of Sums Simplification, Sum of Products Simplification, Don't Care Conditions.

### **UNIT–III:**

#### **Combinational Logic**

Review of adders, half subtractor, full subtractor, ripple carry adder, 4-bit binary adder/subtractor circuit, BCD adder, Decoders, encoders, priority encoder, multiplexers, demultiplexers, one bit comparator, realization of Boolean functions using decoders & multiplexers.

### **UNIT–IV:**

#### **Sequential Circuits**

Introduction to Sequential Circuits, Latches, RS- Latch Using NAND and NOR Gates, Flipflops, Truth Tables. RS, JK, D and T Flip Flops, Truth and Excitation Table.

#### **Registers and Counters**

Registers, Shift Registers, Universal Shift register, Ripple Counters – Binary Ripple counter, BCD ripple counter, Synchronous Counters – Binary counter, Up-down Counter, BCD counter, Ring Counter, Johnson Counter

### **Unit-V:**

**Programmable Logic Devices:** Introduction to PLDs: PROM, PAL, PLA-Basics structures, realization of Boolean function with PLDs, comparison, merits & demerits of PROM, PAL, PLA.

#### **Text Books:**

1. Switching and Finite Automata Theory, ZviKohavi& Niraj K.Jha, 3rdEdition, ISBN: 978-0521857482.
2. Digital Design, Morris Mano, Pearson, 3rd Edition, ISBN: 978-8178085555.

#### **Reference Books:**

1. Modern Digital Electronics, RP Jain, Tata Mc Graw Hill, 5thEdition, 2022, ISBN: 978-9355321770.
2. Fundamentals of Logic Design, Charles H. Roth Jr., Jaico Publishers, ISBN: 978-0534378042.

#### **Web Links:**

1. <http://nptel.ac.in/courses/117/106/117106086/> (By Prof. Goutam Saha, Electronics & Electrical Communication Engineering Dept, IIT Kharagpur)
2. [www.nptelvideos.in/2012/12/digital-circuits-and-systems.html](http://www.nptelvideos.in/2012/12/digital-circuits-and-systems.html)(By Prof. Santanu Chattopadhyay, Electronics & Electrical Communication Engineering Dept, IIT Kharagpur).
3. <https://www.smartzworld.com/notes/switching-theory-and-logic-design-stld/>.



**Basics of Electrical & Electronics Engineering**  
(Common to CE,ME,ECE,CSE,IT,AI ML,CSE(DS),PT&Min.E)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501EE01</b> | <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO 1:** Analyze the concepts associated to AC and DC circuits.
- CO 2:** Explain the operating principles of motors, generators and measuring instruments.
- CO 3:** Analyze the Different Energy Resources and Equipment Safety Measures.
- CO 4:** Explain the concept and the applications of semiconductor Diodes.
- CO 5:** Analyze the Basic Electronic Circuits and interpret numeric information in different code formats.

**Mapping of course outcomes with program outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1   | 2   | 3   | 1   |     | 1   |     |     |     | 2   | 2    |      |
| CO2   | 2   | 3   | 1   |     |     |     |     |     | 2   | 2    |      |
| CO3   | 3   | 2   | 1   |     |     |     |     |     | 2   | 2    |      |
| CO4   | 3   | 2   | 1   |     |     |     |     |     | 2   | 2    |      |
| CO5   | 3   | 2   | 1   |     |     |     |     |     | 2   | 2    |      |

**UNIT-I:**

**DC & AC Circuits:**

**DC circuits:** Ohm's and Kirchhoff's laws, analysis of series, parallel and series-parallel circuits excited by independent voltage sources for R, L, C parameters, current division, voltage division

**AC circuits:** Generation of sinusoidal voltage, frequency of generated voltage, average value, RMS value, form, and peak factors. Real power, reactive power, apparent power, and Power factor.

**Practice:**

1. Verification of Ohm's Law.
2. Verification of KCL and KVL.
3. Verification of KCL, KVL and ohm's law using simulation.

**UNIT-II:**

**Machines and Measuring Instruments:**

Principles and operation of DC machines, Transformers – Synchronous Machines - three Phase and single phase induction motors - Moving coil and moving iron instruments, Wheatstone bridge and Megger.

**Practice:**

1. To study Magnetisation Characteristics of DC shunt generator
2. Measurement of Power and Power factor using Single-phase wattmeter
3. Measurement of Resistance using Wheat stone bridge
4. Measurement of Earth Resistance using Megger.

### **UNIT-III:**

Energy Resources, Electricity Bill & Safety Measures

Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Thermal, Solar & Wind power generation. Calculation of electricity bill for domestic appliances. Working principle of Fuse and Miniature circuit breaker (MCB). Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

#### **Practice:**

1. Calculation of Electrical Energy for Domestic Premises

### **UNIT-IV:**

#### **Semiconductor Devices**

Intrinsic semiconductors – Extrinsic semiconductors - P type and N type - P-N junction characteristics of P N Junction Diode — Zener Effect — Zener Diode and its Characteristics. working of simple zener voltage regulator and amplifier- Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics.

#### **Practice:**

1. Sketch the V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Sketch the V-I characteristics of Zener Diode and its application as voltage Regulator
3. Plot Input & Output characteristics of BJT in CE and CB configurations.
4. Obtain Frequency response of CE amplifier.

### **UNIT-V:**

#### **Basic Electronic Circuits**

Block diagram description of a dc power supply, working of a half and full wave, bridge rectifier, filters.

#### **Digital Electronics**

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adders

#### **Practice:**

1. Implementation of half wave and full wave rectifiers.
2. Design Half Adder and Full Adder circuits.
3. Verification of truth table for Logic gates using ICs.

**Text Books:**

1. Basic Electrical and Electronics Engineering, Salivahanan S, Tata McGraw Hill Education (India) Private Limited, New Delhi, ISBN: 9789389691801.
2. Principles of Electrical Engineering, V. K. Mehta, R. Mehta, S. Chand & Company Ltd., New Delhi, ISBN-13: 9788121930888
3. Digital Fundamentals, Thomas Floyd, Prentice Hall, 10th Edition, ISBN: 9780132737968).

**Reference Books:**

1. Electronic Devices & Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson, 11/e, ISBN: 9780135026496.
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co., ISBN: 9788177000207.

**Web Links:**

1. <https://nptel.ac.in/courses/108/101/108101091/> (NPTEL Video by Dr.Mahesh B. Patil from IIT Bombay)
2. <https://nptel.ac.in/courses/117/106/117106108/> ( NPTEL Video by Prof. Nagendra Krishnapura from IIT Madras)

**Engineering Economics & Management**  
(Common to CE, EEE, ME, CSE, IT, AIML & CSE (DS))

**Course Code: 2501MB01**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>0</b> | <b>2</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain the Business Economic concepts, law of demand and forecasting methods.
- CO2:** Identify the production, cost behavior for managerial decision making with Break-Even Point (BEP).
- CO3:** Make use of financial accounting and capital budgeting techniques for decision making.
- CO4:** Summarize management and motivational theories to renovate the practice of Management.
- CO5:** Illustrate the functional management and project management using PERT and CPM.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   |      |      |      |      |      |      |      |      | 2    | 2     |       |
| CO2   | 1    |      |      |      |      |      |      |      |      |       | 2     |
| CO3   |      |      |      |      |      |      |      |      |      |       | 3     |
| CO4   | 1    |      |      |      |      |      |      |      | 1    | 1     | 2     |
| CO5   |      |      |      |      |      |      |      |      |      |       | 3     |

**UNIT – I**

**Introduction to Managerial Economics and demand Analysis:**

Definition of Managerial Economics –Scope of Managerial Economics- Concept of Demand, Types of Demand, Determinants of Demand- Law of Demand and its limitations- Elasticity of Demand, Types- Demand forecasting and its Methods.

**UNIT – II**

**Production and Cost Analyses:**

Concept of Production function Law of Variable Proportions-Isoquants and Isocosts - Producer Equilibrium-, cost concepts: opportunity costs, explicit and implicit costs- Fixed costs, Variable Costs – Cost –Volume-Profit Analysis-Determination of Breakeven point (simple problems).

**UNIT – III**

Introduction to Markets and Financial Accounting: Market Structures-Classification of markets, Introduction to Financial Accounting , Concepts and conventions, Accounting cycle, Journal entries and Ledger (Simple Problems), Methods of capital budgeting (Simple Problems).

## **UNIT – IV**

### **Operations Management :**

Concept nature and importance of Management, Generic Functions of Management, Theories of Motivation, Plant location and layout, Principles of organization, SWOT analysis.

Material Management: Need for Inventory control, EOQ, ABC analysis

## **UNIT – V**

### **Functional Management And Project Management**

Concept of HRM , HRD and PMIR, Functions of HR Manager , Job Evaluation and Merit Rating , Marketing Management, Functions of Marketing , Channels of distributions - Development of Network , Difference between PERT and CPM, Finding Critical Path (Simple Problems)

### **Text Books:**

- 1 Managerial Economics and Financial Analysis, A. R. Aryasri , McGraw Hill Education, ISBN: 978-0070078031
- 2 Managerial Economics and Financial Analysis', N. Appa Rao, P. Vijay Kumar, Cengage Publications, New Delhi, ISBN: 978-8131515952
- 3 Management Science by Aryasri; Publisher: Tata McGraw Hill, 2009, ISBN: 978-0070090279
- 4 Management by James Arthur, Finch Stoner, R. Edward Freeman, and Daniel R. Gilbert 6th Ed; Publisher: Pearson Education/Prentice Hall, ISBN: 978-0131087477

### **Reference Books:**

- 1 Principles of Marketing: A South Asian Perspective by Kotler Philip, Gary Armstrong, Prafulla Y. Agnihotri, and Eshanul Haque, 13th Edition, Publisher: Pearson Education/ Prentice Hall of India, ISBN: 9788131731017
- 2 A Handbook of Human Resource Management Practice by Michael Armstrong, 2010; Publisher: Kogan Page Publishers, ISBN: 978-1789661033

### **Web Links:**

- 1 [www.managementstudyguide.com](http://www.managementstudyguide.com)
- 2 [www.citehr.com](http://www.citehr.com)
- 3 [www.nptel.ac.in/courses/122106032](http://www.nptel.ac.in/courses/122106032)
- 4 [www.btechguru.com/courses--nptel--basic-course](http://www.btechguru.com/courses--nptel--basic-course)

### Ability Enhancement Courses (AEC)

| Course Code  | Course Name                              | Level | L        | T | P        | C        | CIE | SEE | Total | Pre-requisite |
|--------------|------------------------------------------|-------|----------|---|----------|----------|-----|-----|-------|---------------|
| 2501EN01     | Essential Cognitive Skills for Engineers | FC    |          |   | 1        | 1        | 100 | -   | 100   | -             |
| 2501UC07     | Design Thinking using AI                 | FC    |          |   | 1        | 1        | 100 | -   | 100   | -             |
| 2501EN02     | Advanced Cognitive Skills for Engineers  | FC    |          |   | 1        | 1        | 100 | -   | 100   | ECSE-I        |
| 2501UC08     | Universal Human Values                   | FC    | 2        |   |          | 2        | 100 | -   | 100   | -             |
| 2501UC09     | Technical Paper Publication              | AC    |          |   | 2        | 2        | 100 | -   | 100   | -             |
| 2501CS72     | Student Activity Based Learning          | AC    |          |   |          | 2        | 100 | -   | 100   | -             |
| <b>Total</b> |                                          |       | <b>2</b> |   | <b>7</b> | <b>9</b> |     |     |       |               |

## Essential Cognitive Skills for Engineers

(Common to all branches)

**Course Code: 2501EN01**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>1</b> | <b>1</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Recognize the different aspects of the English language proficiency with emphasis on LSRW skills.
- CO2:** Apply communication skills through various language learning activities.
- CO3:** Analyze the English speech sounds, stress, intonation and syllable division for better listening and speaking comprehension.
- CO4:** Enable them to learn and apply fundamentals of English grammar concepts for improved language
- CO5:** Make use of various types of vocabulary in different academic and professional careers

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1   | -   | -   | -   | -   | -   | -   | -   | -   | 3   | -    | -    |
| CO2   | -   | -   | -   | -   | -   | -   | -   | -   | 3   | -    | -    |
| CO3   | -   | -   | -   | -   | -   | -   | -   | -   | 3   | -    | -    |
| CO4   | -   | -   | -   | -   | -   | -   | -   | -   | 3   | -    | -    |
| CO5   | -   | -   | -   | -   | -   | -   | -   | -   | 3   | -    | -    |

Practice:

#### Unit – 1

#### Outstanding people A/B/C/D

|               |                                                                                                                                                            |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Listening     | Conversation about Jocelyn Bell- Burnell, Podcast: The 30-day challenge, Starting a new job, Conversation about technology                                 |
| Speaking      | Discussing inspiring people, Asking and answering questions about challenges, Explaining a process; Checking understanding, Discussing technology.         |
| Reading       | Articles: <i>Protector of the sea</i> and <i>The woman who reinvented children's TV</i> , Interviews: <i>30-day challenge</i> , Article: <i>Tech free!</i> |
| Writing       | Article Organizing an article                                                                                                                              |
| Grammar       | Review of Tenses, Questions                                                                                                                                |
| Vocabulary    | Character adjectives, trying and succeeding                                                                                                                |
| Pronunciation | The letter e; Word stress, Rapid speech                                                                                                                    |

#### Unit – 2

#### Survival A/B/C/D

|           |                                                                                                                                  |
|-----------|----------------------------------------------------------------------------------------------------------------------------------|
| Listening | Conversation about a survival situation, Interview: The Tiger, Cooking for a friend, Talking about getting lost                  |
| Speaking  | Telling a survival story, Giving advice; Asking questions, Giving compliments and responding, Discussing the natural environment |
| Reading   | Article: <i>Lost at sea</i> , Leaflet: <i>How to survive...an animal attack</i> , Leaflet: <i>Be wise and survive</i>            |

|               |                                                           |
|---------------|-----------------------------------------------------------|
| Writing       | Guidelines, organizing guidelines in a leaflet            |
| Grammar       | Narrative tenses, Future time clauses and conditionals    |
| Vocabulary    | Expressions with <i>get</i> , Animals and the environment |
| Pronunciation | Sound and Spelling: g, Intonation in question tags        |

### **Unit – 3 Talent A/B/C/D**

|               |                                                                                                                                                                |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Listening     | Conversation: learning experiences, Radio Programme: The sports gene, Making wedding plans, Interviews about sport                                             |
| Speaking      | Talking about something you have put a lot of effort into, Discussing sport and ways to improve performance, planning a party, Talking about popular sports    |
| Reading       | Text about learning; <i>Learning to learn</i> , Article: <i>Born to be the best</i> ; Three articles about athletes, Article: <i>Fitness: Seattle snapshot</i> |
| Writing       | Article describing data                                                                                                                                        |
| Grammar       | Multi-word verbs, Present perfect and present perfect continuous                                                                                               |
| Vocabulary    | Ability and achievement, word connected with sport                                                                                                             |
| Pronunciation | Word stress, sound and spelling consonant sounds                                                                                                               |

### **Unit – 4 Life Lessons A/B/C/D**

|               |                                                                                                                                                                                  |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Listening     | Interview: Psychology of money; Two monologues: Life-changing events, Two monologues; training for a job, Presenting photos, Three monologues; living in different places        |
| Speaking      | Talking about how your life has changes, Discuss experiences of training and rules, Describing photos: Expressing careful disagreement, Discussing living in a different country |
| Reading       | Two texts about life-changing events that helped people become rich, Article: <i>Training for the emergency frontline</i> , Advert for being an international student ‘buddy’    |
| Writing       | Job application, Giving a positive impression                                                                                                                                    |
| Grammar       | <i>Used to</i> and <i>would</i>                                                                                                                                                  |
| Vocabulary    | Cause and result, Talking about difficulty                                                                                                                                       |
| Pronunciation | Sound and spelling: <i>u</i>                                                                                                                                                     |

### **Unit – 5 Chance A/B/C/D**

|               |                                                                                                                                                                                                                                                 |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Listening     | Monologue: What are your chances?, Conversation: Talking about work, Money problems, News reports: environmental problems                                                                                                                       |
| Speaking      | Discussing possible future events, Role Play: job interview, Explaining and responding to an idea for a café, Giving opinions on environmental problems                                                                                         |
| Reading       | Quiz: <i>Are you an optimist or a pessimist?</i> ; Article: <i>Why we think we’re going to have a long and happy life</i> , Quiz: <i>The unknown continent</i> ; Article: <i>Cooking in Antarctica</i> , Essay about protecting the environment |
| Writing       | For and against essay, Arguing for and against an idea                                                                                                                                                                                          |
| Grammar       | Future probability, Future perfect and future continuous                                                                                                                                                                                        |
| Vocabulary    | Adjectives describing attitude, The natural world                                                                                                                                                                                               |
| Pronunciation | Sound and spelling : <i>th</i> , Intonation groups                                                                                                                                                                                              |



**Text Book:**

Cambridge Empower – Second Edition B2 Level - Adrian Doff, Craig Thaine,

- 1 Herbert Puchta, Jeff Stranks, Peter Lewis – Jones, ISBN: 978-1107468726

**Suggested Software:**

- 1 Cambridge Empower
- 2 Soft X (K-Van Solutions)

**Reference Books:**

- 1 M Ashraf Rizvi: Effective Technical Communication, ISBN: 9352605780
- 2 Raymond Murphy: English Grammar in Use, Cambridge University Press. Fifth Edition, ISBN: 978-3125354241
- 3 J. Sethi & P.V. Dhamija. A Course in Phonetics and Spoken English, (2nd Ed), Kindle, ISBN: 9788120314955

**Web Links:**

- 1 [www.cambridgeone.org](http://www.cambridgeone.org)
- 2 <https://www.britishcouncil.in/english/online>
- 3 [www.englishmedialab.com](http://www.englishmedialab.com)

**Design Thinking using AI**  
(Common to CE,ME,ECE,CSE,IT,AI ML,CSE(DS),PT&Min.E)

**Course Code: 2501UC07**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>1</b> | <b>1</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Appreciate various design process procedure
- CO2:** Generate and develop design ideas through different technique
- CO3:** Identify the significance of reverse Engineering to Understand products
- CO4:** Draw technical drawing for design ideas
- CO5:** Illustrate design teams to create feasible and user-focused solutions to complex problems in design.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   |      |      |      |      |      |      |      | 2    | 2    |       |       |
| CO2   |      |      |      |      |      |      |      |      |      | 2     |       |
| CO3   |      |      |      |      |      |      |      |      |      | 3     |       |
| CO4   |      |      |      |      |      |      |      | 1    | 1    | 2     |       |
| CO5   |      |      |      |      |      |      |      |      |      | 3     |       |

**UNIT – I**

**Process of Design Understanding Design thinking:** Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping.

**UNIT – II**

Tools for Design Thinking: Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design

Practice using any AI tool:

Students are advised to use any AI tool like Otter AI etc for Transcribe interviews automatically and summarize user insights.

**UNIT – III**

Design Thinking in IT: Design Thinking to Business Process modelling – Agile in Virtual collaboration environment – Scenario based Prototyping

Practice using any AI tool:

Students are advised to use any AI tool like ChatGPT, Claude, Perplexity etc to define, synthesize, ideate and prototype.

#### **UNIT – IV**

DT For strategic innovations: Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design.

Practice using any AI tool:

Students are advised to use any AI tool like looka, logomkr, canva and figma etc for logo, prototyping and sketching.

#### **UNIT – V**

**Design thinking workshop:** Design Thinking Work shop Empathize, Design, Ideate, Prototype and Test.

#### **Text Books:**

- 1 Engineering Design by John. R. Karsnitz, Stephen O'Brien and John P. Hutchinson, Cengage learning (International edition) Second Edition. ISBN: 9781133708766
- 2 The Design of Business: Why Design Thinking is the Next Competitive Advantage Roger Martin by Harvard Business Press. ISBN: 9781422177808

#### **Reference Books:**

- 1 Engineering Design Process by Yousef Haik and Tamer M. Shahin, Cengage Learning, Second Edition. ISBN: 978-8131529041
- 2 Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author). ISBN: 978-0231163569

#### **Web Links:**

- 1 [www.tutor2u.net/business/presentations/. /Product lifecycle/default.html](http://www.tutor2u.net/business/presentations/. /Product lifecycle/default.html)
- 2 [https://docs.oracle.com/cd/E11108\\_02/otn/pdf/. /E11087\\_01.pdf](https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf)

## Universal Human Values

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

|                       | L | T | P | C |
|-----------------------|---|---|---|---|
| Course Code: 2501UC08 | 1 | 1 | 0 | 2 |

**Pre Requisites:** Universal Human Values (UHV-I) (desirable).

### Course Objectives:

This course input is intended

1. To help the students appreciate the complementarity between 'VALUES' and 'SKILLS' and understand how ethical foundations enhance technical competence to achieve sustainable happiness, prosperity, and responsible professional growth.
2. To develop a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a right understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values (UHV) and movement towards value-based living in a natural way.
3. To highlight real-world implications of Holistic understanding of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. To encourage the students to realise their full potential and act accordingly.
5. To assist the students to live with a feeling of relationship, harmony and co-existence.

Thus, this course is intended to provide a much-needed input in value education to the young enquiring minds.

### Course Outcomes:

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

**CO1:** Demonstrate an understanding of basic human aspiration and the concept of Natural Acceptance and apply them in personal and professional decision-making.

**CO2:** Develop self-awareness and practice self-regulation.

**CO3:** Recognize human-human relationship (Justice) and identify human goals in society.

**CO4:** Appreciate the harmony in nature and existence.

**CO5:** Develop as socially and ecologically responsible engineers in handling problems with sustainable solutions (user-friendly and eco-friendly).

## UNIT I INTRODUCTION TO VALUE EDUCATION

Lecture 1: Holistic Development and the Role of Education (Right Understanding, Relationship and Physical Facility)

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 - Sharing about Oneself

Lecture 3: Self-Exploration as the Process for Value Education

Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 - Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 - Exploring Natural Acceptance.

## UNIT II HARMONY IN THE HUMAN BEING

Lecture 7: Understanding Human being as the Co-existence of the self and the body

Lecture 8: Distinguishing between the Needs of the self and the body

Tutorial 4: Practice Session PS4 - Exploring the difference of Needs of self and body

Lecture 9: The body as an Instrument of the self  
Lecture 10: Understanding Harmony in the self  
Tutorial 5: Practice Session PS5 - Exploring Sources of Imagination in the self  
Lecture 11: Harmony of the self with the body  
Lecture 12: Programme to ensure self-regulation and Health  
Tutorial 6: Practice Session PS6 - Exploring Harmony of self with the body.

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

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction  
Lecture 14: 'Trust' – the Foundational Value in Relationship  
Tutorial 7: Practice Session PS7 - Exploring the Feeling of Trust  
Lecture 15: 'Respect' – as the Right Evaluation  
Tutorial 8: Practice Session PS8 - Exploring the Feeling of Respect  
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship  
Lecture 17: Understanding Harmony in the Society  
Lecture 18: Vision for the Universal Human Order  
Tutorial 9: Practice Session PS9 - Exploring Systems to fulfil Human Goal

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

Lecture 19: Understanding Harmony in Nature  
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature  
Tutorial 10: Practice Session PS10 - Exploring the Four Orders of Nature  
Lecture 21: Realizing Existence as Co-existence at All Levels  
Lecture 22: The Holistic Perception of Harmony in Existence  
Tutorial 11: Practice Session PS11 - Exploring Co-existence in Existence.

### **UNIT V IMPLICATIONS OF THE HOLISTIC UNDERSTANDING A LOOK AT PROFESSIONAL ETHICS**

Lecture 23: Natural Acceptance of Human Values  
Lecture 24: Definitiveness of (Ethical) Human Conduct  
Tutorial 12: Practice Session PS12 - Exploring Ethical Human Conduct  
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order  
Lecture 26: Competence in Professional Ethics  
Tutorial 13: Practice Session PS13 - Exploring Humanistic Models in Education  
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies  
Lecture 28: Strategies for Transition towards Value-based Life and Profession  
Tutorial 14: Practice Session PS14 - Exploring Steps of Transition towards Universal Human Order

#### **Text Books:**

1. R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 3<sup>rd</sup> Revised Edition, UHV Publications, Sarva Shubha Nyas, Kanpur, 2023. ISBN: 978- 81-957703-7-3 (Printed Copy) ISBN: 978-81-957703-6-6 (e-book)
2. R R Gaur, R Asthana, G P Bagaria, *Teachers' Manual for a Foundation Course in Human Values and Professional Ethics*, 3<sup>rd</sup> Revised Edition, UHV Publications, Sarva Shubha Nyas, Kanpur, 2023.

**Reference Books:**

1. *Jeevan Vidya: Ek Parichaya*, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999
2. *Human Values*, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. *The Story of Stuff* (Book), Annie Leonard, Free Press, 2010.
4. *The Story of My Experiments with Truth*, Mohandas Karamchand Gandhi, Fingerprint! Publishing
5. *Small is Beautiful* - E. F Schumacher, Random House, 2011.
6. *Slow is Beautiful* - Cecile Andrews, New Society Publishers, 2006
7. *Economy of Permanence* - J C Kumarappa
8. *Vivekananda* - Romain Rolland

**Online Resources**

1. <https://fdp-si.aicte-india.org/index.php>
2. [https://onlinecourses.swayam2.ac.in/aic22\\_ge23/preview](https://onlinecourses.swayam2.ac.in/aic22_ge23/preview)
3. <https://uhv.org.in/>
4. <https://www.youtube.com/@UniversalHumanValues/playlists>

**Advanced Cognitive Skills for Engineers**  
(Common to all branches)

**Course Code: 2501EN02**

**L T P C**  
**0 0 2 1**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Recognize the basics of communication and summarize formal and informal language expressions in all aspects.
- CO2:** Establish and maintain interpersonal relationships and transmit the message through different language activities.
- CO3:** Use language effectively to prepare and demonstrate proficiency in facing various types of interviews.
- CO4:** Demonstrate and exhibit professionalism in participating in various public speaking activities like debates, group discussions and presentation skills.
- CO5:** Identify the basic elements of writing and apply the fundamentals to compose e-mails catering to different professional needs.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1   | -   | -   | -   | -   | -   | -   | -   | -   | -   | 3    | -    |
| CO2   | -   | -   | -   | -   | -   | -   | -   | -   | -   | 3    | -    |
| CO3   | -   | -   | -   | -   | -   | -   | -   | -   | -   | 3    | -    |
| CO4   | -   | -   | -   | -   | -   | -   | -   | -   | -   | 3    | -    |
| CO5   | -   | -   | -   | -   | -   | -   | -   | -   | -   | 3    | -    |

**List of the Topics**

**Unit – 1                      Around the globe A/B/C/D**

|               |                                                                                                                                          |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Listening     | Two monologues about sightseeing tours, Interview: disappearing languages, Asking for a favour, conversation: a trip to the Grand Canyon |
| Speaking      | Comparing different tourist destinations, Agreeing and disagreeing, Asking for a favour, Discussing local tourist destinations.          |
| Reading       | Website about four tourist destinations; Website: <i>Where to go?</i>                                                                    |
| Writing       | Travel blog, Using descriptive language                                                                                                  |
| Grammar       | Infinitives and <i>-ing</i> forms                                                                                                        |
| Vocabulary    | Travel and tourism, Describing changes                                                                                                   |
| Pronunciation | Consonant clusters, Consonant sounds                                                                                                     |

**Unit – 2                      City living A/B/C/D**

|           |                                                                                                                                                                 |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Listening | Interview: 'Smart' cities: Two monologues talking about 'smart' cities, Two monologues: house renovations, Flat hunting, Interviews about a new shopping centre |
| Speaking  | Discussing good and bad points about a city                                                                                                                     |

|               |                                                                                                                                    |
|---------------|------------------------------------------------------------------------------------------------------------------------------------|
| Reading       | Article: <i>Quick-slow down!</i> , Article: <i>Who puts the 'real' in reality TV?</i> Email: Complaining about an important issue. |
| Writing       | Email of complaint, Using formal language                                                                                          |
| Grammar       | <i>Too/enough; so/such</i> , Causative <i>have/get</i>                                                                             |
| Vocabulary    | Describing life in cities, Film and TV; Houses                                                                                     |
| Pronunciation | Sound and spelling: o, Stress in compound nouns                                                                                    |

### **Unit – 3                      Dilemmas A/B/C/D**

|               |                                                                                                                                       |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Listening     | Radio programme: person finance, Three monologues about honesty, Going to the bank, Conversation about a TV programme                 |
| Speaking      | Giving opinions on financial matters, Discussing moral dilemmas, Talking about hopes and worries Discussing programmes about crime    |
| Reading       | Article: <i>Is it time to give up on cash?</i> , Newspaper article: <i>The honesty experiment</i> , Review: <i>Crime with a smile</i> |
| Writing       | Review, Organising a review                                                                                                           |
| Grammar       | First and second conditionals, Third conditional; <i>should have+past participle</i>                                                  |
| Vocabulary    | Money and finance, Crime                                                                                                              |
| Pronunciation | Stressed and unstressed words; Sound and spelling: l, Word groups                                                                     |

### **Unit – 4                      Discoveries A/B/C/D**

|               |                                                                                                                                            |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Listening     | Conversation about inventions, Conversation about an email hoax, Finding the perfect flat, Four monologues about alternative medicine      |
| Speaking      | Talking about inventions, Describing a hoax or a scam or a case of fraud, Giving and receiving surprises                                   |
| Reading       | Article: <i>Too good to be true?</i> , Article: <i>The rise and fall of Barry Minkow</i> , Essay: <i>The Value of alternative medicine</i> |
| Writing       | Opinion essay, Presenting a series of arguments                                                                                            |
| Grammar       | Relative clauses, Reported speech; Reporting verbs                                                                                         |
| Vocabulary    | Health, Verbs describing thought and knowledge                                                                                             |
| Pronunciation | Sound and spelling : <i>ui</i> , Linking and intrusion                                                                                     |

### **Unit – 5                      Possibilities A/B/C/D**

|           |                                                                                                               |
|-----------|---------------------------------------------------------------------------------------------------------------|
| Listening | Interview about Dan Cooper, Two monologues: pursuing a dream, Celebrating good news, conversation about goals |
| Speaking  | Telling stories about coincidences, Describing                                                                |



|               |                                                                                                                                                            |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               | and comparing brave or amazing people,<br>Telling an important piece of news, Talking<br>about performing                                                  |
| Reading       | Story: The man who disappeared; Blog: <i>The<br/>Wreck of the Titan</i> , Article: <i>Dream to help</i> ,<br>Story: Rosa's diary: <i>The ultimate goal</i> |
| Writing       | Story, Making a story interesting                                                                                                                          |
| Grammar       | Past modals of deduction, Wishes and regrets                                                                                                               |
| Vocabulary    | Adjectives with prefixes, Verbs of effort                                                                                                                  |
| Pronunciation | Word stress, Linking, Consonant clusters                                                                                                                   |

### Text Book:

1. Cambridge Empower – Second Edition B2 Level - Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis – Jones. ISBN: 978-1107468726

### Suggested Software:

- Cambridge Empower
- Soft X (K-Van Solutions)

### Reference Books:

- 1 Raman Meenakshi, Sangeeta-Sharma. Technical Communication. Oxford University Press.2018. ISBN: 9789354972256
- 2 Michael Swan- Practical English Usage ISBN: 9780194202466
- 3 Taylor Grant: English Conversation Practice, Tata McGraw-Hill Education India,2016 ISBN: 978-0070996038

### Web Links:

- 1 <https://www.cambridgeone.org/login>
- 2 <https://www.coursera.org/>
- 3 <https://www.skillshare.com/>
- 4 <https://www.mindtools.com/cawh8bu/communication-tools>

### Skill Enhancement Courses (SEC)

| Course Code           | Course Name                                                       | Level | L | T | P        | C        | CIE | SEE | Total | Pre-requisite |
|-----------------------|-------------------------------------------------------------------|-------|---|---|----------|----------|-----|-----|-------|---------------|
| 2501AI34/<br>2601CS01 | Web Application Development using MERN Stack*/ Linux Programming# | AC    |   |   | 2        | 2        | 50  | 50  | 100   | -             |
| 2501CS17              | Object Oriented Analysis & Design using UML                       | IC    |   |   | 2        | 2        | 50  | 50  | 100   | ASE           |
| 2501IT08              | Bigdata Spark                                                     | AC    |   |   | 2        | 2        | 50  | 50  | 100   | -             |
| <b>Total</b>          |                                                                   |       |   |   | <b>6</b> | <b>6</b> |     |     |       |               |

## WEB Application Development using MERN Stack

(Syllabus for the batch admitted in the year 2025)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code:</b> 2501AI34 | <b>0</b> | <b>0</b> | <b>2</b> | <b>2</b> |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Make use of HTML elements, CSS styles and their attributes for designing static web pages.
- CO2:** Apply JavaScript to develop dynamic web pages and validate forms.
- CO3:** Build a basic web server using Node.js and also working with Node Package Manager (NPM) & Make use of Typescript to optimize JavaScript code using strict type checking
- CO4:** Make use of router, template engine and authentication using sessions to develop application in Express JS & components, props, stats and render data in ReactJS
- CO5:** Build a single page application using RESTful APIs in ExpressJS. & Make use of MongoDB queries

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | 3    |      | 2    |      |      | 1    | 2    |       | 2     |
| <b>CO2</b> | 2    | 3    | 2    |      | 2    |      |      | 1    | 2    |       | 2     |
| <b>CO3</b> | 2    | 2    | 3    | 1    | 2    |      |      | 1    | 2    |       | 2     |
| <b>CO4</b> | 2    | 3    | 2    | 2    | 2    |      |      | 1    | 2    |       | 2     |
| <b>CO5</b> | 2    | 2    | 3    | 1    | 2    |      |      | 1    | 2    |       | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 2    |      |

### Practice:

1. Lists, Links, Images, Tables, Forms.
  - a. Write a HTML program, to explain the working of lists.  
Note: It should have an ordered list, unordered list, nested lists and ordered list in an unordered list and definition lists.
  - b. Write a HTML program, to explain the working of hyperlinks using <a> tag and href, target Attributes.  
Note: Use text to link □ <https://www.aec.edu.in/>  
Use image to link □ <https://www.aec.edu.in/?p=Gallery>
  - c. Create a HTML document that has your image and your friend's image with a specific height and width. Also when clicked on the images it should navigate to their respective profiles.
  - d. Write a HTML program, to explain the working of tables. (use tags: <table>, <tr>, <th>, <td> and attributes: border, rowspan, colspan)

- e. Write a HTML program, to explain the working of forms by designing Registration form. (Note: Include text field, password field, number field, date of birth field).
2. HTML 5 and Cascading Style Sheets, Types of CSS & CSS Box Model
  - a. Write a HTML program, that makes use of <article>, <aside>, <figure>, <figcaption>, <footer>, <header>, <main>, <nav>, <section>, <div>, <span> tags.
  - b. Write a HTML program, to embed audio and video into HTML web page.
  - c. Write a program to demonstrate the various ways you can reference a color in CSS.
  - d. Write a program, to explain the importance of CSS Box model using
    - i. Content      ii. Border      iii. Margin      iv. padding
3. Selector forms & JavaScript-internal and & I/o
  - a. Write a program to apply different types of selector forms
    - i. Simple selector (element, id, class, group, universal)
    - ii. Combinator selector (descendant, child, adjacent sibling, general sibling)
    - iii. Write a program to embed internal and external JavaScript in a web page.
    - iv. Write a program to explain the different ways for displaying output.
4. Javascript Pre-defined and User-defined Objects, Conditional & Loop Statements
  - a. Write a program using document, window, math & string object properties and methods.
  - b. Write a program which asks the user to enter three integers, obtains the numbers from the user and outputs HTML text that displays the larger number followed by the words "LARGER NUMBER" in an information message dialog. If the numbers are equal, output HTML text as "EQUAL NUMBERS".
  - c. Write a program to print 1 to 10 numbers using for, while and do-while loops.
5. Javascript Functions and Events & Node.js
  - a. Design an appropriate function should be called to display
    - i. Factorial of that number
    - ii. Fibonacci series up to that number
    - iii. Write a program to show the workflow of JavaScript code executable by creating web server in Node.js.
    - iv. Write a program to transfer data over http protocol using http module.
    - v. Create a text file src.txt and add the following content to it. (HTML, CSS, Javascript, Typescript, MongoDB, Express.js, React.js, Node.js)
6. Typescript
  - a. Write a program to understand simple and special types.
  - b. Write a program to understand function parameter and return types.
7. ExpressJS – Routing, HTTP Methods, Templating
  - a. Write a program to define a route, Handling Routes, Route Parameters, Query Parameters and URL building.
  - b. Write a program to accept data, retrieve data and delete a specified resource using http methods.
  - c. Write a program using templating engine.
8. ExpressJS – Cookies, Sessions, Authentication, Database.
  - a. Write a program for session management using cookies and sessions.
  - b. Write a program for user authentication.

- c. Write a program to connect MongoDB database using Mongoose and perform CRUD operations
9. ExpressJS – Templating, Form Data, Cookies, Sessions
  - a. Write a program using templating engine.
  - b. Write a program to work with form data.
  - c. Write a program for session management using cookies and sessions.
10. ReactJS – Render HTML, JSX, Props and States
  - a. Write a program to render HTML to a web page.
  - b. Write a program for writing markup with JSX.
  - c. Write a program to work with props and states.
11. ReactJS – Conditional Rendering, Rendering Lists, React Router
  - a. Write a program for conditional rendering.
  - b. Write a program for rendering lists.
  - c. Write a program for routing to different pages using react router.
12. ReactJS – Hooks, Sharing data between Components, To-do list and Quiz & MongoDB – Installation, Configuration
  - a. Write a program to understand the importance of using hooks.
  - b. Write a program for sharing data between components.
  - c. Design to-do list application.
  - d. Install MongoDB and configure ATLAS

### **Cornerstone Project:**

#### **Project 1 : Student Management System (MERN CRUD App)**

- **Implementation mainly focuses on**
  - Create, update, view, and delete student records using MongoDB, Express, React, Node.js.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis& Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

#### **Project 2: Online Food Ordering System Using MERN**

- **Implementation mainly focuses on**
  - Menu display, cart, orders, user login, admin panel.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis& Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

#### **Project 3: Personal Portfolio with Admin Dashboard (MERN + Authentication)**

- **Implementation mainly focuses on**
  - Edit portfolio sections via a protected admin panel.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis& Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

**Project 4: To-Do List Application with User Login (MERN + Sessions/JWT)**

- **Implementation mainly focuses on**
  - Add, edit, delete tasks, user registration/login, MongoDB storage.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

**Project 5: Event Registration Portal (HTML + CSS + JS + MERN Backend)**

- **Implementation mainly focuses on**
  - Users register for events; admin can view/manage registrations.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

**Project 6: E-Commerce Product Catalog Using MERN**

- **Implementation mainly focuses on**
  - Product listings, categories, product details, cart basics.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

**Project 7: College Information & Admission Portal (MERN Full Stack)**

- **Implementation mainly focuses on**
  - Forms, tables, student admission data, admin management.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

**Project 8: Blog Posting Platform Using MERN (CRUD + File Upload)**

- **Implementation mainly focuses on**
  - Users create posts, add images, edit, comment, delete.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

**Project 9: Movie Review and Rating System Using MERN**

- **Implementation mainly focuses on**
  - Users can review movies, give ratings, view reviews list.

- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

### **Project 10: Employee Record Management (MERN CRUD)**

- **Implementation mainly focuses on**
  - Employee details, salary, department, search filters.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

### **Project 11: Notes Application Using MERN with Authentication**

- **Implementation mainly focuses on**
  - Create/edit notes, categorize them, private notes per user.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

### **Project 12. Online Quiz Application Using MERN (MCQ Based)**

- **Implementation mainly focuses on**
  - Admin adds questions; users take quiz; store scores.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

### **Project 13: Library Book Management System**

- **Implementation mainly focuses on**
  - Add books, issue/return system, student records, dashboards.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

### **Project 14: Hospital Appointment Booking System**

- **Implementation mainly focuses on**
  - Users book appointments; doctors manage schedules.
- **Documentation must contain**
  - Problem Definition, Objectives, Analysis & Design, Implementation and Sample Code, Output screens, Conclusion & Enhancement

### **Reference Books:**

- 1 Programming the World Wide Web, Robert W. Sebesta, Pearson, 7th Edition. ISBN 139789332518827
- 2 Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, APress, O'Reilly, 2nd edition. ISBN 9781484226520

**Web Links:**

- 1 [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_17739732834840810000\\_shared/overview \(HTML5\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_17739732834840810000_shared/overview (HTML5))
- 2 [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_18109698366332810000\\_shared/overview \(Javascript\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_18109698366332810000_shared/overview (Javascript))
- 3 [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01384329019595161635073\\_shared/overview \(Express Js\)](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384329019595161635073_shared/overview (Express Js))
- 4 [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_013177169294712832113\\_shared/overview \(MongoDB\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overview (MongoDB))

**Note:**

- Students must submit the Certificate of Completion offered by any Industry.
- The capstone project team size shall be four (4) students.
- Students may select any one of the above prescribed projects or a project of their own choice with the prior permission of the Course instructor.
- The SEE – Lab shall be evaluated for 50 marks based on project implementation, oral presentation, 10-minute video presentation, report and viva voce.
- The video presentation should consist of the working procedure of the project along with contribution of each student for a minimum of 2 minutes.
- Finally, the Source code of the capstone Project has to be pushed into the Students GitHub repository.



**Linux Programming**  
(Common to CSE, AIML, CSE(DS))  
(Syllabus for the batch admitted in the year 2026)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2601CS01</b> | <b>0</b> | <b>0</b> | <b>2</b> | <b>2</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

|             |                                                                    |
|-------------|--------------------------------------------------------------------|
| <b>CO1:</b> | Demonstrate proficiency in Linux commands, file-system operations  |
| <b>CO2:</b> | Develop shell scripts using decision-making and looping constructs |
| <b>CO3:</b> | Apply Linux utilities for file handling operations                 |
| <b>CO4:</b> | Exhibit user management and file transfer operations               |
| <b>CO5:</b> | Develop shell scripts to access data using web urls.               |

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | -    | -    | 2    | -    | -    | 1    | 2    | -     | -     |
| <b>CO2</b> | 3    | 2    | -    | -    | 3    | -    | -    | 1    | 2    | -     | -     |
| <b>CO3</b> | 2    | 2    | -    | -    | 3    | -    | -    | 2    | 1    | -     | -     |
| <b>CO4</b> | 2    | 2    | -    | -    | 1    | -    | -    | 1    | 1    | -     | -     |
| <b>CO5</b> | 2    | 2    | -    | -    | 2    | -    | -    | 1    | 1    | -     | -     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    | 2    |
| <b>CO2</b> | 2    | 1    |
| <b>CO3</b> | 2    | 1    |
| <b>CO4</b> | 1    | 2    |
| <b>CO5</b> | 2    | 1    |

**Practice:**

**Week 1:** Practice the following basic Linux commands

Basic commands: pwd, ls, mkdir, rmdir, chmod, chown, time, cp, rm, man, echo, touch, cat, vi, cal, df, du, nano, vim, fallocation, read, bash.

**Week 2:** Observe the usage of the following Networking commands: useradd, userdel, passwd, df, du, ps, uname, hostname, systemctl, find, mount watch, jobs, kill, shutdown, ping, wget, curl, scp, rsync, ip, netstat, traceroot, nslookup, dig, history, ln, alias, unalias

**Week 3:** Excersie how to execute sudo command for adding and deleting users

Root privileges: sudo, sudo adduser, sudo deluser, sudo deluser, sudo mv, sudo gedit, uname, sudo apt-get update, sudo apt-get install, sudo apt-get upgrade, sudo apt-get remove, sudo apt-get purge, sudo apt-get autoremove, sudo apt-get clean, sudo apt-get autoclean, sudo apt-get check

**Week 4:** if-fi loop variants

1. Write a shell script to display your name by taking input from the user.
2. Write a shell script to calculate SGPA using conditional statements.

3. Write a shell script to find the factorial of a number by taking input from the user.

**Week 5:** For and case-esac

1. Write a shell script using for loop to print numbers of the user's choice by accepting input at the command prompt.

2. Write a shell script to create menu using case and esac.

**Week 6:** File operations

1. Write a shell script to extract first column of data from .csv file.

2. Write a shell script to copy file to another using 'cp' command.

**Week 7:** Editing file

1. Write a shell script to create and edit a file using vi and nano.

2. Write a shell script to a) find b) replace c) first and third columns of a .csv file using sed, find and cut commands.

3. Write a shell script to remove duplicate lines in a file.

**Week 8:** Pattern matching using filters

1. Write a shell script to search for a pattern using 'grep' with all possible flags and wildcards.

2. Write a shell script to sort lines of text which is stored in a .csv file.

3. Write a shell script using while loop to display week days.

**Week 9:** Changing the location of file from one location to another

1. Write a shell script to link and unlink a text file using ln and unlink commands.

2. Write a shell script to check username and password of the user logged in.

**Week 10:** User privileges using sudo command

1. Illustrate 'sudo' to show administrative privileges with all possible options.

2. Illustrate 'su' command to show user logged in with possible options.

**Week 11:** Accessing file from web and perform operations

1. Write a shell script to display contents of a file from web using curl.

2. Write a shell script to open a 'google.com' from the shell prompt using 'xdg-open'.

**Week 12:** Installing software using sudo apt-get install

1. Install python in linux terminal and execute simple python program.

2. Install 'C' on linux platform and execute simple program.

**Week 13:** Transfer of files from local to remote

1. Install VMWARE and run 'C' program

2. Install VMWARE and run simple Java program.

### Additional Practice

1. Write a shell script to create menus for illustrating inter process communication for displaying student details like marks, attendance, list of students in each branch etc.
2. Write a c program using signals in UNIX for checking authenticated user or not by checking with the password file.

### Text Books:

1. Red Hat Enterprise Linux 9 , Vishesh Kumar, Gitanjali Mehra, BPB Publications.
2. Linux Essentials – Christine Bresnahan and Richard Blum, Wiley Publications.

### Reference Books:

1. The Linux Command Line: A Complete Introduction (2nd Edition) – William E. Shotts Jr.  
Linux Command Line and Shell Scripting Bible (4th Edition) – Richard Blum and Christine Bresnahan.
2. Linux Administration: A Beginner's Guide (8th Edition) – Wale Soyinka.
3. UNIX and Linux System Administration Handbook (5th Edition) – Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley, Dan Mackin.

4. How Linux Works: What Every Superuser Should Know (3rd Edition) – Brian Ward.
5. Red Hat System Administration I (RH124) – Red Hat Press.

**Web Links:**

1. [https://docs.redhat.com/en/documentation/red\\_hat\\_enterprise\\_linux/9](https://docs.redhat.com/en/documentation/red_hat_enterprise_linux/9)
2. <https://www.gnu.org/software/bash/manual/>
3. <https://labex.io/linuxjourney>
4. <https://www.freecodecamp.org/news/tag/linux/>
5. <https://linuxize.com/>

## Object Oriented Analysis & Design using UML

(Common to CSE, IT AIML & CSE (DS))

**Course Code: 2501CS17**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>2</b> | <b>2</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Explain the importance of system analysis and design in solving complex problems.
- CO2:** Compare object-oriented approach with traditional approach in system analysis and design.
- CO3:** Analyze the importance of modeling and design of various applications.
- CO4:** Compare various object relationships.
- CO5:** Show the role and function of each UML model in developing object- oriented software.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | 3    | 1    |      |      |      |      |      |       |       |
| <b>CO2</b> | 2    | 3    | 2    |      |      |      |      |      |      |       |       |
| <b>CO3</b> | 3    | 2    | 2    | 1    | 3    |      |      |      |      |       |       |
| <b>CO4</b> | 1    | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO5</b> | 2    | 1    | 1    | 3    | 1    |      |      |      |      |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 3    |      |
| <b>CO4</b> | 3    |      |
| <b>CO5</b> | 3    |      |

### Practice:

#### List of Case Studies:

ATMApplication.  
Library ManagementSystem.  
Online Book Shop.  
Customer SupportSystem.  
Point ofSale.  
Familiarization with RationalRose

1. For each case study:
  - 1.1) Identify and analyze events
  - 1.2) Identify Usecases
2. For each case study:
  - 2.1) Develop event table
  - 2.2) Identify & analyze domain classes
3. For each case study:
  - 3.1) Represent use cases and a domain class diagram using Rational Rose
  - 3.2) Develop CRUD matrix to represent relationships between use cases and problem domain classes
4. For each case study:
  - 4.1) Develop Use case diagrams
  - 4.2) Develop elaborate Use case descriptions & scenarios
5. For each case study
  - 5.1) develop system sequence diagrams
6. For each case study:
  - 6.1) Develop highlevel sequence diagrams for each usecase
  - 6.2) Develop Detailed Sequence Diagrams / Communication diagrams for each use case showing interactions among all the threelayerobjects
7. For each case study:
  - 7.1) Develop highlevel sequence diagrams for each usecase1
  - 7.2) Develop Detailed Sequence Diagrams / Communication diagrams for each use case showing interactions among all the threelayerobjects
8. For each case study:
  - 8.1) Develop highlevel sequence diagrams for each usecase
  - 8.2) Develop Detailed Sequence Diagrams / Communication diagrams for each use case showing interactions among all the threelayerobjects
9. For each case study:
  - 9.1) Develop highlevel Collaboration diagrams for each usecase
  - 9.2) Develop detailed collaboration diagrams for each use case showing interactions among all the threelayerobjects
10. For each case study:
  - 10.1) Develop Use case Packages.
  - 10.2) Develop component diagrams.
  - 10.3) Develop sample diagrams for other UML diagrams state chart diagrams, activity diagrams and deployment diagrams.
11. Design UML models for the following application. RestaurantSystem.

### **Additional practice:**

Design UML models for the following Case studies.

1. Banking Application System.
2. Railway Reservation System
3. Online Movie Ticket BookingSystem.

### **Text Books:**

- 1 Object-oriented analysis and design using UML, Mahesh P. Matha, PHI. ISBN: 9788120333222
- 2 Head first object-oriented analysis and design, Brett D. McLaughlin, Gar Pollice, Dave West, O'Reilly. ISBN: 9780596008673

**Reference Books:**

- 1 Object-oriented analysis and design with the Unified process, John W. Satzinger, Robert B. Jackson, Stephen D. Burd, CengageLearning. ISBN: 978-0619216436
- 2 The Unified modeling language Reference manual, James Rumbaugh, Ivar Jacobson, Grady Booch, AddisonWesley. ISBN: 9780321245625
- 3 Object Oriented Analysis & Design, AtulKahate, The McGraw-Hills Companies. ISBN: 9780070583764

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc24\\_cs40/preview](https://onlinecourses.nptel.ac.in/noc24_cs40/preview)
- 2 <https://www.quora.com/in/What-are-the-best-website-to-study-UML-for-beginners>
- 3 <https://creately.com/lp/uml-diagram-tool/>

## Bigdata Spark

(Common to CSE, IT, AIML & CSE (DS))

|                              | L        | T        | P        | C        |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501IT08</b> | <b>0</b> | <b>0</b> | <b>2</b> | <b>2</b> |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Demonstrate Hadoop Installation process.
- CO2:** Illustrate Hadoop architecture
- CO3:** Compare Bigdata models
- CO4:** Implement various Scalable Algorithms
- CO5:** Illustrate Applications of Bigdata

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    | 2    | 1    | 2    | 1    |      |      |      |       |       |
| <b>CO2</b> | 2    | 2    | 2    | 1    | 2    |      |      |      |      |       |       |
| <b>CO3</b> | 2    | 2    | 3    | 1    | 2    | 1    |      |      |      |       |       |
| <b>CO4</b> | 2    |      | 2    | 1    | 3    |      |      |      |      |       |       |
| <b>CO5</b> | 2    |      | 2    | 1    | 3    | 1    |      |      |      |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 2    |      |

### Practice:

1. Set up and Configuration Hadoop Using Cloudera Creating a HDFS System with minimum 1 Name Node and 1 Data Nodes HDFS Commands Self-Learning Topics: Set up Hadoop in Linux Environment.
2. Map Reduce Programming Examples Word Count. Union, Intersection and Difference. Matrix Multiplication. Self-Learning Topics: Natural Join Programming Example.
3. Implement an iterative PageRank graph algorithm in MapReduce.
4. Perform an efficient semi-join in MapReduce. Hint: Perform a semi-join by having the mappers load a Bloom filter from the Distributed Cache, and then filter results from the actual MapReduce data source by performing membership queries against the Bloom filter to determine which data source records should be emitted to the reducers.
5. Hive: Introduction Creation of Database and Table, Hive Partition, Hive Built in Function and Operators, Hive View and Index. Self-Learning Topics: Configure Hive Metastore to MySQL
6. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes
7. Pig: Pig Latin Basic Pig Shell, Pig Data Types, Creating a Pig Data Model, Reading and Storing Data, Pig Operations Self-Learning Topics:
8. Analytics at Large Scale: Libraries of algorithms include SparkMLlib, H2O; integrations

with TensorFlow and PyTorch;

9. Visualization: Connect to data, Build Charts and Analyze Data, Create Dashboard, Create Stories using Tableau Self-Learning Topics: Tableau using web.
10. Mongo DB: Installation and Creation of database and Collection CRUD Document: Insert, Query, Update and Delete Document. Self-Learning Topics: HBASE Commands

### **Additional Practice:**

1. Spark: RDD, Actions and Transformation on RDD , Ways to Create -file, data in memory, other RDD. Lazy Execution, Persist RDD Self-Learning Topics: Machine Learning Algorithms like K-Means using Spark
2. Spark joins: Consider a scenario where 2 datasets of a leading retail client to be joined with one another using Spark joins. Customer dataset: Sales dataset: Schema Details: 101 ravi 1 102 keerth 2 101 Syam 1 101 Geetha 1 103 Dawn 3 101 ravi 1 102 keerth 2 101 Syam 1 101 Geetha 1 103 Dawn 3 ) 66 Customer schema (customer id,customer name,product id) Sales Schema (product id,product name and price) Join both datasets with common key Product id and print customer id, customer name, product name and price.
3. Matrix-Vector Multiplication by Map Reduce
4. Implement an iterative PageRank graph algorithm in MapReduce

**Note:** The student must Complete & Submit a Big Data 101 & Big Data – 201 Certificate Courses offered by Infosys Spring board at the end of the Practice Session.

### **Text Books:**

- 1 Understanding Big data, Chris Eaton, Dirk Deroos et al., McGraw Hill, ISBN : 9789339221270.
- 2 Professional Hadoop Solutions, Boris Lublin sky, Kevin t. Smith, Alexey Yakubovich, Wiley, ISBN: 9788126551071.

### **Reference Books:**

- 1 Spark in Action, Marko Bonaci and Petar Zecevic,Manning, ISBN: 978-1617292606
- 2 PySpark SQL Recipes: With HiveQL, Dataframe and Graphframes, Raju Kumar Mishra and Sundar Rajan Raman, Apress Media, ISBN: 978-1484243343

### **Web Links:**

- 1 [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01256841991858585686\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01256841991858585686_shared/overview)
- 2 [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01258388119638835242\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01258388119638835242_shared/overview)
- 3 [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_0126052684230082561692\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_0126052684230082561692_shared/overview)



### Value Added Courses (VAC)

| Course Code  | Course Name              | Level | L | T | P         | C        | CIE | SEE | Total | Pre-requisite |
|--------------|--------------------------|-------|---|---|-----------|----------|-----|-----|-------|---------------|
| 2501UC11     | Employability Skills-I   | FC    |   |   | 3         | 0        | 100 | -   | 100   | -             |
| 2501UC13     | Employability Skills-II  | FC    |   |   | 3         | 0        | 100 |     | 100   | ES-I          |
| 2501AI06     | Data Analysis Essentials | IC    |   |   | 2         | 2        | 50  | 50  | 100   | PP            |
| 2501UC14     | Employability Skills-III | IC    |   |   | 3         | 0        | 100 |     | 100   | ES-II         |
| 2501UC15     | Employability Skills-IV  | IC    |   |   | 3         | 0        | 100 |     | 100   | ES-III        |
| 2501CS04     | Internet of Things       | FC    |   |   | 1         | 1        | 50  | 50  | 100   | -             |
| 2501UC16     | Employability Skills-V   | AC    |   |   | 3         | 1        | 100 |     | 100   | ES-IV         |
| <b>Total</b> |                          |       |   |   | <b>18</b> | <b>4</b> |     |     |       |               |

## Employability Skills- I

(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,CSE(DS),PT&Min.E,Agri.E)

**Course Code:** 2501UC11

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>3</b> | <b>0</b> |

### Course Outcomes:

**At the end of the course, student will be able to :**

- CO1** Apply fundamental arithmetic concepts such as number systems, LCM & HCF, ratio & proportion, and averages to solve quantitative problems efficiently.
- CO2** Analyze number and letter series to identify logical patterns and predict subsequent elements.
- CO3** Select the option by evaluating relationships in analogy-based problems and detecting inconsistencies in logical sequences
- CO4** Demonstrate effective verbal communication skills by using appropriate parts of speech and tone in various interpersonal and professional contexts.

### Mapping with Program Outcomes:

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| <b>CO1</b> | 2   | 3   |     |     | 1   |     |     |     |     |      |      |
| <b>CO2</b> | 1   | 3   |     | 2   | 2   |     |     |     |     |      |      |
| <b>CO3</b> |     | 3   |     | 2   | 1   |     |     |     |     |      |      |
| <b>CO4</b> |     |     |     |     |     |     |     | 2   | 3   |      | 1    |

### Aptitude:

Number System, LCM & HCF, Ratio and Proportion, Averages

### Reasoning:

Number Series, Letter Series, Number Analogy, Letter Analogy, Odd Man Out, Logical Sequence of Words.

### Verbal:

Introduction to soft skills, how to improve communication? Parts of Speech, Mind your language towards better English, Vocabulary Expansion

### Text Books

- Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, ISBN: 9789355012326.
- A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, ISBN-13. 978-9352832163.
- Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, , ISBN-13. 978-8121922111.

### Reference Books:

- Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications, ISBN-13 9789389957426.
- How To Crack Test of Reasoning Verbal, Non-Verbal & Analytical – Jaikishan and Premkishan, Arihant Publications, New Edition 2024, ASIN : B0CRQ9BVBC.
- A New Approach to Objective English – R. S. Dhillon DGP Publications, ISBN-13: 978-8186651032

**Web Links:**

- 1 [www.indiabix.com](http://www.indiabix.com)
- 2 [www.bankersadda.com](http://www.bankersadda.com)

## Employability Skills- II

(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,CSE(DS),PT&Min.E,Agri.E)

**Course Code: 2501UC13**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>3</b> | <b>0</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1** Apply percentage, profit & loss, and partnership concepts to solve real-world quantitative problems.
- CO2** Analyze age-related problems to develop logical problem-solving strategies.
- CO3** Evaluate logical reasoning questions including ranking, directions, and alphabet tests for accurate decision-making.
- CO4** Solve pattern-based problems in coding and decoding to enhance analytical skills.
- CO5** Demonstrate effective written communication using correct grammar and structured presentation techniques

### Mapping with Program Outcomes:

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1   | 3   | 3   |     |     | 2   |     |     |     |     |      |      |
| CO2   | 2   | 3   | 2   |     | 1   |     |     |     |     |      |      |
| CO3   |     | 3   |     | 2   | 2   |     |     |     |     |      |      |
| CO4   |     | 3   |     | 2   | 2   |     |     |     |     |      |      |
| CO5   |     |     |     |     |     |     |     | 2   | 2   |      | 2    |

### Aptitude:

Problems on Ages, Partnership, Percentages, Profit and Loss

### Reasoning:

Coding and Decoding, Ranking Test, Alphabet Test, Direction Test

### Verbal:

Written communication skill practice, Grammatical use, Concept of 4 step method for presentation, Present Tense

### Text Books

- 1 Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, ISBN: 9789355012326.
- 2 A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, ISBN-13. 978-9352832163.
- 3 Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, , ISBN-13. 978-8121922111.

### Reference Books:

- 1 Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications, ISBN-13 9789389957426.
- 2 How To Crack Test of Reasoning Verbal, Non-Verbal & Analytical – Jaikishan and Premkishan, Arihant Publications, New Edition 2024, ASIN : B0CRQ9BVBC.

- 3 A New Approach to Objective English – R. S. Dhillon DGP Publications, ISBN-13: 978-8186651032

**Web Links:**

- 1 [www.indiabix.com](http://www.indiabix.com)
- 2 [www.bankersadda.com](http://www.bankersadda.com)

## Data Analysis Essentials

(Common to CSE,IT,AI ML,CSE(DS))

**Course Code: 2501AI06**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>2</b> | <b>2</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Perform various operations on NumPy arrays.
- CO2:** Importing data from different file formats using pandas
- CO3:** Draw different types of charts using matplotlib.
- CO4:** Demonstrate web scraping using python.
- CO5:** Design preprocessing techniques on loan prediction dataset.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | -    | -    | 2    | -    | -    | 1    | 2    | -     | -     |
| <b>CO2</b> | 3    | 2    | -    | -    | 3    | -    | -    | 1    | 2    | -     | -     |
| <b>CO3</b> | 2    | 2    | -    | -    | 3    | -    | -    | 2    | 1    | -     | -     |
| <b>CO4</b> | 2    | 2    | -    | -    | 1    | -    | -    | 1    | 1    | -     | -     |
| <b>CO5</b> | 2    | 2    | -    | -    | 2    | -    | -    | 1    | 1    | -     | -     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    | 2    |
| <b>CO2</b> | 2    | -    |
| <b>CO3</b> | 2    | -    |
| <b>CO4</b> | 1    | 2    |
| <b>CO5</b> | 2    | -    |

### Practice:

#### Week 1: Creating a NumPy Array

- a. Basic ndarray
- b. Array of zeros
- c. Array of ones
- d. Random numbers in ndarray
- e. An array of your choice
- f. Imatrix in NumPy
- g. Evenly spaced ndarray

#### Week 2: The Shape and Reshaping of NumPy Array

- a. Dimensions of NumPy array
- b. Shape of NumPy array
- c. Size of NumPy array
- d. Reshaping a NumPy array
- e. Flattening a NumPy array
- f. Transpose of a NumPy array

**Week 3: Expanding and Squeezing a NumPy Array**

- a. Expanding a NumPy array
- b. Squeezing a NumPy array
- c. Sorting in NumPy Arrays

**Week 4: Indexing and Slicing of NumPy Array**

- a. Slicing 1-D NumPy arrays
- b. Slicing 2-D NumPy arrays
- c. Slicing 3-D NumPy arrays
- d. Negative slicing of NumPy arrays

**Week 5: Stacking and Concatenating Numpy Arrays**

- a. Stacking ndarrays
- b. Concatenating ndarrays
- c. Broadcasting in Numpy Arrays

**Week 6: Perform following operations using pandas**

- a. Creating dataframe
- b. concat()
- c. Setting conditions
- d. Adding a new column

**Week 7: Perform following operations using pandas**

- a. Filling NaN with string
- b. Sorting based on column values
- c. groupby()

**Week 8: Read the following file formats using pandas**

- a. Text files
- b. CSV files
- c. Excel files
- d. JSON files

**Week 9: Read the following file formats**

- a. Pickle files
- b. Image files using PIL
- c. Multiple files using Glob
- d. Importing data from database

**Week 10: Demonstrate web scraping using python****Week 11: Perform following preprocessing techniques on loan prediction dataset**

- a. Feature Scaling
- b. Feature Standardization
- c. Label Encoding
- d. One Hot Encoding

**Week 12: Perform following visualizations using matplotlib**

- a. Bar Graph
- b. Pie Chart
- c. Box Plot
- d. Histogram
- e. Line Chart and Subplots
- f. Scatter Plot.

**Additional Practice:**

1. Write a program that reads a list of temperatures from a file called temps.txt, converts those temperatures to Fahrenheit, and writes the results to a file called ftemps.txt
2. Write a program to find the greatest number that can be formed by using given set of numbers.
3. Write a program to find sum of digits of a number till you get single digit sum.

Example:

Input: 142 (Hint:  $1+4+2=7$ )

Output: 7

Input: 4683 (Hint:  $4+6+8+3=21 \Rightarrow 2+1=3$ )

Output: 3

4. Write a program to count how many times each word present in a file.

**Text Books:**

1. Python Data Science Handbook, Jake VanderPlas, 2nd Edition, 2022, ISBN: 978-1098121228
2. Data Analysis from Scratch with Python: Step By Step Guide, Peters Morgan, 2018, ISBN: 978-1725678095

**Reference Books:**

1. Python for Data Analysis, Wes McKinney, 3rd Edition 2022, ISBN: 978-1098104030
2. An Introduction to Statistical Learning: With Applications in Python, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Jonathan Taylor, 1st Edition, 2023, ISBN: 978-3031387463

**Web Links:**

1. <https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/>
2. <https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/>
3. <https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/>
4. <https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/>
5. <https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-explorationpython/>



### Employability Skills- III

(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,CSE(DS),PT&Min.E,Agri.E)

**Course Code: 2501UC14**

**L T P C**  
**0 0 3 0**

#### Course Outcomes:

**At the end of the course, student will be able to :**

- CO1** Solve financial and quantitative aptitude problems using concepts of simple and compound interest.
- CO2** Apply logical time-work frameworks to solve real-time problems related to work efficiency and pipe systems.
- CO3** Analyze and interpret problems related to blood relations, clocks, calendars, and coded inequalities.
- CO4** Evaluate spatial and logical reasoning through cubes, dice, and symbolic interpretation problems.
- CO5** Demonstrate effective communication using correct grammar, and participate actively in discussions and comprehension activities.

#### Mapping with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 3    |      |      | 1    |      |      |      |      |       |       |
| CO2   | 3    | 3    |      |      | 1    |      |      |      |      |       |       |
| CO3   |      | 3    |      | 2    | 1    |      |      |      |      |       |       |
| CO4   |      | 3    |      | 2    | 2    |      |      |      |      |       |       |
| CO5   |      |      |      |      |      |      |      | 2    | 3    |       | 2     |

#### Aptitude:

Simple Interest, Compound Interest, Time and Work, Pipes and Cisterns

#### Reasoning:

Blood Relations, Calendar, Clocks, Cubes and Dice, Coded Inequalities

#### Verbal:

Grammar in use, Group discussion, Reading Comprehension, Past Tense, Future Tense

#### Text Books

- 1 Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, ISBN: 9789355012326.
- 2 A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, ISBN-13. 978-9352832163.
- 3 Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, , ISBN-13. 978-8121922111.

#### Reference Books:

- 1 Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications, ISBN-13 9789389957426.
- 2 How To Crack Test of Reasoning Verbal, Non-Verbal & Analytical – Jaikishan and Premkishan, Arihant Publications, New Edition 2024, ASIN : B0CRQ9BVBC.
- 3 A New Approach to Objective English – R. S. Dhillon DGP Publications, ISBN-13: 978-8186651032

**Web Links:**

- 1 [www.indiabix.com](http://www.indiabix.com)
- 2 [www.bankersadda.com](http://www.bankersadda.com)

### Employability Skills- IV

(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,CSE(DS),PT&Min.E,Agri.E)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501UC15</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>0</b> | <b>0</b> | <b>3</b> | <b>0</b> |

#### Course Outcomes:

At the end of the course, student will be able to:

- CO1** Apply concepts of time, speed, distance, trains, boats and streams to solve motion-related aptitude problems.
- CO2** Solve mensuration problems involving surface area and volume in real-world contexts.
- CO3** Analyze logical reasoning questions involving Venn diagrams and syllogisms to make valid conclusions.
- CO4** Interpret seating arrangements and solve non-verbal reasoning questions involving patterns and spatial reasoning.
- CO5** Demonstrate effective communication through structured self-introduction, emails, letters, reports, and grammar usage.

#### Mapping with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 3    |      |      | 2    |      |      |      |      |       |       |
| <b>CO2</b> | 3    | 3    |      |      | 2    |      |      |      |      |       |       |
| <b>CO3</b> |      | 3    |      | 2    | 2    |      |      |      |      |       |       |
| <b>CO4</b> |      | 3    |      | 2    | 2    |      |      |      |      |       |       |
| <b>CO5</b> |      |      |      |      |      |      |      | 2    | 2    |       | 2     |

#### Aptitude:

Time, Speed and Distance, Problems on Trains, Boats and Streams, Mensuration - I, Mensuration – II

#### Reasoning:

Venn Diagrams, Syllogisms, Non - Verbal Reasoning, Seating Arrangement

#### Verbal:

Grammatical use, Self-introduction, Letters, E-Mail & Report writing, Error correction, Effective Communication

#### Text Books

- 1 Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, ISBN: 9789355012326.
- 2 A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, ISBN-13. 978-9352832163.
- 3 Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, , ISBN-13. 978-8121922111.

#### Reference Books:

- 1 Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications, ISBN-13 9789389957426.
- 2 How To Crack Test of Reasoning Verbal, Non-Verbal & Analytical – Jaikishan and Premkishan, Arihant Publications, New Edition 2024, ASIN : B0CRQ9BVBC.

- 3 A New Approach to Objective English – R. S. Dhillon DGP Publications, ISBN-13:  
978-8186651032

**Web Links:**

- 1 [www.indiabix.com](http://www.indiabix.com)
- 2 [www.bankersadda.com](http://www.bankersadda.com)

## Internet of Things

(Common to EEE,ME,ECE,CSE,IT,AIIML,CSE(DS),PT&Min.E)

**Course Code: 2501CS04**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>1</b> | <b>1</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Identify and select appropriate sensors, actuators, and boards (Arduino/Pi) for specific tasks.
- CO2:** Execute digital and analog interfacing of peripherals with embedded platforms.
- CO3:** Develop control algorithms and decision-making logic for real-time automation.
- CO4:** Configure cloud platforms and APIs for data transmission and visualization.
- CO5:** Design and build functional end-to-end IoT prototypes for real-world applications.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 1    |      |      | 1    |      |      |      |      |       |       |
| <b>CO2</b> | 2    | 2    | 1    |      | 2    |      |      |      |      |       |       |
| <b>CO3</b> | 1    | 2    | 2    | 1    |      |      |      |      |      |       |       |
| <b>CO4</b> | 1    | 1    |      | 1    | 2    |      |      |      |      |       | 1     |
| <b>CO5</b> | 1    | 2    | 2    | 2    | 2    | 1    | 1    | 1    | 2    | 2     | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      |      |
| <b>CO2</b> |      |      |
| <b>CO3</b> |      |      |
| <b>CO4</b> |      |      |
| <b>CO5</b> |      |      |

### Practice:

- Study of Arduino UNO and Raspberry Pi boards including architecture, pin configuration, power supply, communication interfaces and development environments.
- Study of commonly used sensors and actuators such as temperature sensor, moisture sensor, LDR, ultrasonic sensor, IR sensor, PIR sensor, LED and motor. Identify their working principles and applications.
- Design and implement basic digital input–output operations using Arduino by controlling LED/buzzer.
- Interface an analog sensor (LDR) with Arduino and display sensor values on Serial Monitor.
- Interface a digital sensor (Ultrasonic sensor) with Arduino and display measured values on Serial Monitor.
- Develop conditional logic using Arduino to control LED or buzzer based on sensor threshold values.
- Interface a servo motor with Arduino and control its angular position based on sensor input to demonstrate automatic gate or smart irrigation model.

8. Design and implement a multi-sensor monitoring system using Arduino to read analog and digital sensors simultaneously and display results on Serial Monitor.
9. Create a cloud platform account, explore available IoT services and register a device (Thing) on the platform.
10. Demonstration of IoT based system to upload sensor data to cloud platform and visualize the received data in graphical form.

#### **Additional Practice (Any 2 from the following)**

1. **Smart Lighting System:** Design a lighting system that automatically turns ON/OFF or dims lights based on human movement or surrounding light conditions to demonstrate energy saving.
2. **Intelligent Traffic Control System:** Develop an automated traffic signal system for busy roads with priority control for emergency vehicles (such as ambulances).
3. **Smart Parking System:** Create a sensor-based parking system to detect available slots and provide parking guidance or remote monitoring.
4. **Air Pollution Monitoring System:** Build an IoT-based setup using gas or environmental sensors to measure air quality and indicate whether pollution levels are safe or dangerous.
5. **Bluetooth-Based Actuator Control:** Control motors or other actuators connected to a development board using Bluetooth communication.

#### **Reference Books:**

- 1 An Introduction to Internet of Things, Connecting devices, Edge Gateway and Cloud with Applications, Rahul Dubey, Cengage, 2019. ISBN: 9789353501020
- 2 Adrian McEwen, Designing the Internet of Things, Wiley Publishers. ISBN:978-1118430620
- 3 IoT Fundamentals, Networking Technologies, Protocols and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetette, rob Barton, Jerome Henry, CISCO, Pearson, 2018. ISBN:9789386873743
- 4 Internet of Things, by Vengalapudi Appala Konda and Prof. Sangareddy B. Krutakoti, Scientific International Publishing House, First Edition, 2024. ISBN: 978-93-6132-958-6.

#### **Web Links:**

- 1 <https://iotvirtuallab.github.io/vlab/Experiments/index.html>
- 2 [https://onlinecourses.nptel.ac.in/noc21\\_cs17/preview](https://onlinecourses.nptel.ac.in/noc21_cs17/preview)
- 3 <https://www.electronicsforu.com/electronics-projects/internet-of-things-iot>
- 4 <https://www.coursera.org/specializations/iot>
- 5 <https://projecthub.arduino.cc/>
- 6 <https://www.edureka.co/iot-certification-training>

**Employability Skills- V**  
(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,CSE(DS),PT&Min.E)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501UC16</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>0</b> | <b>0</b> | <b>3</b> | <b>1</b> |

**Course Outcomes:**

**At the end of the course, student will be able to :**

- CO1** Apply principles of permutations, combinations, probability, and logarithms to solve quantitative aptitude problems.
- CO2** Interpret and analyze data from charts, graphs, and statistical tables for decision-making and accuracy.
- CO3** Evaluate logical reasoning statements involving arguments, assumptions, conclusions, and data sufficiency.
- CO4** Solve puzzle and eligibility test problems using analytical and critical thinking skills.
- CO5** Demonstrate effective interpersonal, communication, and time management skills for successful personal and professional interactions.

**Mapping with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 3    |      |      | 2    |      |      |      |      |       |       |
| <b>CO2</b> | 3    | 3    |      |      | 2    |      |      |      |      |       |       |
| <b>CO3</b> |      | 3    |      | 2    | 2    |      |      |      |      |       |       |
| <b>CO4</b> |      | 3    |      | 2    | 2    |      |      |      |      |       |       |
| <b>CO5</b> |      |      |      |      |      |      |      | 2    | 3    |       | 2     |

**Aptitude:**

Permutations and Combinations, Probability, Data Interpretation, Logarithms, Statistics

**Reasoning:**

Puzzle Tests, Eligibility Test, Data Sufficiency, Statements – Arguments, Statements – Assumptions, Statements - Course of Action, Statements – Conclusions

**Verbal:**

Interview skills, Grammar in use, Interpersonal Skills, Negotiation Skills, Social Skills, Problem-Solving Skills, Time Management Skills

**Text Books**

- 1 Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, ISBN: 9789355012326.
- 2 A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, ISBN-13. 978-9352832163.
- 3 Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, , ISBN-13. 978-8121922111.

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- 2 How To Crack Test of Reasoning Verbal, Non-Verbal & Analytical – Jaikishan and Premkishan, Arihant Publications, New Edition 2024, ASIN : B0CRQ9BVBC.
- 3 A New Approach to Objective English – R. S. Dhillon DGP Publications, ISBN-13: 978-8186651032

**Web Links:**

- 1 [www.indiabix.com](http://www.indiabix.com)
- 2 [www.bankersadda.com](http://www.bankersadda.com)



### Mandatory Courses (MC)

| Course Code  | Course Name                            | Level | L         | T | P | C        | CIE | SEE | Total | Pre-requisite |
|--------------|----------------------------------------|-------|-----------|---|---|----------|-----|-----|-------|---------------|
| 2501AC01     | Environmental Science                  | FC    | 2         |   |   | 0        | 100 | -   | 100   | -             |
| 2501AC02     | Constitution of India                  | FC    | 2         |   |   | 0        | 100 | -   | 100   | -             |
| 2501AC03     | Research Methodology                   | FC    | 2         |   |   | 0        | 100 | -   | 100   | -             |
| 2501AC04     | Intellectual Property Rights & Patents | FC    | 2         |   |   | 0        | 100 | -   | 100   | -             |
| 2501AC05     | Indian Knowledge Systems               | FC    | 2         |   |   | 0        | 100 | -   | 100   | -             |
| <b>Total</b> |                                        |       | <b>10</b> |   |   | <b>0</b> |     |     |       |               |

**Environmental Science**  
(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,CSE(DS),PT,Min.E)

**Course Code: 2501AC01**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>0</b> | <b>0</b> |

**Course Outcomes:**

**At the end of the Course, Student will be able to:**

- CO1:** Outline the natural resources and their importance for the sustenance of the life
- CO2:** Explain about the biodiversity of India, threats and its conservation methods
- CO3:** Illustrate various attributes of the pollution, impacts and measures to control the pollution along with waste management practices
- CO4:** Describe social issues of both rural and urban environment to combat the challenges and the legislations of India in environmental protection
- CO5:** Explain the population growth and its implications

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 1    | -    | -    | -    | 1    | -    | 2    | -    | -    | -     | -     |
| CO2   | 1    | -    | -    | -    | -    | -    | 3    | -    | -    | -     | -     |
| CO3   | -    | -    | -    | -    | 2    | -    | 3    | -    | -    | -     | 1     |
| CO4   | -    | -    | -    | -    | 1    | -    | 3    | 1    | -    | -     | 1     |
| CO5   | -    | -    | -    | -    | -    | -    | 3    | -    | -    | -     | -     |

**UNIT – I**

**Multidisciplinary Nature of Environmental Studies:**

Definition, Scope and Importance, Need for Public Awareness.

**Natural Resources:** Renewable and non-renewable resources – Natural resources and associated problems.

**UNIT – II**

**Ecosystem, Biodiversity and Its Conservation:**

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers,

consumers, and decomposers. Food chains, food webs and ecological pyramids.

Biodiversity And Its Conservation: Definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Values of biodiversity. Hot-spots of biodiversity – Threats to biodiversity. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

**UNIT – III**

**Environmental Pollution and Solid Waste Management:**

Environmental Pollution: Definition, Cause, effects, and control measures of:

- a. Air Pollution.
- b. Water Pollution
- c. Soil Pollution
- d. Marine Pollution
- e. Noise Pollution

Solid Waste Management:

Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution

#### **UNIT – IV**

##### **Social Issues and The Environment:**

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to Energy & Water. Resettlement and rehabilitation of people, Environmental ethics, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, and holocaust. Environment Protection Act – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act-Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

#### **UNIT – V**

##### **Human Population and The Environment:**

Population growth, variation among nations.

Environment and human health, Human Rights, Value Education. Role of Information Technology in Environment and human health.

##### **Text Books:**

1. Textbook of Environmental Studies for Undergraduate Courses, Erach Bharucha for University Grants Commission, Universities Press. ISBN: 9788173718625.
2. Environmental Studies, Palaniswamy – Pearson education. ISBN: 978-9332528277.

##### **Reference Books:**

1. Textbook of Environmental Science, Deeksha Dave and E.Sai Baba Reddy, Cengage Publications. ISBN: 978-8131517604.
2. Textbook of Environmental Sciences and Technology by M.Anji Reddy, B.S Publication. ISBN: 9385433385.
3. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications. ISBN: 978-8170087380.

##### **Web Links:**

1. <https://archive.nptel.ac.in/courses/127/105/127105018/>
2. [https://onlinecourses.swayam2.ac.in/cec24\\_ge05/preview](https://onlinecourses.swayam2.ac.in/cec24_ge05/preview)

## Constitution of India

(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,CSE(DS),PT,Min.E)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501AC02</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>0</b> | <b>0</b> |

### Course Outcomes:

At the end of the Course, Student will be able to:

- CO1:** Explain historical background of the constitution making and its importance for building a democratic India
- CO2:** Compare the functioning of three wings of the government i.e., executive, legislative and judiciary
- CO3:** Interpret the value of the fundamental rights and duties for becoming good citizen of India
- CO4:** Compare the decentralization of power between central, state and local self-government
- CO5:** Extend the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | -    | -    | -    | -    | 3    | -    | -    | 1    | 2    | -     | -     |
| <b>CO2</b> | -    | -    | -    | -    | 2    | -    | -    | 1    | 3    | -     | -     |
| <b>CO3</b> | -    | -    | -    | -    | 3    | -    | -    | 2    | 3    | -     | -     |
| <b>CO4</b> | -    | -    | -    | -    | 3    | -    | -    | 2    | 1    | -     | -     |
| <b>CO5</b> | -    | -    | -    | -    | 2    | -    | -    | 1    | 3    | -     | -     |

### UNIT – I

#### Introduction to Indian Constitution:

Constitution' meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

### UNIT – II

#### Union Government and its Administration Structure of the Indian Union:

Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions.

### UNIT – III

#### State Government and its Administration Governor:

Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions

### UNIT – IV

#### Local Administration:

District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation PanchayatiRaj: Functions PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level

Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy.

## **UNIT – V**

### **Election Commission:**

Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC and women.

### **Text Books:**

1. Introduction to the Constitution of India, Durga Das Basu, Prentice – Hall of India Pvt. Ltd. New Delhi. ISBN: 978-9388548861.
2. Indian Constitution, Subash Kashyap, National Book Trust. ISBN: 9788123707341.

### **Reference Books:**

1. Dynamics of Indian Government & Politics, J.A. Siwach. ISBN: 9788120709768.
2. Indian Government and Politics, D.C. Gupta. ISBN: 9780706987782.
3. Constitutional Law of India, H.M.Sreevai, 4<sup>th</sup> edition in 3 volumes (Universal Law Publication). ISBN: 9788194776529.

### **Web Links:**

1. [nptel.ac.in/courses/109104045/](https://nptel.ac.in/courses/109104045/)
2. [nptel.ac.in/courses/101104065/](https://nptel.ac.in/courses/101104065/)

## Research Methodology

(Common to CE,EEE,ME,ECE,CSE,IT,AIIML,CSE(DS),PT,Min.E)

**Course Code: 2501AC03**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>0</b> | <b>0</b> |

### Course Outcomes:

**At the end of the Course, Student will be able to:**

- CO1:** Explain the characteristics and process of research.
- CO2:** Select the research problem by applying problem identification techniques.
- CO3:** Formulate and execute research design process.
- CO4:** Report the results of research process adhering to professional ethics.
- CO5:** Analyze the results of research using statistical measures of central tendency

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 1    | -    | -    | 2    | -    | -    | -    | -    | -    | 2     | 1     |
| <b>CO2</b> | 1    | -    | -    | 2    | -    | -    | -    | -    | -    | 2     | 1     |
| <b>CO3</b> | 1    | -    | -    | 2    | -    | -    | -    | -    | -    | 2     | 1     |
| <b>CO4</b> | 1    | -    | -    | 2    | -    | -    | -    | 3    | -    | 2     | 1     |
| <b>CO5</b> | 1    | -    | -    | 2    | 2    | -    | -    | -    | -    | 2     | 1     |

### UNIT – I

#### Meaning of Research:

Function of Research - Characteristics of Research – Steps involved in Research – Research in Pure and Applied Sciences - Inter Disciplinary Research. Factors which hinder Research – Significance of Research - Research and scientific methods – Research Process– Criteria of good Research – Problems encountered by Researchers – Literature review.

### UNIT – II

#### Identification of Research Problem :

Selecting the Research problem – Necessity of defining the problem – Goals and Criteria for identifying problems for research. Perception of Research problem – Techniques involved in defining the problem.

### UNIT – III

#### Research Design :

Formulation of Research design – Need for Research design – Features of a good design – Important concepts related to Research design.

### UNIT – IV

#### Interpretation and Report Writing:

Meaning and Technique of interpretation – Precautions in interpretation – Significance of report writing – Different steps in writing a report – Layout of a Research report.

## UNIT – V

### **Statistical Techniques and Tools :**

Introduction of statistics – Functions – Limitations – Measures of central tendency - Arithmetic mean – Median – Mode – Standard deviation – Co-efficient of variation (Discrete series and continuous series) – Correlation – Regression.

### **Text Books:**

1. Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint. ISBN: 9788122415223.
2. A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMM Vidyalaya press. ISBN: 9780367135720.

### **Reference Books:**

1. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd. ISBN: 978-8126530755.
2. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi. ISBN: 9788120349469.
3. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi. ISBN: 978-8180545283.

### **Web Links:**

1. <https://nptel.ac.in/courses/127106227>
2. <https://archive.nptel.ac.in/courses/121/106/121106007/>

## Intellectual Property Rights & Patents

(Common to CE,EEE,ME,ECE,CSE,IT,AIIML,CSE(DS),PT,Min.E)

**L      T      P      C**

**Course Code: 2501AC04**

**2      0      0      0**

### Course Outcomes:

**At the end of the Course, Student will be able to:**

- CO1:** Compare various types of Intellectual Property rights.
- CO2:** Discuss Intellectual Property and infer rights on such Intellectual Property owners
- CO3:** Explain the process of patenting
- CO4:** Apply for Trade marks and Copyrights.
- CO5:** Explain the methods to protect Trade secrets

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 1    | -    | -    | -    | 1    | -    | -    | 3    | -    | -     | 2     |
| CO2   | 1    | -    | -    | -    | 1    | -    | -    | 3    | -    | -     | 2     |
| CO3   | 1    | -    | -    | -    | 1    | -    | -    | 3    | -    | -     | 2     |
| CO4   | 1    | -    | -    | -    | 1    | -    | -    | 3    | -    | -     | 2     |
| CO5   | 1    | -    | -    | -    | 1    | -    | -    | 3    | -    | -     | 2     |

### UNIT – I

Introduction to Intellectual Property Rights (IPR): Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO –Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR – Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

### UNIT – II

Copyrights and Neighboring Rights: Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works – Rights of Distribution – Rights of Performers – Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act.

### UNIT – III

Patents: Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Double Patenting — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations.

### UNIT – IV

Trademarks and Trade secrets: Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark



Maintenance – Transfer of rights - Deceptive Similarities - Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing off Action - Introduction to Trade Secrets – General Principles - Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements.

## **UNIT – V**

Cyber Law and Cyber Crime : Introduction to Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions - E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers. Relevant Cases Shall be dealt where ever necessary.

### **Text Books:**

1. Fundamentals of IPR for Engineers- Kompal Bansal & Parishit Bansal, B. S. Publications (Press). ISBN: 9788178002774.
2. Intellectual Property -Deborah E.Bouchoux, Third Edition, Cengage Learning, New Delhi. ISBN: 0 340 67786 4.

### **Reference Books:**

1. Intellectual property rights- Prabuddha Ganuli, Tata Mcgraw hill. ISBN: 978-0070077171.
2. Intellectual property rights M.Ashok kumar and Mohd.Iqbal Ali:, Serials Publications. ISBN: 9788183871648.
3. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi. ISBN: 979-8886848229.
4. Intellectual Property- Richard Stim, Cengage Learning, New Delhi. ISBN: 978-0766826656.

### **Web Links:**

1. <http://www.wipo.int/portal/en/index.html>
2. <https://indiankanoon.org/>
3. <http://www.ipindia.nic.in/patents.htm>
4. <http://www.ipindia.nic.in/trade-marks.htm>
5. <http://copyright.gov.in>

**Indian Knowledge Systems (IKS)**  
(CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT, Min. E)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501AC05</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>0</b> | <b>0</b> |

**Course Outcomes:**

**At the end of the course, students will be able to:**

- CO1:** Describe the foundations and scope of Indian Knowledge Systems.
- CO2:** Recognize major Indian contributions to knowledge, science, and culture.
- CO3:** Appreciate ethical values and sustainability rooted in Indian traditions.
- CO4:** Relate traditional knowledge to contemporary societal and technological needs.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | -    | -    | -    | -    | -    | 3    | 1    | 1    | -    | -     | -     |
| CO2   | -    | -    | -    | -    | -    | 3    | 1    | 1    | -    | -     | -     |
| CO3   | -    | -    | -    | -    | -    | 3    | 1    | 1    | -    | -     | -     |
| CO4   | -    | -    | -    | -    | -    | 3    | 1    | 1    | -    | -     | -     |
| CO5   | -    | -    | -    | -    | -    | 3    | 1    | 1    | -    | -     | -     |

**UNIT – I**

**Foundations of Indian Knowledge Systems**

Meaning, scope, and importance of IKS. Sources of IKS: Vedas, Upanishads, Itihasas, Puranas, Shastras. Traditional Knowledge, Indigenous Knowledge, and Western Knowledge – comparison. Gurukula system and knowledge transmission traditions

**UNIT – II**

**Indian Civilization and Philosophical Traditions**

Overview of ancient Indian civilization (Indus Valley, Maurya, Gupta). Indian philosophical schools and ethical values. Epics: Ramayana and Mahabharata – cultural and moral significance. Religious traditions: Hinduism, Buddhism, Jainism, Sikhism

**UNIT – III**

**Arts, Architecture and Cultural Expressions**

Temple architecture: Nagara, Dravidian, Vesara. Mughal architecture and monuments. Indian classical dance forms and music traditions. Handicrafts, sculpture, painting, and iconography

**UNIT – IV**

**Traditional Knowledge in Health, Environment and Sustainability**

Ayurveda and Yoga – holistic health systems. Traditional agriculture and food practices. Water conservation methods and environmental ethics. Biodiversity conservation and sustainable living

## UNIT – V

### Traditional Knowledge and Contemporary Relevance

Protection of Traditional Knowledge. Traditional Knowledge (TK) and Intellectual Property Rights (overview). Role of government and national initiatives. Relevance of IKS to engineering, innovation, and entrepreneurship

#### Text Books:

1. **Indian Knowledge Systems**, Kapil Kapoor & Avadhesh Kumar Singh, D.K. Printworld (India) Pvt. Ltd., New Delhi. ISBN: 9788124608177.
2. **Indian Philosophy – Volume I & II**, S. Radhakrishnan, Oxford University Press, New Delhi. ISBN: 9780195698418.
3. **Science and Technology in Ancient India**, O.P. Jaggi, Atma Ram & Sons, Delhi. ISBN: 9788185694085.
4. **Indian Heritage and Culture**, Madhukar K. Bhagat, McGraw Hill Education (India). ISBN: 9789332901476.
5. **Traditional Knowledge System in India**, Yogendra K. Malik, Pearson Education India. ISBN: 9788131762219.

#### Reference Books:

1. **Ancient Indian Science and Technology**, Debiprasad Chattopadhyaya, History of Science, Philosophy and Culture in Indian Civilization Series. ISBN: 9788187586098.
2. **Indian Culture and Heritage**, Nitin Singhania, McGraw Hill Education. ISBN: 9789353161132.
3. **Knowledge Traditions of India**, Bhu Dev Sharma, Indian Council of Philosophical Research (ICPR). ISBN: 9788185636306.

#### Web Links:

1. <https://iks.aicte-india.org/>
2. <https://www.education.gov.in/iks>

### Minor Stream: Network Security

| Course Code  | Course Name                           | Level | L         | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|---------------------------------------|-------|-----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501CS32     | Cyber Security Essentials             | FC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS30     | Information Security Analysis & Audit | FC    | 2         |   |           | 2         | 50  | 50  | 100   | -             |
| 2501CS23     | Cloud Computing                       | FC    | 2         |   | 2         | 4         | 50  | 50  | 100   | -             |
| 2501CS24     | Wireless Networks                     | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS25     | Cloud IoT & Edge ML                   | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS28     | Ethical Hacking                       | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | -             |
| 2501CS27     | Digital Forensics                     | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS26     | Block Chain Technologies              | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | CSE           |
| 2501CS31     | Cyber Laws                            | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS33     | Secure Coding Techniques              | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                                       |       | <b>20</b> |   | <b>12</b> | <b>32</b> |     |     |       |               |

**Cyber Security Essentials**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501CS32</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

At the end of the course, student will be able to:

- CO1:** Describe the basic concepts of Cyber security issues and challenges
- CO2:** Analyze the cybercrimes and cyber laws.
- CO3:** Demonstrate various privacy and security concerns on social media
- CO4:** Illustrate the concepts related to E-Commerce and digital payments.
- CO5:** Summarize tools and technologies to protect communication devices.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 1    |      |      |      |      | 2    |      |      |       |       |
| <b>CO2</b> | 2    | 3    |      | 2    | 1    |      |      | 1    | 1    |       |       |
| <b>CO3</b> | 1    | 2    |      | 2    | 1    | 1    |      | 1    | 1    |       | 1     |
| <b>CO4</b> | 1    | 2    | 3    | 1    | 1    |      | 1    | 1    |      | 1     | 1     |
| <b>CO5</b> | 2    | 1    |      |      |      |      | 3    |      |      |       |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 3    |      |
| <b>CO4</b> | 2    | 1    |
| <b>CO5</b> | 2    |      |

**UNIT – I**

**Introduction to Cyber security:**

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

**Practice:**

- Study on how to register a Cyber Crime Complaint through online.  
([https://cybercrime.gov.in/Webform/Crime\\_AuthoLogin.aspx](https://cybercrime.gov.in/Webform/Crime_AuthoLogin.aspx))

**UNIT – II**

**Cyber crime and Cyber law:**

Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Legal perspective of cyber

crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India.

**Practice:**

1. Reporting on types of phishing emails.
2. Demonstration of email phishing attack and preventive measures

## **UNIT – III**

### **Social Media Overview and Security**

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Laws regarding posting of inappropriate content.

**Practice:**

1. Basic checklist, privacy and security settings for popular Social media platforms.

## **UNIT – IV**

### **E-Commerce and Digital Payments**

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best **Practices**, Introduction to digital payments, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures.

**Practice:**

1. Configuring security settings in Mobile Wallets and UPIs

## **UNIT – V**

### **Digital Devices Security , Tools and Technologies for Cyber Security**

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best **Practices**, Significance of host firewall and Anti-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

**Practice:**

1.
  - a. Setting and configuring two factor authentication in the Mobile phone.
  - b. Security patch management and updates in Computer and Mobiles.

**Text Books:**

- 1 Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd, ISBN: 9788126521791.
- 2 Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform ISBN: 978-1516821020.

**Reference Books:**

- 1 Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press. ISBN: 978-1498721042
- 2 Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, Wiley Publication, 1<sup>st</sup> Edition,. ISBN: 978-1933284736
- 3 Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon, Jones Bartlett Learning, 2<sup>nd</sup> Edition. ISBN: 978-1284090703

**Web Links:**

- 1 <https://www.coursera.org/specializations/cyber-security>.
- 2 <https://www.nptel.ac.in/courses/106105031/>.
- 3 CERT-In Guidelines- <http://www.cert-in.org.in/>

**Information Security Analysis & Audit**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS30**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| 2        | 0        | 0        | 2        |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Demonstrate fundamental concepts of information security and systems auditing
- CO2:** Analyze latest trend in management control framework
- CO3:** Identify security operations in management control framework.
- CO4:** Distinguish data evidence collection techniques.
- CO5:** Analyze data evidence evaluation in audit.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1   | 3   | 1   |     |     |     |     |     |     |     |      | 1    |
| CO2   | 2   | 2   |     |     |     |     | 2   |     |     |      | 2    |
| CO3   | 1   | 3   |     | 1   |     | 1   |     | 1   |     |      | 2    |
| CO4   | 1   | 2   |     |     |     |     | 1   | 1   |     | 1    | 1    |
| CO5   | 1   | 3   |     | 2   | 1   |     | 2   | 2   |     |      |      |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    |      |
| CO2    | 2    |      |
| CO3    | 2    |      |
| CO4    | 1    |      |
| CO5    | 1    |      |

**UNIT – I**

**Overview of Information System Auditing:** Effect of Computers on Internal Controls, Effects of Computers on Auditing, Foundations of information Systems Auditing, Conducting an Information Systems Audit.

**UNIT – II**

**The management Control Framework-I:** Introduction, Evaluating the planning Function, Leading Function, Controlling Function, Systems Development Management Controls, Approaches to Auditing Systems Development, Programming Management Controls, Data Resource Management Controls.

**UNIT – III**

**The Management Control Framework-II:** Security Management Controls, Operations management Controls Quality assurance Management Controls, Case Studies



## UNIT – IV

**Evidence Collection:** Audit Software, Code Review, Test Data, and Code Comparison, Concurrent Auditing techniques, Interviews, Questionnaires, and Control Flowcharts. Performance Management tools- Case Studies.

## UNIT – V

**Evidence Evaluation:** Evaluating Asset Safeguarding and Data Integrity, Evaluating System, Effectiveness, Evaluating System Efficiency, Information Systems Audit and Management: Managing the Information Systems Audit Function.

### Text Books:

- 1 Information Systems Control and Audit, Ron Weber, Pearson Education, 1st Edition, ISBN-10. 9788131704721 ; ISBN-13. 978-8131704721.
- 2 Cryptography Engineering: Design Principles and Practical Applications ,Niels Ferguson, Bruce Schneier, and Tadayoshi Kohno, John Wiley & Sons, ISBN-10. 0470474246 · ISBN-13. 978-0470474242.

### Reference Books:

- 1 Information System Audit and Assurance, D P Dube, TMH, New Delhi. ISBN: 978-0070585690
- 2 Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi. ISBN: 978-8170083412

### Web Links:

- 1 <https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks>
- 2 <https://computersecurity.stanford.edu/free-online-video/> [ Free Online Videos]
- 3 CERT-In Guidelines- <http://www.cert-in.org.in/>

**Cloud Computing**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501CS23</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | 2        | 0        | 2        | 4        |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain basic concepts and terminologies of Cloud Computing and Virtualization.
- CO2:** Demonstrate Cloud deployment models, Service models and Architectures.
- CO3:** Analyze Cloud services, Applications and Capacity Planning.
- CO4:** Use different PaaS application frameworks to construct Cloud applications.
- CO5:** Develop web applications through Google, Microsoft and Amazon web services for Realtime application.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| <b>CO1</b> | 2   | 2   |     |     | 1   |     |     | 1   | 1   |      | 1    |
| <b>CO2</b> | 2   | 2   |     |     | 1   |     |     | 1   | 1   |      | 1    |
| <b>CO3</b> | 3   | 1   |     |     | 1   |     |     | 2   | 1   |      | 1    |
| <b>CO4</b> | 2   | 2   |     |     | 1   |     |     | 2   | 1   |      | 1    |
| <b>CO5</b> | 2   | 2   |     |     | 1   |     |     | 2   | 1   |      | 1    |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 2    |      |

**UNIT – I**

**Fundamental Cloud Computing and Virtualization Cloud Computing:** Origin and influences, Basic concepts and terminology, Goals and benefits, Risks and challenges, Roles and boundaries and Cloud characteristics.

**Introduction to Virtualization:** Characteristics, Taxonomy of virtualization technologies, Pros and cons of virtualization, Virtualization Technologies: Xen, VMware and Hyper-V.

**Practice:**

1. Introduction to Cloud Computing.
2. Overview of cloud computing concepts.
3. Hands-on: Setting up a free-tier account on AWS/Azure/GCP.

**UNIT - II**

**Understanding Cloud Models and Architectures Cloud Models:** NIST model, Cloud Cube model, Deployment models: Public, Private, Hybrid and Community; Service models: IaaS, PaaS and SaaS. Understanding Cloud Architecture: Exploring the Cloud Computing Stack, Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications; Connecting to the Cloud: The Jolicloud Netbook OS and Chromium OS - The Browser as an Operating System.

**Practice:**

1. Virtual Machines and Computer Services.
  - a. Creating and managing virtual machines.
  - b. Hands-on: Launching and configuring EC2 instances on AWS.

**UNIT – III**

**Understanding Cloud Services, Applications and Capacity Planning:** Understanding Cloud Services and Applications Infrastructure as a Service (IaaS): IaaS workloads, Pods, aggregation, and silos; Platform as a Service (PaaS), Software as a Service (SaaS): SaaS characteristics, Open SaaS and SOA, Salesforce.com and CRM SaaS; Identity as a Service (IDaaS): Identity, Networked identity service classes, Identity system codes of conduct, IDaaS interoperability; Compliance as a Service (CaaS). Capacity Planning: Defining Baseline and Metrics: Baseline measurements, System metrics, Load Testing, Resource ceilings, Server and instance types; Network Capacity and Scaling.

**Practice:**

1. Storage Solutions.
  - a. Exploring different storage options (S, EBS, Glacier).
  - b. Hands-on: Implementing S3 buckets and managing data.

**UNIT – IV**

**Exploring Platform as A Service (PaaS):** PaaS Application Frameworks: Drupal, Eccentex AppBase 3.0, Long Jump, Squarespace, Wavemaker and Wolf Frameworks. Exploring Platform as a Service using Google Web Services: Surveying the Google Application Portfolio, Google Toolkit and Working with the Google App Engine. Exploring Platform as a Service using Microsoft Cloud Services: Exploring Microsoft Cloud Services, Microsoft Azure- Live Essentials, Live Home and Live for Mobile.

**Practice:**

1. Networking in the Cloud.
  - a. Configuring virtual private clouds (VPC), subnets, and security groups.
  - b. Hands-on: Setting up a VPC and deploying instances within it.

**UNIT -V**

**Exploring Infrastructure As A Service (IaaS):** Understanding Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2): Amazon Machine Images, Pricing models, System images and software, Creating an account and instance on EC2; Working with Amazon Storage Systems: Amazon Simple Storage System (S3), Amazon Elastic Block Store (EBS) and CloudFront; Understanding Amazon Database Services: Amazon SimpleDB, Amazon Relational Database Service (RDS) and Choosing a database for AWS.

**Practice:**

1. Database Services
  - a. Understanding cloud-based database services (RDS, DynamoDB).
  - b. Hands-on: Setting up and querying a relational database in AWS RDS.

**Text Books:**

- 1 Cloud Computing Bible, Barrie Sosinsky, Wiley India Pvt Ltd, ISBN-10. 0470903562 ; ISBN-13. 978-0470903568.
- 2 Cloud Computing- Concepts, Technology and Architecture, Thomas Erl and Ricardo Puttini, Pearson, ISBN 10: 0133387526 - ISBN 13: 9780133387520.

**Reference Books:**

- 1 Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola and S Thamarai Selvi, McGraw Hill Education. ISBN: 978-0-12-411454-8.
- 2 Cloud Application Architectures, George Reese, O'Reilly. ISBN: 978 0596156367.
- 3 Enterprise Cloud Computing Technology Architecture Applications, Gautam Shroff, Cambridge university press; 1<sup>st</sup> edition. ISBN: 978-0521137355.

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc24\\_cs17/preview](https://onlinecourses.nptel.ac.in/noc24_cs17/preview)
- 2 <https://docs.aws.amazon.com/>
- 3 <https://learn.microsoft.com/en-us/training/azure/>

**Wireless Networks**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS24**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Describe evolution of wireless networks and wireless communication technologies.
- CO2:** Simulate Wireless Communication network for analyzing packet transmission using NS3.
- CO3:** Discuss IEEE 802.11 Standards and Protocols.
- CO4:** Explain evolution and architecture of cellular networks.
- CO5:** Summarize Emerging Trends such as cognitive radio networks, VANETs.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 2    |      |      | 1    |      |      | 1    | 1    |       |       |
| CO2   | 2    | 1    | 2    |      | 2    |      |      | 1    | 1    |       |       |
| CO3   | 2    | 1    |      |      | 1    |      |      | 1    | 1    |       |       |
| CO4   | 2    |      | 2    |      | 2    |      |      | 1    | 1    |       |       |
| CO5   | 2    | 2    | 1    |      |      |      |      |      |      |       |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 1    |      |
| CO2    | 2    |      |
| CO3    | 1    |      |
| CO4    | 1    |      |
| CO5    | 1    |      |

**UNIT – I**

**Introduction to Wireless Networks:** Evolution of Wireless Networks, Basic Wireless Communication Concepts, Wireless Spectrum and Regulations, Wireless Network Architectures, Infrastructure Networks, Ad-Hoc Networks, Wireless Standards: IEEE 802.11, Bluetooth, Zigbee.

**Practice:**

1. Simulate an ad-hoc network using NS3.

**UNIT – II**

**Wireless Communication Technologies:** Radio Propagation Models, Modulation Techniques, Multiple Access Techniques: TDMA, FDMA, CDMA, OFDM Antennas and Diversity Techniques, MIMO (Multiple Input Multiple Output) Systems.

**Practice:**

1. Create multiple nodes, establish peer to peer connections, and analyze packet transmission using NS3.

**UNIT – III**

**Wireless LANs and PANs:** IEEE 802.11 Standards and Protocols, WI-FI Network Design and Deployment, Bluetooth and Zigbee Protocols, Security in Wireless LANs: WEP, WPA, WPA2, QoS (Quality of Service) in Wireless Networks.

**Practice:**

1. Simulate a basic GSM network using NS3.

**UNIT – IV**

**Cellular Networks:** Evolution from 1G to 5G, GSM, CDMA, and LTE Architectures, 5G Network Architecture and Key Technologies, Handoff and Roaming, Cellular Network Planning and Optimization.

**Practice:**

1. Set up and configure a Wi-Fi network using Wireshark.
2. Explore the signal strength and coverage area of a Wi-Fi network.

**UNIT – V**

**Emerging Trends and Future Directions:** Internet of Things (IoT) and Wireless Sensor Networks (WSNs), Cognitive Radio Networks, Vehicular Ad-hoc Networks (VANETs), Wireless Mesh Networks, Security and Privacy Challenges in Wireless Networks.

**Text Books:**

- 1 Wireless Communications: Principles and Practice by Theodore S. Rappaport, Prentice Hall 2nd Edition, ISBN: 9780130422323.
- 2 Wireless Communications by Andrea Goldsmith, Cambridge University Press, ISBN: 9780521837163.

**Reference Books:**

- 1 Principles of Wireless Access and Localization by Kaveh Pahlavan and Prashant Krishnamurthy. Wiley-IEEE Press, ISBN: 9780470697085.
- 2 802.11 Wireless Networks: The Definitive Guide by Matthew S. Gast, O'Reilly Media 2<sup>nd</sup> Edition, ISBN: 9780596100520.
- 3 Wireless Communications, A. Molisch, Wiley, 2005 Haykin & Moher, Modern Wireless Communications, Pearson (Indian Edition).

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc22\\_ee85/preview/](https://onlinecourses.nptel.ac.in/noc22_ee85/preview/)
- 2 Wireshark Network Protocol Analyzer [Wireshark] (<https://www.wireshark.org/>)
- 3 NS3 Network Simulator [NS3] (<https://www.nsnam.org/>)

**Cloud IoT and Edge ML**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501CS25</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain technologies behind the communication and management of Fog and edge resources.
- CO2:** Discuss techniques for storage and computation in Fog, edge, 5G and cloud
- CO3:** Implement Internet of Everything (IoE) applications through Fog computing architecture.
- CO4:** Illustrate optimization strategies in Fog and Edge Architectures.
- CO5:** Summarize applications in Fog and Edge Computing.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 1    | 2    |      |      | 2    |      |      | 2    | 2    |       | 2     |
| <b>CO2</b> | 2    | 2    |      |      | 2    |      |      | 2    | 2    |       | 2     |
| <b>CO3</b> | 1    | 2    | 3    |      | 2    |      |      | 2    | 2    |       | 2     |
| <b>CO4</b> | 2    | 1    | 1    | 3    | 2    |      |      | 2    | 2    |       | 2     |
| <b>CO5</b> | 2    | 1    | 1    |      | 2    |      |      | 2    | 2    |       | 2     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 1    |      |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

**UNIT – I**

**Internet of Things (IoT) and New Computing Paradigms:**

Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud, Hierarchy of Fog and Edge Computing, Business Models, Edge Computing Platforms, Opportunities and Challenges.

**Practice:**

1. Building a Simple Edge Computing Application with Data Processing and Cloud Integration.

**UNIT – II**

**Challenges in Federating Edge Resources:**

Introduction, Methodology, Integrated C2F2T Literature by Modeling Technique, Integrated C2F2T Literature by Use Case Scenarios, Integrated C2F2T Literature by Metrics, Threads, Standards.

**Practice:**

1. Setting Up a Simple IoT Device with Edge Computing

### **UNIT – III**

#### **Orchestration of Network Slices in Fog, Edge, and Clouds:**

Introduction, Background, Network Slicing, Network Slicing in Software, Defined Clouds, Network Slicing Management in Edge and Fog, Internet of Vehicles (IoV): Architecture, Protocols and Seven-layer security model architecture for Internet of Vehicles, IoV: Network Models, Challenges and future aspects.

#### **Practice:**

1. Implementing a Simple Network Slicing Scenario for Internet of Vehicles (IoV) Using Edge and Fog Computing.

### **UNIT – IV**

#### **Optimization Problems in Fog and Edge Computing:**

Preliminaries, The Case for Optimization in Fog Computing, Formal Modeling Framework

for Fog Computing, Metrics, Further Quality Attributes, Optimization Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle, Toward a Taxonomy of Optimization Problems in Fog Computing.

#### **Practice:**

1. Optimizing Task Scheduling in Fog Computing

### **UNIT – V**

#### **Applications of Fog and Edge Computing:**

Exploiting Fog Computing in Health Monitoring-Smart Surveillance Video Stream Processing at the Edge for Real - Time Human Objects Tracking-Fog Computing Model for Evolving Smart Transportation Applications - Testing Perspectives of Fog - Based IoT Applications - Legal Aspects of Operating IoT Applications in the Fog.

#### **Practice:**

1. Real-Time Human Object Tracking Using Fog Computing in a Smart Surveillance System

#### **Text Books:**

- 1 Fog and Edge computing: Principles and Paradigms, Buyya, Rajkumar, and Satish Narayana Srirama, John Wiley & Sons, USA, 1st edition, ISBN-10. 1119524989 · ISBN-13. 978-1119524984, 2019.
- 2 Internet of Things –From Research and Innovation to Market Deployment, Ovidiu Vermesan, Peter Friess, “River Publishers, India, 1<sup>st</sup> edition, ISBN 10: 8793102941.

#### **Reference Books:**

- 1 Cloud computing: A hands-on approach, Bahga, Arshdeep, and Vijay Madisetti, CreateSpace Independent Publishing Platform, USA, 2<sup>nd</sup> edition. ISBN: 978-1494435141.

#### **Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc24\\_cs66/preview](https://onlinecourses.nptel.ac.in/noc24_cs66/preview)



## Ethical Hacking

(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501CS28</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Describe the concepts and types of Ethical hacking.
- CO2:** Apply tools and techniques for Social Engineering.
- CO3:** Illustrate concepts of data security for various networking systems.
- CO4:** Analyze techniques to protect Web servers and Communication Systems.
- CO5:** Demonstrate ethical laws and tests related to ethical hacking.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 1    |      |      |      |      |      | 1    | 1    |       | 1     |
| <b>CO2</b> | 2    | 2    |      | 1    | 2    |      |      | 1    | 1    |       | 2     |
| <b>CO3</b> | 2    | 2    |      | 2    |      |      |      | 1    | 1    |       | 1     |
| <b>CO4</b> | 2    | 2    |      |      | 1    |      |      | 1    | 1    |       | 2     |
| <b>CO5</b> | 2    | 2    |      |      |      |      | 2    | 1    | 1    |       | 1     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PO      | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

## UNIT – I

### Ethical Hacking

Types of Data Stolen From the Organizations, Elements of Information Security, Authenticity and NonRepudiation, Security Challenges, Effects of Hacking, Hacker – Types of Hacker, Ethical Hacker, Hacktivism - Role of Security and Penetration Tester, Penetration Testing Methodology, Networking & Computer Attacks – Malicious Software (Malware), Protection Against Malware, Intruder Attacks on Networks and Computers, Addressing Physical Security – Key Loggers and Back Doors.

#### Practice:

1. Create a social networking website login page using phishing techniques.
2. Sniffing tools to analyze traffic on a network and dissect information.

## UNIT – II

### Foot Printing And Social Engineering

Web Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking.

**Practice:**

1. Social Engineering Countermeasures
2. Tools for Foot Printing

**UNIT – III****Data Security**

Physical Security – Attacks and Protection, Steganography – Methods, Attacks and Measures, Cryptography– Methods and Types of Attacks, Wireless Hacking, Windows Hacking, Linux Hacking.

**Practice:**

1. Write a code to demonstrate DoS attacks.
2. Windows ,Linux OS hacking.

**UNIT – IV****Network Protection System & Hacking Web Servers**

Routers, Firewall & Honeypots, IDS & IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking.

**Practice:**

1. Write a script or code to demonstrate SQL injection attacks.
2. Setup a honey pot and monitor the honey pot on network.

**UNIT – V****Ethical Hacking Laws And Tests**

An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking, ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking – Social Engineering, Host Reconnaissance, Session Hijacking, Hacking - Web Server, Database, Password Cracking.

**Practice:**

1. Study of Techniques uses for Web Based Password Capturing.
2. Study on how to register a Cyber Crime Complaint through online.  
( [https://cybercrime.gov.in/Webform/Crime\\_AuthoLogin.aspx](https://cybercrime.gov.in/Webform/Crime_AuthoLogin.aspx))

**Text Books:**

- 1 Hands-On Ethical Hacking and Network Defense, Corley, Michael T. Simpson, Kent Backman, James E., CENGAGE Learning, ISBN 10 1435486099 , ISBN 13 9781435486096.
- 2 Penetration Testing and Network Defense ,Whitaker & Newman , Cisco Press, Indianapolis, ISBN-10. 1587052083 · ISBN-13. 978-1587052088.

**Reference Books:**

- 1 Official Certified Ethical Hacker Review Guide,Steven DeFino, Barry Kaufman, Nick Valenteen,CENGAGE Learning. ISBN: 978-1435488533.
- 2 The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy ,Patrick Engebretson, Syngress Basics Series – Elsevier. ISBN: 978-0124116443.

**Web Links:**

- 1 <https://www.springboard.com/blog/cybersecurity/7-free-sources-to-learn-ethical-hacking-from-scratch/>
- 2 <https://hackernoon.com/top-resources-to-learn-ethical-hacking3>
- 3 [https://onlinecourses.nptel.ac.in/noc22\\_cs13/preview](https://onlinecourses.nptel.ac.in/noc22_cs13/preview)

## Digital Forensics

(Common to CSE, IT, AIML & CSE (DS))

**Course Code:** 2501CS27

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Apply forensic analysis tools to recover evidence for identifying crime.
- CO2:** Discuss next-generation computer crime investigations.
- CO3:** Apply digital evidences for data acquisition.
- CO4:** Illustrate processing crimes and incident scenes through digital evidence.
- CO5:** Identify current computer forensic tools for various digital usages.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 3    |      | 3    |      |      |      | 2    | 1    |       | 1     |
| <b>CO2</b> | 2    | 2    |      | 3    |      |      |      | 2    | 1    |       | 1     |
| <b>CO3</b> | 2    | 3    |      | 3    |      |      |      | 1    | 1    |       | 1     |
| <b>CO4</b> | 2    | 2    |      | 3    |      |      |      | 2    | 1    |       | 1     |
| <b>CO5</b> | 2    | 2    |      | 3    | 3    |      |      | 3    | 1    |       | 1     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 2    |      |

## UNIT – I

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

### Practice:

1. Study of Computer Forensics and different tools used for forensic investigation

## UNIT – II

Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.

### Practice:

1. Live Forensics Case Investigation using Autopsy.

## UNIT – III

Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions.

### Practice:

1. How to Recover Deleted Files using Forensics Tools?

## UNIT – IV

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.

### Practice:

1. How to view last activity of your PC?
2. How to Collect Email Evidence in Victim PC?

## UNIT – V

Current computer forensics tools- software, hardware tools, validating and testing forensic software. E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

### Practice:

1. Study the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt.
1. Data extraction from call logs using Sleuth Kit.

### Text Books:

- 1 Computer Forensics: Incident Response Essentials, Warren G. Kruse II and Jay G. Heiser, Addison Wesley, ISBN 13: 9780201707199.
- 2 Guide to Computer Forensics and Investigations, Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Thomson Course Technology, 2nd ed., ISBN: 0-619-21706-5.

### Reference Books:

- 1 Computer Forensics, Computer Crime Scene Investigation, Vacca, J, Charles River Media, 2<sup>nd</sup> Ed, ISBN: 1-58450-389.
- 2 Digital Forensics, Andre Arnes, Wiley, 2018. ISBN: 978-1119262381.
- 3 The basics of digital Forensics (Latest Edition) – The primer for getting started in digital forensics by John Sammons – Elsevier Syngress Imprint ISBN: 978-1597496612.
- 4 Cybersecurity – Understanding of cybercrimes, computer forensics and Legal perspectives by Nina Godbole and Sunit Belapure – Wiley India Publication, ISBN: 9788126521791.
- 5 Practical Digital Forensics – Richard Boddington [PACKT] Publication, Open source community. ISBN: 9781785887109.

### Web Links:

- 1 [https://onlinecourses.swayam2.ac.in/cec20\\_lb06/preview](https://onlinecourses.swayam2.ac.in/cec20_lb06/preview)
- 2 [https://onlinecourses.swayam2.ac.in/nou24\\_cs05/preview](https://onlinecourses.swayam2.ac.in/nou24_cs05/preview)
- 3 [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_0135015538612879367592/](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0135015538612879367592/)

**Block Chain Technologies**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501CS26</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Demonstrate blockchain and crypto currency basics.
- CO2:** Compare and contrast permissioned and permissionless blockchains.
- CO3:** Explain different types of crypto currency wallets.
- CO4:** Explain how to compile and deploy smart contracts using Ethereum.
- CO5:** Illustrate Hyperledger fabric and use cases of block chain technologies.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|------|
| <b>CO1</b> | 3   | 1   |     |     |     |     |     |     |     |       | 2    |
| <b>CO2</b> | 2   | 3   | 1   | 2   |     |     |     |     |     |       | 2    |
| <b>CO3</b> | 2   | 3   | 1   | 1   |     |     |     |     |     |       | 2    |
| <b>CO4</b> | 2   | 2   | 3   | 2   |     |     |     |     |     |       | 2    |
| <b>CO5</b> | 2   | 2   | 3   | 2   |     |     |     |     |     |       | 2    |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 3    |
| <b>CO5</b> |      | 3    |

**UNIT – I**

**Introduction:** Overview of Block chain, History of Blockchain, Real-world applications, Peer to Peer Network, Smart Contract, Wallet, Digital Currency, Ledgers, Types of Blockchain Platforms.

**Practice:**

1. Creating Merkle tree

**UNIT – II**

**Consensus Mechanism:** Permissioned Blockchain, Permissionless Blockchain, Different Consensus Mechanisms- Proof of Work, Proof of Stake, Proof of Activity, Proof of Burn, Proof of Elapsed Time, Proof of Authority, Proof of Importance, voting-based consensus algorithms, and federated consensus.

**Practice:**

1. Creation of Block.

## UNIT – III

**Crypto currency and Wallet:** Types of Wallet, Desktop Wallet, App based Wallet, Browser based wallet, Metamask, Creating an account in Metamask, Use of faucet to fund wallet, transfer of cryptocurrency in meta mask, Merkle tree, hard and soft forks, network models and properties of secure state machine replication (SMR)

**Practice:**

1. Block chain Implementation Programming code

## UNIT – IV

**Smart contract and Ethereum:** Overview of Ethereum, Writing Smart Contract in Solidity, Remix IDE , Different networks of ethereum, understanding blocks practically at blockhchain.com, how to compile and deploy smart contract in remix

**Practice:**

1. Java code to implement blockchain in Merkle Trees

## UNIT – V

**Understanding Hyperledger Fabric:** Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contracts using Hyperledger Fabric.

**Use Cases:** Cross border payments, Know Your Customer (KYC), Food Security, Block chain enabled Trade, Anti-Money Laundering (AML)

**Practice:**

1. Creating a Crypto-currency Wallet

**Text Books:**

- 1 Blockchain: Blueprint for a New Economy, Melanie Swan, O'Reilly, ISBN : 9781491920497.
- 2 Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashier, Packt publishing, ISBN: 9781787125445.

**Reference Books:**

- 1 Mastering Ethereum: Building Smart Contracts and DApps by Andrews ISBN:978-1491971949.
- 2 Mastering Bitcoin: Programming the Open Blockchain, by Andreas M. Antonopoulos, O'Reilly, ISBN: 9781491954362.

**Web Links:**

- 1 [https://onlinecourses.swayam2.ac.in/aic21\\_ge01/](https://onlinecourses.swayam2.ac.in/aic21_ge01/)
- 2 <https://github.com/blockchainedindia/resources>
- 3 <https://github.com/HyperledgerHandsOn/trade-finance-logistics>

**Cyber Laws**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS31**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Identify the needs of IT Act.
- CO2:** Summarize IT Act 2000 and its relevance.
- CO3:** Discuss digital signatures and E-governance.
- CO4:** Analyze traditional computer crime and early hacker.
- CO5:** Demonstrate Identity theft and Identity fraud.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 3    |      |      |      |      |      | 2    | 1    |      |       | 2     |
| CO2   | 2    | 2    |      |      |      |      | 3    |      |      | 1     | 2     |
| CO3   | 2    | 3    |      | 1    | 1    | 1    | 2    | 1    | 1    |       | 2     |
| CO4   | 2    | 2    |      |      |      | 2    | 3    | 1    |      |       | 2     |
| CO5   | 1    | 2    |      |      |      |      | 3    |      |      |       | 2     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    |      |
| CO2    | 1    |      |
| CO3    | 2    |      |
| CO4    | 1    |      |
| CO5    | 1    |      |

**UNIT – I**

**The IT Act, 2000: A Critique:** Crimes in this Millennium, Section 80 of the IT Act, 2000 – A Weapon or a Farce?, Forgetting the Line between Cognizable and Non-Cognizable Offences, Arrest for “About to Commit” an Offence Under the IT Act.

**Practice:**

1. Create awareness on sections in IT Act 2000 and how they can be related to each illegal activity

**UNIT – II**

**Cyber Crime and Criminal Justice:** Penalties, Adjudication and Appeals Under the IT Act, 2000: Concept of Cyber Crime and, Hacking, Teenage Web Vandals, Cyber fraud and Cyber Cheating, Virus on Internet Deformation, Harassment and E-mail Abuse Cyber Pornography, Other IT Offences, Monetary Penalties, Adjudication and Appeals Under IT Act 2000, Network Service Providers, Jurisdiction and Cyber Crimes, Nature of Cyber Criminality Strategies to Tackle Cyber Crime and Trends, Criminal Justice in India and Implications.



**Practice:**

1. Installation and configuration of Computer Host Firewall to protect system from unauthorized activities.

**UNIT – III**

**Digital Signatures, Certifying Authorities and E-Governance:** Digital Signatures, Digital Signature Certificate, Certifying Authorities and Liability in the Event of Digital Signature compromise, E-Governance in the India. A Warning to Babudom, Are Cyber Consumers Covered under the Consumer Protection, Goods and Services, Consumer Complaint Defect in Goods and Deficiency in Services Restrictive and Unfair Trade Practices .

**Practice:**

1. Study on how to register a Consumer Complaint through online.  
(<https://consumerhelpline.gov.in/>)

**UNIT – IV**

**Traditional Computer Crime: Early Hacker and Theft of Components:** Traditional problems, Recognizing and Defining Computer Crime, Phreakers: Yesterday's Hackers, Hacking, Computers as Commodities, Theft of intellectual Property Web Based Criminal Activity, Interference with Lawful Use of Computers, Malware, DoS (Denial of Service) and DDoS (Distributed Denial of Service) Attacks, Ransomware and Kidnapping of Information, Theft of Information, Data Manipulation, and Web Encroachment , Dissemination of Contraband or Offensive materials, Online Gambling Online Fraud, Securities Fraud.

**Practice:**

1. Study on how to file a complaint against web based activity through online.  
(<https://cybercrime.gov.in/>)

**UNIT – V**

**Identity Theft and Identity Fraud:** Typologies of Internet Theft/Fraud, Prevalence and Victimology, Physical Methods of Identity Theft, Virtual and Internet Facilitated methods, Crimes facilitated by Identity theft/fraud, Organized Crime and Technology Protection of Cyber consumers in India Cyber-consumer act Consumer, Goods and service, consumer compliant, restricted and unfair trade Practices.

**Practice:**

1. Wi-Fi security management in computer and create awareness on illegal cyber activities.

**Text Books:**

- 1 Cyber Law Simplified, Vivek Sood, Tata McGraw Hill, 4<sup>th</sup> edition, ISBN-10. 0070435065 , ISBN-13. 978-0070435063.
- 2 Computer Forensics and Cyber Crime, Marjie T. Britz, Pearson, 3rd edition, ISBN 10: 0132677717 - ISBN 13: 9780132677714.

**Reference Books:**

- 1 Cyber Laws Texts and Cases, Ferrera, CENGAGE India, 3<sup>rd</sup> sediton. ISBN: 978-8131517925
- 2 Cyber Law by PavanDuggal, Universal law publishing, 2<sup>nd</sup> edition. ISBN: 978-8131253663

**Web Links:**

- 1 <http://www.cyberlawsindia.net/>
- 2 <http://meity.gov.in/content/cyber-laws5>
- 3 <https://www.coursera.org/learn/cyber-conflicts>

## Secure Coding Techniques

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS33**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Describe the objectives and services of Cyber security.
- CO2:** Analyze importance of OWASP and Security risks.
- CO3:** Outline importance of SDLC and Design Principles. .
- CO4:** Summarize reasons and impact of Common security flaws in C and C++
- CO5:** Apply secure coding best practices in Python programming language.

### Mapping of Course Outcomes with Program Outcomes:

| CO\PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    | 2    | 2    | 1    |      |      | 3    | 3    |       |       |
| <b>CO2</b> | 3    | 3    | 2    | 2    | 3    |      |      | 3    | 3    |       |       |
| <b>CO3</b> | 3    | 2    | 2    | 2    | 3    |      |      | 3    | 3    |       |       |
| <b>CO4</b> | 3    | 2    | 2    | 2    | 3    |      |      | 3    | 3    |       |       |
| <b>CO5</b> | 3    | 2    | 2    | 2    | 2    |      |      | 3    | 3    |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PO      | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 1    |
| <b>CO2</b> |      | 3    |
| <b>CO3</b> |      | 3    |
| <b>CO4</b> |      | 3    |
| <b>CO5</b> |      | 3    |

### UNIT – I

Network and Cyber Security Fundamentals: Network Basics, Network Components, Types of Networks, Networking Models, Introduction to Cyber Security, Why Cyber Security is important, Objectives and Services of Cyber Security, various Security Attacks, Types of Cyber threats, Cyber Security Challenges .

#### Practice:

1. Practical learning - Installation and working with Wireshark tool
2. Practical learning - Wireshark Lab: Ethernet and ARP

### UNIT – II

OWASP Top 10-2021 : Importance of OWASP Top 10 , OWASP Top 10 Application Security Risks – 2021: Broken Access Control Risk Root Causes and its Mitigation, Cryptographic Failures Risk Root Causes and its Mitigation, Injection Risk Root Causes and its Mitigation , Vulnerable and Outdated Components Risk Root Causes and its Mitigation , Identification and Authentication Failures Risk Root Causes and its Mitigation, Software and Data Integrity Failures Risk Root Causes and its Mitigation, Security Misconfiguration Risk Root Causes

and its Mitigation, Security Logging and Monitoring Failures Risk Root Causes and its Mitigation, Server-Side Request Forgery Risk Root Causes and its Mitigation .

**Practice:**

1. Practical learning – How to find and exploit different types of SQLi vulnerabilities.
2. Practical learning – Burp Suite Practice How to find vulnerabilities.

**UNIT – III**

Secure Coding Best Practices: Secure Design Principles, Password Management, Access Control, Error Handling and Logging, system Configuration, Threat Modeling, Cryptography Practices, Input and Output Sanitization, Tokenizing and Sandboxing, Static and dynamic testing, vulnerability scanning and penetration testing, Microsoft SDL Tool .

**Practice:**

1. Practical learning – How to conduct penetration testing
2. Practical learning – Microsoft SDL Tool Practice

**UNIT – IV**

Secure coding Practices in C/C++: Common security flaws in C and C++, Buffer Overflows and Code Injections: Stack Overflows attacks, Array indexing attacks Format strings attacks, Integer Overflows.

**Practice:**

1. Practical learning – How to handle Buffer Overflows risks
2. Practical learning – Practice to find Code Injections attacks

**UNIT – V**

Secure coding **Practices** in Python: Basics of Python, Version of Python, Upgrade, update, patch, use a Virtual Environment Python, Sanitize inputs, String Formatting, Handle Python HTTP Requests Safely, Handling Data Deserialization Safely.

**Practice:**

1. Practical learning – Identifying supported HTTP methods with Burp Suite
2. Practical learning – How to prevent CSRF attacks with Burp Suite

**Text Books:**

- 1 Networking Fundamentals, Packt, Author: Gordon Davies, 2019 edition, ISBN 13: 9781838643508.
- 2 OWASP Handbook, ISBN-10. 1329427092.

**Reference Books:**

- 1 Secure coding in C and C++ by Robert C. Seacord, Pearson , Second Edition . ISBN: 978-0321822130 .
- 2 Secure Coding Guidelines for Python by Zádrapa Jan 2021

**Web Links:**

- 1 <https://www.stealthlabs.com/blog/infographic-top-15-cybersecurity-myths-vs-reality/>
- 2 <https://www.microsoft.com/en-us/securityengineering/sdl/threatmodeling>
- 3 <https://www.checkpoint.com/cyber-hub/threat-prevention/what-is-sandboxing/>

### Minor Stream: Machine Intelligence

| Course Code  | Course Name                 | Level | L         | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|-----------------------------|-------|-----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501AI07     | Computer Vision             | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | DAE           |
| 2501AI14     | Soft Computing              | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | AI            |
| 2501AI10     | Natural Language Processing | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | DAE           |
| 2501AI11     | Deep Learning               | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | DAE           |
| 2501AI13     | Recommender Systems         | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | DAE           |
| 2501AI09     | Reinforcement Learning      | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | ML            |
| 2501AI16     | Prompt Engineering & GenAI  | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | ML            |
| 2501AI15     | AI Chatbot                  | IC    | 2         |   |           | 2         | 50  | 50  | 100   | DAE           |
| 2501AI17     | Federated Machine Learning  | AC    | 2         |   |           | 2         | 50  | 50  | 100   | ML            |
| 2501AI08     | Expert Systems              | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                             |       | <b>20</b> |   | <b>12</b> | <b>32</b> |     |     |       |               |

**Computer Vision**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501AI07**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain the Fundamentals of Computer Vision and Comprehend Image Formation and Photometric Concepts.
- CO2:** Apply the principles of feature detection and matching.
- CO3:** Analyze basic methods of computer vision related to Structure and Motion.
- CO4:** Evaluate Computational Photography Techniques and Achieve SuperResolution and Blur Removal and Synthesize Textures.
- CO5:** Implement the design of a computer vision system for a 3D Reconstruction, Albedos, image based rendering views and depths.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/ PO     | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    | 2    |      | 2    |      |      | 1    | 1    |       |       |
| <b>CO2</b> | 2    | 2    | 1    |      | 2    |      |      | 1    | 1    |       |       |
| <b>CO3</b> | 2    | 2    | 1    |      | 2    |      |      | 1    | 1    |       |       |
| <b>CO4</b> | 2    | 2    | 1    |      | 2    |      |      | 1    | 1    |       |       |
| <b>CO5</b> | 2    | 2    | 1    |      | 2    |      |      | 1    | 1    |       |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/ PO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 2    | 1    |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 1    | 2    |
| <b>CO5</b> | 1    | 2    |

**UNIT – I**

**Introduction to Computer Vision and Transformation:** What is computer vision, A brief history, Applications, Geometric Primitives, Photometric Image Formation, Digital Camera, Image Processing: Point Operators, Linear Filtering, Global Optimization.

**Transformation:** Orthogonal, Euclidean, Affine, Projective, etc., Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing, Geometric Transformations.

**Practice :**

1. Implement contrast adjustment of an image. Implement Histogram processing and equalization.
2. Use of Fourier transform for filtering the image.

## UNIT – II

### **Feature Detection and Matching:**

Points and Patches, Edges, Lines, Segmentation: Active Contours, Split and Merge, Mean Shift and Mode Finding, Normalized Cuts, Feature detectors, Feature descriptors, Feature matching, Feature tracking.

### **Practice :**

1. Implementing image processing operations in python/mat lab/openCV: Reading image, writing image, conversion of images, and complement of an image.
2. Write a program to display of color image.

## UNIT – III

### **Structure and Motion:**

Triangular, Twoframe Structure from Motion, Factorization, Bundle Adjustment, Constrained Structure and Motion.

**Dense Motion Estimation:** Translation Alignment, Parametric Motion, Spline Based Motion.

### **Practice :**

1. Write a program to apply morphological algorithms on an image.
2. Write a program to perform segmentation on an image.

## UNIT – IV

### **Image Stitching:**

Motion Analysis, Motion Models, Global Alignment, Composing

**Computational Photography:** Photometric Calibration, High Dynamic Range Imaging, SuperResolution and Blur Removal, image Matting and Compositing, Texture Analysis and Synthesis.

### **Practice :**

1. Utilization of Texture Analysis and Synthesis.
2. Performing/Implementing Blur Removal and Image Matting using python.

## UNIT – V

### **3D Reconstruction & Recognition:**

Shape From X, Active Range Finding, Surface Representation, point based Representation, Volumetric Representation.

**Image based Rendering:** View Interpolation, Layered Depth Images, Light Fields and Lumigraphs, Environment Mattes.

**Recognition:** Object detection, Face detection, Pedestrian detection, Face recognition, Eigenfaces, Active appearance and 3D shape models.

### **Practice :**

1. Write a program to detect edges of an image using Operators.
2. Write a program to apply 2D DFT and DCT on an image and display the result.

**Text Books:**

- 1 Computer Vision: Algorithms and Applications, Richard Szeliski, Springer, ISBN-10. 1848829345 · ISBN-13. 978-1848829343.
- 2 Digital Image Processing, Rafael C. Gonzalez, Pearson Education; Fourth edition, ISBN 9789353062989, 2018

**Reference Books:**

- 1 Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall ISBN:978-9332550117
- 2 Computer and Robot Vision, Haralick & Shapiro, Vol II, ISBN: 978-0201569438
- 3 Computer Vision and Image Processing, S. Nagabhushana, New Age International Pvt Ltd; First edition, ISBN: 978-8122416428

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc22\\_ee48/preview](https://onlinecourses.nptel.ac.in/noc22_ee48/preview)
- 2 <https://www.geeksforgeeks.org/computer-vision/>



**Soft Computing**  
(Common to CSE, IT & AIML)

**Course Code: 2501AI14**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Compare intelligent systems and knowledge based systems
- CO2:** Explain fuzzy sets and fuzzy operations
- CO3:** Discuss neuro systems and neural network applications
- CO4:** Apply genetic algorithm and operators
- CO5:** Compare and contrast Swarm Intelligence based algorithms

**Mapping of Course Outcomes with Program Outcomes:**

| CO/ PO     | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | 2    |      | 1    |      |      | 1    | 1    |       | 2     |
| <b>CO2</b> | 2    | 2    | 3    |      | 2    |      |      | 2    | 2    |       | 2     |
| <b>CO3</b> | 2    | 2    | 3    |      | 1    |      |      | 2    | 2    |       | 2     |
| <b>CO4</b> | 2    | 2    | 3    |      | 1    |      |      | 2    | 2    |       | 2     |
| <b>CO5</b> | 2    | 2    | 3    |      | 1    |      |      | 2    | 2    |       | 2     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/ PSO    | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 1    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

**UNIT – I**

**Introduction to Intelligent systems and soft computing:** Intelligent systems, Knowledgebased systems, Knowledge representation and processing, Soft computing techniques.

**Practice:**

1. Text summarization using a simple sequencetosequence model with LSTM (Long ShortTerm Memory) layers.
2. Apply networkx library to represent and process knowledge

**UNIT – II**

**Fundamentals of fuzzy logic systems:** Introduction , Background ,Evolution of fuzzy logic, Popular applications, Stages of development of an intelligent product, Use of fuzzy logic in expert systems, Fuzzy sets , Fuzzy logic operations

**Practice:**

1. Learn the fundamentals of the fuzzy logic ,experiment the basic operations of fuzzy logic (Virtual Labs)
2. Learn about the Fuzzy inference system (FIS) with an example (Virtual Labs)

**UNIT – III**

**Fundamentals of artificial neural networks:** Introduction Learning and acquisition of knowledge , Symbolic learning , Numerical learning, Features of artificial neural networks , Neural network topologies, Neural network activation functions, Neural network learning algorithms, Fundamentals of connectionist modeling

**Practice:**

1. Implement Neural Networks and Perceptron with an example (Virtual Labs)  
Virtual Labs
2. Study Multilayer Perceptron apply it for image classification

**UNIT – IV**

**Genetic algorithms and evolutionary programming:** Introduction, Genetic algorithms, Procedures of genetic algorithms, working of genetic algorithms, genetic algorithm operators, Issues in GAs.

**Practice:**

1. Implement a genetic algorithm for finding the maximum value of a function.
2. Implement Crossover and Mutation in genetic algorithms

**UNIT – V**

**Swarm Intelligent systems:** Introduction, Swarm Intelligence based algorithms – Ant Algorithms; Bee Algorithms; Particle Swarm Optimization, Background of Ant intelligent system, ant colony systems Importance, development, applications, working of ant colony systems, Artificial Bee Colony (ABC) Optimization Behavior of real bees, ABC Algorithm, Variations of ABC: Abcgbest and Abcgbestdist.

**Practice:**

1. Implement Particle Swarm Optimization algorithm
2. Implement ABC with GBest Algorithm:And GBestDist Algorithm

**Text Books:**

- 1 Soft Computing and Intelligent Systems Design Theory, Tools and Applications, Fakhreddine O. Karray and Clarence de Silva ISBN: 978-8131723241
- 2 Artificial Intelligence and Intelligent Systems, N. P. Padhy,Oxford University press. ISBN: 9780195671544

**Reference Books:**

- 1 Fuzzy Logic: A Pratical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional. ISBN: 978-0124859654
- 2 An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press. ISBN: 9780262280013

**Web Links:**

- 1 <https://nptel.ac.in/courses/106105174/>
- 2 <https://www.kdnuggets.com/>
- 3 <https://www.import.io/post/datascientistsvsdataanalystswhythedistinctionmatters/>

**Natural Language Processing**  
(Common to CSE, IT AIML & CSE(DS))

**Course Code: 2501AI10**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain datasets for NLP tasks and context free grammar.
- CO2:** Explain Text preprocessing and stemming algorithms.
- CO3:** Explain feature engineering on text data
- CO4:** Apply similarity measures and word embedding models
- CO5:** Explain text summarization and semantic analysis.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | 1    |      | 1    |      |      |      |      |       | 2     |
| <b>CO2</b> | 2    | 2    | 2    |      | 2    |      |      |      |      |       | 2     |
| <b>CO3</b> | 2    | 2    | 3    |      | 1    |      |      |      |      |       | 2     |
| <b>CO4</b> | 2    | 2    | 3    |      | 1    |      |      |      |      |       | 1     |
| <b>CO5</b> | 2    | 2    | 3    |      | 1    |      |      |      |      |       | 1     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 1    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

**UNIT – I**

Overview of Natural Language Processing, Natural Language Processing and Python: Understanding Natural language Processing and applications, NLTK, Corpus and Dataset, understanding structure of sentence Defining Context free grammar, Morphological Analysis

**Practice:**

1. Word Analysis Learn about morphological features of a word by analysing it
2. Word Generation generate word forms from root and suffix information.

**UNIT – II**

Syntactic Analysis, Semantic analysis, Ambiguity resolution, Discourse integration, Preprocessing tokenization, stemming , lemmatization, Word tokenization and lemmatization

**Practice:**

1. Implement Porter Stemming Algorithm
2. NGrams learn to calculate bigrams from a given corpus and calculate probability of a sentence

### UNIT – III

Feature engineering and NLP algorithms parsers, contextfree grammars, different types of parsers, POS tagging and different types of POS parsers.

#### Practice:

1. Morphology understanding the morphology of a word by the use of AddDelete table.
2. POS Tagging – calculate emission and transition matrix which will be helpful for tagging Parts of Speech

### UNIT – IV

**Basic statistical features of NLP:** TFIDF, Vectorization Encoders and Decoders, Normalization, Advanced feature engineering and NLP algorithms Basics of Word2Vec

#### Practice:

1. Apply term frequency"(TFIDF) to Measures the importance of a word to a specific document
2. Implement word embedding using word2vec

### UNIT – V

Rule Based system for NLP, Machine Learning for NLP problems, Applications of NLP Text Summarization, Sentiment Analysis

#### Practice:

1. Chunking understand the concept of chunking and get familiar with the basic chunk tag set.
2. Building Chunker the importance of selecting proper features for training a model and size of training corpus in learning how to do cunking.

#### Text Books:

- 1 Python Natural Language Processing , Thanaki J, Packt Publishing Ltd, ISBN-13 : 9781787121423.
- 2 Springer Handbook of Speech Processing, Jacob Benesty, M. M. Sondhi, Yiteng Huang Springer, ISBN-10. 3540491252 ; ISBN-13. 978-3540491255.

#### Reference Books:

- 1 Speech & language processing, Jurafsky D, Pearson Education India.
- 2 Foundations of Statistical Natural Language Processing, Christopher, D. Manning and Hinrich Schütze, MIT Press.

#### Web Links:

- 1 <https://www.nltk.org/data.html>
- 2 <https://www.analyticsvidhya.com/blog/2017/01/ultimateguidetounderstandimplemenntnaturallanguageprocessingcodesinpython/>
- 3 [https://datahack.analyticsvidhya.com/contest/linguipediacodefestnaturallanguageprocessing1/?utm\\_source=ultimateguidetounderstandimplementnaturallanguageprocessi ngcodesinpython&utm\\_medium=blog](https://datahack.analyticsvidhya.com/contest/linguipediacodefestnaturallanguageprocessing1/?utm_source=ultimateguidetounderstandimplementnaturallanguageprocessi ngcodesinpython&utm_medium=blog)

## Deep Learning

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501AI11**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Demonstrate the basic statistical concepts in deep learning.
- CO2:** Explain architecture and mathematical foundation for various deep neural networks.
- CO3:** Illustrate the challenges and optimization strategies in Deep Learning.
- CO4:** Build a convolutional neural network using different activation functions.
- CO5:** Build and train RNN and LSTMs using sequence modelling.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   |      | 2    | 1    |      | 2    |      |      | 1    | 1    |       | 3     |
| CO2   |      | 2    | 1    |      | 2    |      |      | 1    | 1    |       | 3     |
| CO3   |      | 2    |      | 3    | 1    |      |      | 1    | 1    |       | 1     |
| CO4   | 2    | 2    | 3    |      | 1    |      |      | 1    | 1    |       |       |
| CO5   | 1    | 2    | 3    |      | 1    |      |      | 1    | 1    |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    | 1    |
| CO2    | 2    | 1    |
| CO3    | 2    | 1    |
| CO4    | 2    | 1    |
| CO5    | 2    | 1    |

### UNIT-I

#### Deep Learning Concepts

Fundamentals about Deep Learning, Perception Learning Algorithms, Probabilistic modelling, Early Neural Networks, How Deep Learning different from Machine Learning, Scalars. Vectors, Matrixes, Higher Dimensional Tensors, Manipulating Tensors. Vector Data, Hyper parameters Vs Parameters - validation sets - Estimators, Bias, Variance , Overfitting and Underfitting, Introduction to Keras and TensorFlow and PyTorch.

#### Practice:

1. Installation and basic commands of scikit, TensorFlow and PyTorch
2. Implement Random Forest by using scikit, TensorFlow and PyTorch
3. Implement multilayer perceptron algorithm for MNIST Handwritten Digit Classification

### UNIT-II

#### Neural Networks

About Neural Network, Building Blocks of Neural Network, Introduction to Neural Networks, Feed-forward Networks, Deep Feed-forward Networks - Learning XOR, Gradient

Based learning, Hidden Units, Back-propagation and other Differential Algorithms, Data Pre-processing for neural networks, Feature Engineering.

**Practice:**

1. Design a neural network for classifying movie reviews (Binary Classification) using IMDB dataset.
2. a) Design a neural Network for classifying news wires (Multi class classification) using Reuters dataset  
b) Design a neural network for predicting house prices using Boston Housing Price dataset.

**UNIT-III**

**Optimization Techniques**

Optimizers – SGD (Stochastic Gradient Descent), Mini-batch Gradient Descent, MS prop (Root Mean Square Propagation), Adagrad (Adaptive Gradient Algorithm), Adadelata (Adaptive Delta), Adam (Adaptive Moment Estimation), Adamax (Adaptive Moment Estimation with Infinity Norm).

**Activation Functions :** sigmoid, tanh, ReLU, leaky ReLU, Soft Max, Linear Loss Functions - cross-entropy loss, the mean-squared error, the Huber loss, the hinge loss ,L2 loss , mean absolute loss Regularization – L1, L2 and drop out . Learning Rate, Normalization

**Practice :**

1. Implement word embeddings for IMDB dataset.
2. Implement one hot encoding of words or characters.
3. Consider Patient Dataset. Apply linear classification technique(SVM) to identify the rate of heart patients. Also apply the optimization techniques.
4. Write a Python program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set

**UNIT-IV**

**Convolutional Neural Network**

About CNN, Building a convolutional neural network, Input Layers, Convolution Layers, Pooling Layers, Dense Layers, Backpropagation Through the Convolutional Layer, Filters and Feature Maps, Backpropagation Through the Pooling Layers, Dropout Layers and Regularization, Batch Normalization,

**Pre trained CNN:** LeNet, Alex Net, VGG16, ResNet.

**Practice :**

1. Build a Convolution Neural Network for MNIST Handwritten Digit Classification.
2. a) Use a pre-trained convolution neural network (VGG16) for image classification  
b) Build a Convolution Neural Network for simple image (dogs and Cats) Classification
3. Student Portfolio Creation using GitHub, Hugging Face & Kaggle

**UNIT – V**

**RNN**

Recurrent Neural Networks ,Sequence-to-Sequence Modelling – Embedding - Recurrent Neural Networks - Bidirectional RNNs, Analysing Variable Length Inputs – Tackling seq2seq Problem – Beam Search and Global Normalization – Recurrent Neural Networks (RNN)– Hidden States – Perplexity – Character-level Language Models –Modern RNNs: Gated Recurrent Units (GRU), Long Short-Term Memory (LSTM).

**Practice :**

1. Implement a Recurrent Neural Network for IMDB movie review classification problem.
2. Implement Boosting algorithms using scikit, Tensorflow and PyTorch

**Additional Practice:**

1. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
2. Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using kMeans algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

**Capstone Project:****Face Mask Detection Using Convolutional Neural Networks**

**Objective:** Detect whether a person in an image is wearing a mask or not using real-time webcam input.

**Domain:** Healthcare / Public Safety

**Techniques & Concepts Used:**

- \* Image Classification (CNNs – using TensorFlow/Keras)
- \* Data Augmentation  
& Preprocessing
- \* Transfer Learning (e.g., MobileNetV2)
- \* Real-time camera integration using OpenCV

**Text Books:**

- 1 Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, ISBN: 9780262035613.
- 2 Deep learning: A practitioner's approach, Josh Patterson and Adam Gibson, O'Reilly Media, First Edition, ISBN 13 9781491914250.

**Reference Books:**

- 1 Fundamentals of Deep Learning, Designing next generation machine intelligence algorithms, Nikhil Buduma, O'Reilly, Shroff Publishers. ISBN: 978-9352135608
- 2 Deep learning Cookbook, Practical recipes to get started Quickly, Douwe Osinga, O'Reilly, Shroff Publishers. ISBN: 978-9352137572

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc20\\_cs62/preview](https://onlinecourses.nptel.ac.in/noc20_cs62/preview)
- 2 <https://keras.io/datasets/>



## Recommender Systems

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501AI13**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Explain the basic concepts of Recommender systems
- CO2:** Design and implement of Content based recommendation systems, hybrid recommendation
- CO3:** Implementation of Collaborative filtering techniques
- CO4:** Analyze attack resistant recommender systems and neighborhoodbased recommender systems
- CO5:** Evaluate recommender systems effectively, assess their performance using appropriate analysis of design and metrics.

### Mapping of Course Outcomes with Program Outcomes:

| CO/ PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|--------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1    | 3    |      |      |      | 1    | 2    |      | 1    | 1    |       |       |
| CO2    | 3    |      | 2    |      | 1    |      |      | 1    | 1    |       |       |
| CO3    | 3    |      |      |      | 1    |      |      | 1    | 1    |       |       |
| CO4    | 3    | 2    |      |      | 1    |      |      | 1    | 1    |       |       |
| CO5    |      | 3    |      | 2    | 1    |      |      | 1    | 1    |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/ PSO | PSO1 | PSO2 |
|---------|------|------|
| CO1     | 2    |      |
| CO2     | 2    |      |
| CO3     | 2    |      |
| CO4     | 3    | 3    |
| CO5     | 3    | 3    |

### UNIT – I

**Introduction and basic taxonomy of recommender systems :** Traditional and nonpersonalized Recommender Systems Overview of data mining methods for recommender systems similarity measures Dimensionality reduction – Singular Value Decomposition (SVD).

**Introduction :** Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

#### Practice :

1. Programs on Python, Numpy and Pandas.
2. Implement Data similarity measures using Python.

### UNIT – II

**ContentBased Recommendation Systems :** Highlevel architecture of contentbased systems Item profiles, Representing item profiles, Methods for learning user profiles, Similaritybased retrieval, and Classification algorithms.

**Hybrid recommendation approaches:** Opportunities for hybridization, Monolithic hybridization design, parallelized hybridization design, pipelined hybridization design.

**Practice :**

1. Implement dimension reduction techniques for recommender systems
2. Implement Hybrid Recommendation

**UNIT – III**

**Collaborative Filtering :** A systematic approach, Nearestneighbor collaborative filtering (CF), userbased and itembased CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection).

**Practice :**

1. Implement collaborative filter techniques
2. Implement user profile learning

**UNIT – IV**

**AttackResistant Recommender Systems :** Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack –Group attack – Strategies for robust recommender design Robust recommendation algorithms.

**NeighborhoodBased Recommender Systems :** Formal definition, components of neighborhood methods: Rating normalization, Similarity weight computation, neighborhood selection, dimensionality reduction, graphbased methods.

**Practice :**

1. Build Model for Attack resistant Social media recommender systems
2. Create an attack for tampering with recommender systems

**UNIT – V**

**Evaluating Recommender System:** Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations, accuracy metrics in offline evaluation: RMSE, MAE, Limitations of evaluation metrics.

**Practice :**

1. Implement accuracy metrics like Receiver Operated Characteristic curves
2. Analyze evaluation metrics using KNearest Neighbors for Movie recommender systems

**Text Books:**

- 1 Recommender Systems: The Textbook, Charu C. Aggarwal, Springer. ISBN: 978-3319296579
- 2 Recommender Systems Handbook, Francesco Ricci, Lior Rokach, and Bracha Shapira, Springer, First Edition. ISBN: 978-1441995790

**Reference Books:**

- 1 Recommender Systems Handbook, Ricci F., Rokach L., Shapira D., Kantor B.P., Springer, 1<sup>st</sup> ed. ISBN: 978-0387858203
- 2 Recommender Systems For Learning, Manouselis N., Drachsler H., Verbert K., Duval E., Springer, 1<sup>st</sup> ed. ISBN: 978-1461443610

**Web Links:**

- 1 NPTEL, Websites etc. [https://www.coursera.org/specializations/recommender systems](https://www.coursera.org/specializations/recommender%20systems).
- 2 MOOC on NPTEL :<https://nptel.ac.in/courses/>, NPTEL / Swayam[www.edx. com](http://www.edx.com)  
[www.coursera.com](http://www.coursera.com)

## Reinforcement Learning

(Common to CSE, IT AIML & CSE(DS))

**Course Code: 2501AI09**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Outline the basic concepts of Reinforcement learning.
- CO2:** Identify the appropriate learning tasks for Reinforcement learning techniques.
- CO3:** Implement adversarial training techniques to train GAN models.
- CO4:** Analyse the applications of VAEs in various domains.
- CO5:** Evaluate the ethical considerations and societal impact of reinforcement learning.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    |      |      | 2    |      |      |      |      | 1     |       |
| <b>CO2</b> | 2    | 2    |      |      | 2    |      |      |      |      | 1     |       |
| <b>CO3</b> | 3    | 2    |      |      | 2    |      |      |      |      | 1     |       |
| <b>CO4</b> | 3    | 2    | 1    |      | 2    |      |      |      |      | 1     |       |
| <b>CO5</b> | 2    | 1    | 1    |      | 2    |      |      |      |      | 1     |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    | 1    |
| <b>CO3</b> | 3    | 1    |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 3    | 1    |

### UNIT – I

#### Introduction to Reinforcement Learning

Basics of reinforcement learning (RL), RL components: agents, environments, rewardsbased Markov Decision Processes (MDPs), Exploration vs. Exploitation dilemma, Basic algorithms: Qlearning, SARSA, MonteCarlo (MC) Learning.

#### Practice:

1. Installation of TensorFlow and implement the basic programs.
2. Installation of PYTORCH and implement the basic programs.

### UNIT – II

#### Advanced Reinforcement Learning Techniques

Deep QNetworks (DQN), Policy Gradient methods, ActorCritic architectures, Advantage ActorCritic (A2C) and Proximal Policy Optimization (PPO)

#### Practice:

1. Model an agent learning to drive a car up a steep mountain by applying the correct amount of throttle and braking. (Policy Gradient Methods)

2. Use deep reinforcement learning to train an agent to play various Atari games, such as Breakout, Space Invaders, or PacMan.

### **UNIT – III**

#### **Generative Adversarial Networks (GANs)**

Introduction to generative models, Basics of GANs: generator, discriminator, Training GANs: adversarial training, Variants of GANs: Conditional GANs, Wasserstein GANs, etc., data augmentation

#### **Practice:**

1. Train an agent to play Flappy Bird, a sidescrolling game where the agent controls the flight of a bird through a series of pipes.
2. Simulate a colony of ants foraging for food in a dynamic environment, where the agent learns to find and retrieve food while avoiding obstacles and predators

### **UNIT – IV**

#### **Variational Autoencoders (VAEs)**

Introduction to autoencoders, Variational inference and latent variable models, Encoder and decoder architectures in VAEs, Training VAEs Maximizing Evidence Lower Bound(ELBO)

#### **Practice:**

1. Track Detection for Autonomous vehicles using VAE
2. Train a robotic arm to perform various tasks, such as reaching a target location or manipulating objects, using reinforcement learning.

### **UNIT – V**

#### **Advanced Topics in Reinforcement Learning**

Modelbased RL and world models, multiagent reinforcement learning, Transfer learning and metalearning in RL

#### **Practice:**

1. Develop a trading agent that learns to make profitable trades in financial markets by analyzing historical data and adapting its trading strategy over time
2. Experiment with different strategies for solving the multiarmed bandit problem, where an agent must decide which arm of a slot machine to pull to maximize cumulative reward.

#### **Text Books:**

- 1 Reinforcement Learning An Introduction, R. S. Sutton and A. G. Bart., MIT Press, ISBN 978-0262039246, 2018.

#### **Reference Books:**

- 1 Algorithms for Reinforcement Learning, Szepesvári, Csaba, United States: Morgan & Claypool. ISBN: 978-1627050278
- 2 Markov Decision Processes: Discrete Stochastic Dynamic Programming, Arman, Martin L., Germany, Wiley. ISBN: 978-0471727200

#### **Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc20\\_cs74/preview](https://onlinecourses.nptel.ac.in/noc20_cs74/preview)
- 2 <https://www.coursera.org/learn/fundamentalsofreinforcementlearning>

## Prompt Engineering & GenAI

(Common to All, Except CSE, IT, AIML & CSE (DS))

**Course Code: 2501AI16**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Explain the importance of prompt engineering, distinguish between explicit, implicit, and creative prompts.
- CO2:** Apply prompt engineering to improve NLP tasks, enhance creativity and diversity in AI-generated content.
- CO3:** Evaluate the Finetuning Language Models for Optimal Output Managing Prompt Complexity and Length.
- CO4:** Analyse the data preprocessing Techniques for language models.
- CO5:** Evaluate the ethical considerations and societal impact of generative AI technologies.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    |      |      | 2    |      |      | 1    | 1    |       | 1     |
| <b>CO2</b> | 2    | 2    |      |      | 2    |      |      | 1    | 1    |       | 2     |
| <b>CO3</b> | 3    | 2    |      |      | 2    |      |      | 1    | 1    |       | 1     |
| <b>CO4</b> | 3    | 2    | 1    |      | 2    |      |      | 1    | 1    |       | 1     |
| <b>CO5</b> | 2    | 1    | 1    |      | 2    |      |      | 1    | 1    |       | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 1    |
| <b>CO3</b> |      | 1    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 1    |

### UNIT – I

**Introduction to Prompt Engineering:** What is prompt engineering and why it matters, Prompt types: explicit, implicit, and creative prompts, Best Practices for Crafting Effective Prompts

#### Practice:

1. Write a python program for Prompt Clarity Evaluation.
2. Write a python program for prompt Relevance Assessment
3. Write a Python Program for Prompt Diversity Experiment

### UNIT – II

**Practical Applications of Prompt Engineering:** Improving NLP Tasks with Custom Prompts, Enhancing Creativity and Diversity in AIGenerated Content, Addressing AI Ethics and Bias through Thoughtful Prompt Engineering, Personalization and Adaptability in AIGenerated Content

**Practice:**

1. Write a python program for Custom Prompt for NLP Task
2. Write a python program for Enhancing Creativity in AIGenerated Content
3. Write a python program for Addressing Bias in AIGenerated Content

**UNIT – III****Advanced Prompt Engineering Techniques**

Customising Prompts for Specific Use Cases, Finetuning Language Models for Optimal Output  
Managing Prompt Complexity and Length, Enhancing Control and Diversity in Generated Text

**Practice:**

1. write a python program for Customizing Prompts for Specific Use Cases
2. Finetuning Language Models for Optimal Output using python

**UNIT – IV****Foundations of Generative AI**

Neural Networks and Their Relevance in AI Language Generation, Deep Learning Architectures for Text Generation and its Implications for Prompt Engineering, Data Preprocessing Techniques for Language Models

**Practice:**

1. Write a python program for Training a Simple Text Generation Model using LSTM
2. Data Preprocessing Techniques for Language Models using python

**UNIT – V****Advanced Topics inGenerative AI**

Adversarial attacks and defences in generative models, Ethical considerations and societal impact of generative AI,LangChain Framework.

**Practice:**

1. Detecting and Mitigating Adversarial Attacks using python

**Text Books:**

- 1 Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville Version: 1st Edition, ISBN : 9780262035613.
- 2 Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit, Steven Bird, Ewan Klein and Edward Loper Version: 1st Edition, ISBN, 0596555717, 9780596555719.

**Reference Books:**

- 1 Markov Decision Processes: Discrete Stochastic Dynamic Programming, Puterman, Martin L., Germany: Wiley. ISBN: 978-0471727828
- 2 Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, Author: David Foster Version: 1<sup>st</sup> Editon 2019 ISBN: 978-1492041948
- 3 Interpretable Machine Learning: A Guide for Making Black Box Models Explainable" Christoph Molnar Version: 1<sup>st</sup> Edition 2019 ISBN: 978-1700895466

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc20\\_cs74/preview](https://onlinecourses.nptel.ac.in/noc20_cs74/preview)

## AI Chatbots

(Common to All, Except CSE, IT, AIML & CSE (DS))

**Course Code: 2501AI15**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

### Course Outcomes:

**At the end of the course, student will be able to:**

**CO1:** Explore the benefits and challenges of deploying chatbots for business use cases.

**CO2:** Evaluate a fully-functional and interactive chatbot using a commercial platform.

**CO3:** Deploy the finished chatbot for public use and interaction.

**CO4:** Distinguish between the NLP and NLU Tools

**CO5:** Demonstrate Microsoft Bot Framework, RASA and third-party API's

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1   | 2   | 2   | 3   |     |     |     |     | 1   | 1   |      |      |
| CO2   | 2   | 2   | 3   |     | 1   |     |     | 1   | 1   |      |      |
| CO3   | 1   | 1   | 2   |     | 1   |     |     | 1   | 1   |      |      |
| CO4   | 1   | 2   |     |     | 2   |     |     | 1   | 1   |      |      |
| CO5   | 2   | 2   | 2   |     | 2   |     |     | 1   | 1   |      | 1    |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    |      |
| CO2    | 2    |      |
| CO3    |      | 2    |
| CO4    | 2    |      |
| CO5    | 3    |      |

### UNIT I

**Introduction:** Benefits from Chatbots for a Business, A Customer-Centric Approach in Financial Services, Chatbots in the Insurance Industry, Conversational Chatbot Landscape,

**Identifying the Sources of Data:** Chatbot Conversations, Training Chatbots for Conversations, Personal Data in Chatbots, Introduction to the General Data Protection Regulation (GDPR)

### UNIT II

**Chatbot Development Essentials:** Customer Service-Centric Chatbots, Chatbot Development Approaches, Rules-Based Approach, AI-Based Approach, Conversational Flow, Key Terms in Chatbots, Utterance, Intent, Entity, Channel, Human Takeover, Use Case: 24x7 Insurance Agent

### UNIT III

**Building a Chatbot Solution:** Business Considerations, Chatbots Vs Apps, Growth of Messenger Applications, Direct Contact Vs Chat, Business Benefits of Chatbots, Success Metrics, Customer Satisfaction Index, Completion Rate, Bounce Rate, Managing Risks in Chatbots Service, Generic Solution Architecture for Private Chatbots



## UNIT IV

**Natural Language Processing, Understanding, and Generation:** Chatbot Architecture, Popular Open Source NLP and NLU Tools, Natural Language Processing, Natural Language Understanding, Natural Language Generation, Applications.

## UNIT V

**Introduction to Microsoft Bot, RASA, and Google Dialog flow:** Microsoft Bot Framework, Introduction to QnA Maker, Introduction to LUIS, Introduction to RASA, RASA Core, RASA NLU, Introduction to Dialog flow

**Chatbot Integration Mechanism:** Integration with Third-Party APIs, Connecting to an Enterprise Data Store, Integration Module

### Text Books:

- 1 Artificial Intelligence Based Chat Bot Design, Nazneen Akhter Shaikh, Khan Samrin Syed Zebanaaz, Saniya Raheen Patel, Lambert Publication ISBN: 978-6202786713

### Reference Books:

- 1 Hands-On Chatbots and Conversational UI Development: Build Chatbots and Voice User Interfaces with Chatfuel, Dialogflow, Microsoft Bot Framework, Twilio, and Alexa Skills, Packt publication. ISBN: 9781788294669

### Web Links:

- 1 [https://onlinecourses.nptel.ac.in/noc22\\_ge29/preview](https://onlinecourses.nptel.ac.in/noc22_ge29/preview)
- 2 <https://www.geeksforgeeks.org/nlp-vs-nlu-vs-nlg/>
- 3 <https://dev.botframework.com/>

**Federated Machine Learning**  
(Common to CSE,IT,AIIML & CSE(DS))

**Course Code: 2501AI17**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Outline the Concepts of Federated Machine Learning
- CO2:** Explore the types of Federated machine Learning.
- CO3:** Apply Optimization techniques for Federated heterogeneous networks.
- CO4:** Apply clustering techniques on high dimensional data to group the similar entities.
- CO5:** Make use of ensemble learning techniques to improve the performance of a model.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO2</b> | 2    | 2    | 3    |      |      |      |      |      |      |       |       |
| <b>CO3</b> | 3    | 2    | 3    |      | 2    |      |      |      |      |       | 2     |
| <b>CO4</b> | 3    | 2    | 3    |      |      |      |      |      |      |       |       |
| <b>CO5</b> | 2    | 2    | 2    |      | 2    |      |      |      |      |       | 2     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

**UNIT – I**

**Introduction to Federated learning:**

Introduction to Federated learning, Privacy Preserving, Distributed Machine Learning, Threats to Federated Learning, Data Valuation

**UNIT – II**

**Types of the Federated learning**

Horizontal Federated learning ,Vertical Federated Learning, Federated Transfer learning

**UNIT – III**

**Federated Optimization for heterogeneous networks:**

Deep Networks from Decentralized data, Federated Multitask Learning, Personalized Federated Learning

**UNIT – IV**

**Federated Learning Applications:**

Recommendation in health care and Finance, Mobile keyboard prediction, Learning of out of vocabulary words.

## **UNIT – V**

### **Adaptive personalized Federated learning :**

Privacy Preserving Deep Learning, Advances and Open Problems.

#### **Text Books:**

- 1 Federated Learning, Qiang Yang, Yang Liu, Yong Cheng, Yan Kang, Tianjian Chen, Han Yu, Morgan & Claypool Publishers, ISBN: 978-1681736976, 2019.
- 2 Handbook of Big data Privacy, KimKwang Raymond Choo, Ali Dehghantanha, Springer Nature Switzerland, ISBN: 978-3030385569, 2020.

#### **Reference Books:**

- 1 Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press. ISBN: 9780262018029

#### **Web Links:**

- 1 <https://www.deeplearning.ai/machinelearningyearning/>
- 2 [https://onlinecourses.nptel.ac.in/noc21\\_cs24/preview](https://onlinecourses.nptel.ac.in/noc21_cs24/preview)
- 3 <https://www.udemy.com/course/machinelearning/>

## Expert Systems

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501AI08**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Identify the major characteristics of expert systems.
- CO2:** Illustrate the types of problems in expert systems can solve.
- CO3:** Recognize the types of errors attributed to uncertainty.
- CO4:** Describe the development stages of an expert system.
- CO5:** Utilize different knowledge representation methods.

### Mapping of Course Outcomes with Program Outcomes:

| CO/ PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|--------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1    |      |      | 2    | 1    |      |      | 2    | 2    |      | 1     | 3     |
| CO2    |      | 1    | 1    |      | 1    |      |      | 1    |      |       | 3     |
| CO3    |      |      | 3    |      | 2    | 1    |      |      | 1    |       | 3     |
| CO4    | 1    | 2    | 1    | 1    | 2    |      |      |      | 1    | 1     |       |
| CO5    |      | 2    |      | 1    |      | 3    |      | 1    | 2    |       | 3     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/ PO | PSO1 | PSO2 |
|--------|------|------|
| CO1    |      | 2    |
| CO2    |      | 2    |
| CO3    |      | 2    |
| CO4    |      | 3    |
| CO5    |      | 3    |

### UNIT – I

Introduction to Expert System, general stages in the development of an expert system, Major characteristics of Expert System, Types of applications of Expert Systems, relationship of Expert Systems to Artificial Intelligence and to KnowledgeBased Systems, Components of Expert System, Conventional Systems vs. Expert Systems, Benefits of using an Expert System.

#### Practice :

1. Building a RuleBased Expert System for Diagnosis
2. Implementing a Recommender System using KnowledgeBased Inference

### UNIT – II

Architecture of Expert System, types of problems handled by expert systems, Utilization and functionality of expert systems, Rule Based Expert System, Non Production System, Expert System Development Life Cycle, Basic forms of inference: abduction; deduction; induction.

#### Practice :

1. Rule Based Expert System for Restaurant Recommendation
2. Basic Forms of Inference Demonstration

### **UNIT – III**

The representation and manipulation of knowledge in a computer, Rulebased representations (with backward and forward reasoning), Knowledge Acquisition and Knowledge Representation, difficulties, in knowledge acquisition methods of knowledge acquisition, The meaning of uncertainty and theories devised to deal with it, Sources of uncertainty, types of errors attributed to uncertainty.

#### **Practice :**

1. RuleBased Representation with Forward Reasoning
2. Dealing with Uncertainty using Fuzzy Logic

### **UNIT – IV**

Basic components of an expert system, How to select an appropriate problem, the development of an expert system, types of errors to expect in the development stages, Generation of explanations. Handling of uncertainties. Truth Maintenance Systems.

#### **Practice :**

1. Selecting an Appropriate Problem for an Expert System
2. Handling Uncertainty using Fuzzy Logic

### **UNIT – V**

Building Expert Systems, Methodologies for building expert systems: knowledge acquisition and elicitation; formalisation; representation and evaluation. Knowledge Engineering tools, Case Study

#### **Practice :**

1. Knowledge Elicitation and Representation using Decision Trees
2. Knowledge Engineering Tool RuleBased System Development

#### **Text Books:**

- 1 Expert Systems Principles and Programming, J. Giarratano and G. Riley, 4th Edition, PWS Publishing Company, ISBN 10: 0534384471 - ISBN 13: 9780534384470.
- 2 Introduction to Expert Systems, P Jackson, Addison Wesley (2nd Edition), ISBN-13, 978-0201175783.

#### **Reference Books:**

- 1 Artificial Intelligence: A modern approach, Stuart Russel and Peter Norvig, Pearson Education Inc, 2nd ed, ISBN: 978-8120323827

#### **Web Links:**

- 1 [https://onlinecourses.swayam2.ac.in/aic21\\_ge01/](https://onlinecourses.swayam2.ac.in/aic21_ge01/)
- 2 <https://www.geeksforgeeks.org/expertsystems/>
- 3 <https://github.com/mikeroyal/ExpertSystemsGuide>

### Minor Stream: Data Engineering

| Course Code  | Course Name                               | Level | L         | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|-------------------------------------------|-------|-----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501CS12     | NoSQL Databases                           | FC    | 2         |   |           | 2         | 50  | 50  | 100   | -             |
| 2501CS34     | Fundamentals of Data Science              | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | PPSC          |
| 2501AI26     | Information Retrieval Systems             | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS36     | Business Intelligence & Analytics         | IC    | 2         |   | 2         | 4         | 50  | 50  | 100   | PPSC          |
| 2501AI18     | Mining Massive Data Sets                  | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | DM            |
| 2501CS37     | Health Care Data Analytics                | IC    | 2         |   | 2         | 4         | 50  | 50  | 100   | PPSC          |
| 2501AI19     | Data Visualization                        | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | DAE           |
| 2501CS38     | Security & Privacy for Big Data Analytics | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS40     | Social Networks & Semantic Web            | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS14     | Finance & Retail Analytics                | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                                           |       | <b>20</b> |   | <b>12</b> | <b>32</b> |     |     |       |               |

## NoSQL Databases

(Common to CSE, IT, AIML & CSE(DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501CS12</b> | <b>2</b> | <b>0</b> | <b>0</b> | <b>2</b> |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Compare the traditional relational databases and NoSQL.
- CO2:** Explain the principles and architecture of document store databases.
- CO3:** Design and implement keyvalue database solutions.
- CO4:** Illustrate the fundamental concepts and architecture of column family store databases.
- CO5:** Optimize graph databases for performance and scalability.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    |      |      |      |      |      |      |      |       |       |
| <b>CO2</b> | 2    | 2    |      |      | 2    |      |      |      |      |       |       |
| <b>CO3</b> | 2    | 2    | 3    |      | 1    |      |      |      |      |       |       |
| <b>CO4</b> | 2    | 2    | 3    |      | 1    |      |      |      |      |       |       |
| <b>CO5</b> | 2    | 2    | 3    |      | 1    |      |      |      |      |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 1    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

## UNIT – I

**Introduction to No SQL:** Definition And Introduction, Traditional relational databases vs. NoSQL databases, Types of No SQL databases, Storing and Accessing Data in NoSql databases, Querying in NoSql databases, Evolution and motivation behind NoSQL databases, Characteristics, advantages, and challenges of NoSQL databases Performing Crud Operations, Creating Records, Accessing Data, Updating And Deleting Data

## UNIT – II

### Document Stores:

Introduction to MongoDB, Importance of NoSQL databases, Data types, Documents, nested Documents, CRUD Operations, Basic cursor methods: map, to Array, pretty, for Each, limit, count, sort, Columnar Databases, Indexing and Aggregation, MongoDB Node JS Drivers and CAP theorem.

## UNIT – III

### **Key Value databases:**

What Is a Key Value Store, Key Value Store Features, Suitable Use Cases, When Not to Use

**Document Databases:** What Is a Document Database, Features, Suitable Use Cases, When Not to Use NoSQL Data Bases

## UNIT – IV

### **Column family stores:**

What Is a Column Family Data Store, Features, Suitable Use Cases, When Not to Use Graph

**Databases:** What Is a Graph Database, Features, Suitable Use Cases, When Not to Use.

## UNIT – V

### **Graph Database:**

**Graph Oriented Database Platform:** Neo4j Graph Databases – Model relational data – Property graph model – Neo4j Graph Platform – Components – Features – Benefits of Neo4j – Setup Development Environment – Neo4j Sandbox – Neo4j Desktop – Cypher – Match – Graph node retrieval – Graph relations retrieval – Graph properties retrieval – Nodes – Relationships – Merge data into graph – Parameter constraints – Monitor query execution – Indexes – Relational Data.

### **Text Books:**

- 1 Pramod J. Sadalage, Martin Fowler. NoSQL Distilled, Addison Wesley, ISBN-13: 9780321826626.
- 2 Dan McCreary and Ann Kelly, Making Sense of NoSQL, Manning Publications, ISBN 9781617291074.

### **Reference Books:**

- 1 Shashank Tiwari, Professional NoSQL, Wrox Press, Wiley.
- 2 Gaurav Vaish, Getting Started with NoSQL, Packt Publishing.

### **Web Links:**

- 1 <https://nptel.ac.in/courses/106104135>
- 2 <https://www.geeksforgeeks.org/wheredoesmongodstandinthecaptheorem/>
- 3 <https://www.geeksforgeeks.org/columnarddatamodelofnosql/>



**Fundamentals of Data Science**  
(Common to CSE, IT, AIML & CSE(DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501CS34</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain fundamental concepts of Data Science.
- CO2:** Implement Data Collection and Preprocessing Techniques.
- CO3:** Demonstrate Proficiency in Data Loading, Storage, and File Handling
- CO4:** Conduct Exploratory Data Analysis (EDA) using Visualization and Statistical Techniques.
- CO5:** Make use of Neo4j, Cypher tools to manage and analyze graph data.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 3    |      |      |      |      |      |      | 2    | 2     |       |
| CO2   | 2    |      |      |      |      |      |      |      | 1    | 2     |       |
| CO3   | 2    | 2    | 2    |      |      |      |      |      | 2    | 2     |       |
| CO4   | 2    | 2    |      |      | 2    |      |      |      | 2    | 1     |       |
| CO5   | 3    |      |      |      |      |      |      |      | 1    | 1     |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    |      |
| CO2    | 1    |      |
| CO3    | 2    |      |
| CO4    | 2    |      |
| CO5    | 1    |      |

**UNIT – I**

**Introduction To Data Science:** Definition and Scope of Data Science, History and Evolution of Data Science, Applications of Data Science, Data Science Lifecycle, Data Types and Structures, Tools and Technologies in Data Science.

**Practice:**

1. Importing and Exploring Datasets - Loading datasets using libraries and performing basic exploration.
2. Basic Data Structures - Working with data structures such as arrays, lists, data frames, and matrices

**UNIT – II**

**Data Collection and Preprocessing:** Data Collection Methods, Data Cleaning and Handling Missing Values, Data Transformation: Normalization and Standardization, Feature Engineering and Feature Scaling, Data Integration and Aggregation.

**Practice:**

1. Computing summary statistics like mean, median, mode, and standard deviation for a sample dataset.
2. Handling missing values and outliers in a dataset using techniques like imputation and filtering.

**UNIT – III**

**Data Loading, Storage, and File Formats :** Reading and Writing Data in Text Format, Reading Text Files in Pieces, Writing Data Out to Text Format, Manually Working with Delimited Formats, JSON Data, XML and HTML: Web Scraping, Binary Data Formats, Using HDF5 Format, Reading Microsoft Excel Files, Interacting with Databases, Storing and Loading Data in Mongo DB.

**Practice:**

1. Read data from a JSON file into a DataFrame using Pandas (pd.read\_json) or R (jsonlite). Parse nested JSON structures and convert them into a flat table format.
2. Perform web scraping on an HTML page using BeautifulSoup in Python or rvest in R. Extract data from HTML tables and convert it into a DataFrame.

**UNIT – IV**

**Exploratory Data Analysis (EDA):** Descriptive Statistics, Data Visualization Techniques, Correlation and Covariance Analysis, Univariate, Bivariate, and Multivariate Analysis, Pattern Detection and Anomaly Identification.

**Practice:**

1. Plotting histograms and box plots to understand the distribution of a single variable.
2. Creating scatter plots and calculating correlation coefficients to study the relationship between two variables.

**UNIT – V**

**Data Science Tools:** Neo4j for dealing with graph databases, graph query language Cypher, libraries like nltk and SQLite for handling Text mining and analytics.

**Practice:**

1. Get hands-on experience with Neo4j to understand how to manage and query graph databases.
2. Practice writing Cypher queries to interact with graph data in Neo4j.

**Text Books:**

- 1 Python for Data Analysis ,Wes McKinney, O'REILLY, ISBN:978-1-449-31979-3, 1<sup>st</sup> edition, ISBN · 9781449319793.
- 2 Doing Data Science ,Rachel Schutt & O'neil, O'REILLY, ISBN:978-1-449-35865-5, 1<sup>st</sup> edition, ISBN: 9781449358655.

**Reference Books:**

- 1 Data Science from Scratch: First Principles with Python ,Joel Grus, O'Reilly Media. ISBN: 9781492041139.
- 2 Learning the Pandas Library: Python Tools for Data Munging ,Matt Harrison, Analysis, and Visualization , O'Reilly. ISBN: 9781787123137

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc24\\_cs68/preview](https://onlinecourses.nptel.ac.in/noc24_cs68/preview)
- 2 [https://onlinecourses.nptel.ac.in/noc24\\_cs133/preview](https://onlinecourses.nptel.ac.in/noc24_cs133/preview)
- 3 <https://www.geeksforgeeks.org/how-to-become-a-data-analyst-complete-roadmap/>

**Information Retrieval Systems**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501AI26</b> | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain the Information Storage and Retrieval Systems
- CO2:** Explain Basic Concepts of Data Structures and Implementation of Algorithms
- CO3:** Apply retrieval systems for Signature Files, Searching and evaluation of Search Engines
- CO4:** Evaluate retrieval systems for New Indices for Text and its classification.
- CO5:** Implement retrieval systems for Stemming Algorithms, Thesaurus Construction and Web Search tasks.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/ PO     | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    | 1    |      | 2    |      |      | 1    | 1    |       |       |
| <b>CO2</b> | 2    | 3    | 1    |      | 2    |      |      | 1    | 1    |       |       |
| <b>CO3</b> | 3    | 2    | 2    |      | 2    |      | 2    | 1    | 1    |       | 1     |
| <b>CO4</b> | 2    | 2    | 2    | 1    | 2    |      | 2    | 1    | 1    |       | 1     |
| <b>CO5</b> | 2    | 2    | 2    | 1    | 2    |      | 2    | 1    | 1    |       | 1     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/ PSO    | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 2    | 1    |
| <b>CO4</b> | 2    | 2    |
| <b>CO5</b> | 2    | 2    |

**UNIT – I**

**Introduction to Information Storage and Retrieval System**

Introduction, Domain Analysis of IR systems and other types of Information Systems, IR System Evaluation. Retrieval process – Architecture – Boolean retrieval; IR Models: Taxonomy and characterization of IR models; Models for Browsing; Retrieval Evaluation: Performance evaluation

**Processing Text:** Text Statistics, Document Parsing, Tokenizing, Stopping, Stemming, Phrases, Document Structure, Link Extraction, more detail on Page Rank, Internationalization.

**Practice :**

- To Find the Weights of specific Term in a given Documents Using Python.
- Implement handson experience store, and retrieve information from www using semantic approaches.

## UNIT – II

**Introduction to Data Structures and Algorithms related to Information Retrieval:** Basic Concepts, Data structures, Algorithms. Ngram data structure, PAT data structure.

**Inverted Files:** Introduction, Structures used in Inverted Files, Building Inverted file using a sorted array, Modifications to Basic Techniques.

**Practice :**

1. Implement how to analyze ranked retrieval of a very large number of documents with hyperlinks between them
2. Implement how Ngrams are used for detection and correction of spelling errors.

## UNIT – III

**Signature Files:** Introduction, Concepts of Signature Files, Compression, Vertical Partitioning, Horizontal Partitioning.

**Searching:** Sequential searching – Pattern matching; Searching the Web: Characterizing the Web – Search engines – Browsing – Searching using hyperlinks.

**Practice :**

1. Implement Text Pattern Matching and Searching Algorithm using python.
2. Implement Compression of Text Files using python.

## UNIT – IV

**New Indices for Text:** PAT Trees and PAT Arrays: Introduction, PAT Tree structure, algorithms on the PAT Trees, Building PAT trees as PATRICA Trees, PAT representation as arrays.

**Text Classification:** Test collections, Query logs, Averaging and interpolation, focusing on the top documents. Training, Testing, and Statistics: Significance tests, setting parameter values for Classification and Clustering.

**Practice :**

1. Implementation of various classification algorithm on text using python.
2. Implementation of various Clustering algorithm on text using python.

## UNIT – V

**Thesaurus Construction:** Introduction, Features of Thesauri, Thesaurus Construction, Thesaurus construction from Texts, Merging existing Thesauri

**APPLICATIONS & XML Retrieval – Multimedia IR – Parallel and Distributed IR – Digital Libraries – Social Media Retrieval – Contentbased Image Retrieval.**

**Practice :**

1. Implement how to analyze ranked retrieval of a very large number of documents with hyperlinks between them.
2. Case Study on: Demonstrate Information visualization technologies like Cognition and perception in the Internet or Web search engine.

**Text Books:**

- 1 Introduction to Information Retrieval, Christopher D.Manning, Prabhakar Raghavan, Hinrich Schutze, Cambridge University Press, ISBN: 978-0-521-86571-5
- 2 Information Retrieval Data Structures and Algorithms, Frakes, W.B., Ricardo BaezaYates, Prentice Hall, ISBN: 978-0134638379
- 3 Modern Information Retrieval. BaezaYates Ricardo and Berthier RibeiroNeto., AddisonWesley, 2nd edition, ISBN: 978-8131709771

**Reference Books:**

- 1 Modern Information Retrieval, Ricardo BaezaYates, Neto, PEA. ISBN: 978-0321416919
- 2 Information Storage and Retrieval Systems: Theory and Implementation, Kowalski, Gerald, Mark Academic Press. ISBN: 978-0792379249
- 3 Information Retrieval: Algorithms and Heuristics, Grossman, OphirFrieder, 2/e, Springer. ISBN: 978-1461375326

**Web Links:**

- 1 <https://nptel.ac.in/courses/106101007>
- 2 <https://www.geeksforgeeks.org/what-is-information-retrieval/>

**Business Intelligence & Analytics**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS36**

**L      T      P      C**  
**2      0      2      4**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain the Business Intelligence, Analytics and Decision Support system
- CO2:** List the technologies for Decision making, Automated decision systems
- CO3:** Explain sentiment analysis techniques
- CO4:** Illustrate Multicriteria Decision making systems, predictive modelling techniques
- CO5:** Evaluate and validate the performance of automated decision systems and expert systems.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 2    | 1    | 1    | 1    |      |      |      | 2    | 2     | 1     |
| CO2   | 2    | 1    | 2    | 1    | 1    |      |      |      | 1    | 2     | 1     |
| CO3   | 2    | 2    | 1    | 1    | 2    |      |      |      | 2    | 2     | 1     |
| CO4   | 2    | 2    | 2    | 1    | 1    |      |      |      | 2    | 1     |       |
| CO5   | 2    | 1    | 1    |      | 1    |      |      |      | 2    | 1     |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    |      |
| CO2    | 1    |      |
| CO3    | 2    |      |
| CO4    | 1    |      |
| CO5    | 1    |      |

**UNIT – I**

**An Overview of Business Intelligence, Analytics, and Decision Support:** Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics.

**Practice:**

1. Create interactive dashboards to visualize sales data and identify trends.

**UNIT – II**

**Decision Making:** Introduction and Definitions, Phases of the Decision, Making Process, The Intelligence Phase, Design Phase, Choice Phase, Implementation Phase, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components.

**Practice:**

1. Build a predictive model to forecast future sales.

**UNIT – III**

**Neural Networks and Sentiment Analysis :** Basic Concepts of Neural Networks, Developing Neural NetworkBased Systems, Illuminating the Black Box of ANN with Sensitivity, Support Vector Machines, A Process Based Approach to the Use of SVM, Nearest Neighbor Method for Prediction, Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process,, Sentiment Analysis, Speech Analytics.

**Practice:**

1. Use a pretrained sentiment analysis model to classify the sentiment of text data.

**UNIT – IV**

**ModelBased Decision Making:** Decision Support Systems modeling, Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets,Mathematical programming optimization, Decision Analysis with Decision Tables and Decision Trees, MultiCriteria Decision Making With Pairwise Comparisons

**Practice:**

1. Evaluate different investment options considering potential risks and returns.

**UNIT – V**

**Automated Decision Systems and Expert Systems:** Automated Decision Systems, The Artificial Intelligence field, Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems.

**Practice:**

1. Develop a system to recommend products to customers based on their purchase history and preferences.

**Text Books:**

- 1 Ramesh Sharda, Dursun Delen, EfraimTurban, J.E.Aronson,TingPeng Liang, David King, “Business Intelligence and Analytics: System for Decision Support”, 10th Edition, Pearson Global Edition, ISBN: 978-. 0137025060.

**Reference Books:**

- 1 Data Analytics: The Ultimate Beginner's Guide to Data Analytics Paperback – 12 November by Edward Mize. ISBN: 9781925997576

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc24\\_cs65/preview](https://onlinecourses.nptel.ac.in/noc24_cs65/preview)
- 2 <https://www.geeksforgeeks.org/what-is-business-intelligence/>



**Mining Massive Data Sets**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501AI18**

**L      T      P      C**  
**2      0      1      3**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Handle massive data using Map Reduce.
- CO2:** Develop and implement algorithms for massive data sets and methodologies in the context of data mining.
- CO3:** Explain the algorithms for extracting models and information from large datasets
- CO4:** Develop recommendation systems.
- CO5:** Gain experience in matching various algorithms for particular classes of problems

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO       | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b>  | 2    | 2    |      | 1    | 2    |      |      |      |      |       |       |
| <b>CO2</b>  | 2    | 1    |      | 1    | 1    |      |      |      |      |       |       |
| <b>CO3:</b> | 2    | 2    |      | 1    | 1    |      |      |      |      |       |       |
| <b>CO4:</b> | 2    | 3    |      | 2    | 2    |      |      |      |      |       |       |
| <b>CO5:</b> | 1    | 2    |      | 2    | 3    |      |      |      |      |       |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO      | PSO1 | PSO2 |
|-------------|------|------|
| <b>CO1:</b> |      | 2    |
| <b>CO2:</b> |      | 2    |
| <b>CO3:</b> |      | 2    |
| <b>CO4:</b> |      | 2    |
| <b>CO5:</b> |      | 2    |

**UNIT – I**

**Introduction:** Data Mining Introduction Definition of Data Mining Statistical Limits on Data Mining, Map Reduce and the New Software Stack Distributed File Systems, Map Reduce, Algorithms Using Map Reduce.

**Practice:**

1. MapReduceWordCountHadoop Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm
2. Demonstrate performing classification on data sets

**UNIT – II**

**Similarity Search:** Finding Similar Items Applications of Near Neighbor Search, Shingling of Documents, Similarity Preserving Summaries of Sets, Distance Measures. Streaming Data: Mining Data StreamsThe Stream Data Model , Sampling Data in a Stream, FilteringStreams

**Practice:**

1. To understand and implement similarity search techniques using shingling of documents and nearneighbor search algorithms.
2. To explore techniques for mining data streams, including sampling data and filtering streams to extract relevant information.

**UNIT – III**

Link Analysis PageRank, Efficient Computation of Page Rank, Link Spam  
Frequent Item sets Handling Larger Datasets in Main Memory, Limited Pass Algorithms,  
Counting Frequent Items in a Stream. Clustering The CURE Algorithm, Clustering in Non  
Euclidean Spaces, Clustering for Streams and Parallelism

**Practice:**

1. To understand the PageRank algorithm for link analysis and implement efficient computation techniques.
2. To explore algorithms for mining frequent itemsets and handling large datasets in main memory and data streams.

**UNIT – IV**

Advertising on the Web Issues in OnLine Advertising, OnLine Algorithms, The Matching Problem, The Adwords Problem, Adwords Implementation. Recommendation Systems A Model for Recommendation Systems, Content Based Recommendations, Collaborative Filtering, Dimensionality Reduction, The NetFlix Challenge.

**Practice:**

1. To understand the implementation of AdWords and explore optimization techniques for online advertising.
2. To develop and evaluate a movie recommendation system using contentbased and collaborative filtering approaches.

**UNIT – V**

Mining Social Network Graphs Social Networks as Graphs, Clustering of Social Network Graphs, Partitioning of Graphs, Simrank, Counting Triangles

**Practice:**

1. To explore clustering and partitioning techniques for analyzing socialnetwork graphs.
2. To implement algorithms for counting triangles in socialnetwork graphs and analyze their significance.

**Text Books:**

- 1 Mining of Massive Datasets ,Jure Leskovec, Anand Rajaraman, Jeff Ullman,3<sup>rd</sup> Edition, ISBN-13: 978-1108476348.
- 2 Mining of Massive Datasets ,Anand Rajaraman and Jeffrey David Ullman, CUP, ISBN: 9781139924801.

**Reference Books:**

- 1 Jiawei Han & Micheline Kamber, Data Mining – Concepts and Techniques 3rd Edition Elsevier. ISBN: 978-9380931913.
- 2 Margaret H Dunham, Data Mining Introductory and Advanced topics, PEA. ISBN: 978-8177587852.
- 3 Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann. ISBN: 978-0123748560.

**Web Links:**

- 1 <https://online.stanford.edu/courses/soeycs0007miningmassivedatasets>
- 2 [https://onlinecourses.nptel.ac.in/noc21\\_cs06/preview](https://onlinecourses.nptel.ac.in/noc21_cs06/preview)
- 3 <https://www.coursera.org/in/articles/bigdataanalytics>
- 4 <https://www.javatpoint.com/datamining>
- 5 <https://www.cambridge.org/core/books/miningofmassivedatasets/C1B37BA2CBB8361B94FDD1C6F4E47922>

**Health Care Data Analytics**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501CS37</b> | <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain fundamentals of Healthcare Data Analytics.
- CO2:** Demonstrate the technologies for analyzing Biomedical Image
- CO3:** Apply predictive modeling techniques for Clinical Data
- CO4:** Apply predictive analysis techniques for genomic data
- CO5:** Illustrate NLP and Data mining for clinical text.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    |      |      |      |      |      |      |      | 2    | 2     | 1     |
| <b>CO2</b> | 2    | 2    |      | 1    | 2    |      |      |      | 1    | 2     |       |
| <b>CO3</b> | 1    |      |      |      | 2    |      |      |      | 2    | 2     | 1     |
| <b>CO4</b> | 2    |      |      | 2    | 1    |      |      |      | 1    | 1     | 1     |
| <b>CO5</b> | 2    | 2    |      |      | 1    |      |      |      | 2    | 2     |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 1    |      |
| <b>CO5</b> | 1    |      |

**UNIT – I**

**An Introduction to Healthcare Data Analytics:** Healthcare Data Sources and Basic Analytics Advanced Data Analytics for Healthcare Applications and Practical Systems for Healthcare Resources for Healthcare Data Analytics Electronic Health Records Components of EHR Coding Systems Benefits of EHR Barriers to Adopting EHR Challenges of Using EHR Data.

**Practice:**

Clean and explore a health care dataset to understand its structure and key attributes. Use the Diabetes dataset from the UCI Machine Learning Repository.

**UNIT – II**

**Biomedical Image Analysis:** Biomedical Imaging Modalities Object Detection Image Segmentation Image Registration Feature Extraction Mining of Sensor Data in Healthcare Mining Sensor Data in Medical Informatics Challenges in Healthcare Data Analysis Sensor Data Mining Applications.

**Practice:**

Build a model to predict if a patient will be readmitted to the hospital within 30 days. Use the Hospital Readmissions Reduction Program (HRRP) dataset.

**UNIT – III**

**Predictive Models for Integrating Clinical and Genomic Data:** Introduction Issues and Challenges Different Types of Integration Different Goals of Integrative Studies Validation Information Retrieval for Healthcare KnowledgeBased Information in Healthcare and Biomedicine Content of KnowledgeBased Information Resources Indexing Retrieval Evaluation Research Directions.

**Practice:**

Perform survival analysis on a dataset of cancer patients to estimate survival rates. Use the SEER Cancer Incidence dataset

**UNIT – IV**

**Natural Language Processing and Data Mining for Clinical Text:** Natural Language Processing Mining Information from Clinical Text Challenges of Processing Clinical Reports Clinical Applications Social Media Analytics for Healthcare Social Media Analysis for Detection and Tracking of Infectious Disease Outbreaks Social Media Analysis for Public Health Research Analysis of Social Media Use in Healthcare.

**Practice:**

Segment patients into different groups based on their health care utilization patterns. Use a dataset containing patient visit records, such as the National Hospital Ambulatory Medical Care Survey (NHAMCS).

**UNIT – V**

**Advanced Data Analytics for Healthcare:** Automated Decision Systems The Artificial Intelligence field Basic concepts of Expert Systems Applications of Expert Systems Structure of Expert Systems Knowledge Engineering Development of Expert Systems – Locationbased Analytics Cloud Computing Business Intelligence.

**Practice:**

Analyze health care costs and identify factors driving high costs. Use the Medical Expenditure Panel Survey (MEPS) dataset.

**Text Books:**

- 1 Chandan K. Reddy, Charu C. Aggarwal "Healthcare Data Analytics", CRC Press, ISBN 9780367575687.

**Reference Books:**

- 1 Analytics in Healthcare A Practical Introduction, Christo El Morr, Hossam AliHassan, 2019 ISBN: 9783030045067

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc22\\_hs40/preview](https://onlinecourses.nptel.ac.in/noc22_hs40/preview)
- 2 <https://nptel.ac.in/courses/109107190>

**Data Visualization**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501AI19</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain the various types of data and principles of data visualization
- CO2:** Apply visualization techniques to a problem and its associated dataset
- CO3:** Apply structured approach to create effective visualizations
- CO4:** Outline the valuable insights from the massive dataset using visualization.
- CO5:** Build visualization dashboard to support decision making

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    |      |      | 1    |      |      | 1    | 1    |       | 2     |
| <b>CO2</b> | 2    | 2    |      |      | 2    |      |      | 1    | 1    |       | 2     |
| <b>CO3</b> | 2    | 2    | 3    |      | 1    |      |      | 1    | 1    |       | 2     |
| <b>CO4</b> | 2    | 2    | 3    |      | 1    |      |      | 1    | 1    |       | 1     |
| <b>CO5</b> | 2    | 2    | 3    |      | 1    |      |      | 1    | 1    |       | 1     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 1    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

**UNIT – I**

**Introduction to Visualization:**

Introduction to Data Visualizations and Perception: Introduction to visualization and visual perception, visual representation of data, Gestalt principles, Information overload.

**Practice :**

1. Introduction to various Data Visualization tools
2. Basic Visualization in Python

**UNIT – II**

**Visual Representations:** Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

**Practice :**

1. Basic Visualization in R
2. Introduction to Tableau and Installation

### UNIT – III

**Classification of Visualization Systems:** Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multidimensional data, text and text documents.

**Practice :**

1. Connecting to Data and preparing data for visualization in Tableau
2. Data Aggregation and Statistical functions in Tableau

### UNIT – IV

**Visualization of Groups:** Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.

**Practice :**

1. Data Visualizations in Tableau

### UNIT – V

**Visualization of Volumetric Data And Evaluation of Visualizations:** Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations

**Practice :**

1. Basic Dashboards in Tableau

### Text Books:

- 1 Interactive Data Visualization: Foundations, Techniques, and Applications, Ward, Grinstein, Keim, Natick, A K Peters, Ltd, 2nd edition, ISBN-13. 978-1482257373.

### Reference Books:

- 1 Visualization Analysis & Design, Tamara Munzner, AK Peters Visualization Series, 1st edition.
- 2 Interactive Data Visualization for the Web, Scott Murray, 2nd Edition.

### Web Links:

- 1 <https://elearn.nptel.ac.in/shop/iit-workshops/completed/data-visualization-with-r/?v=c86ee0d9d7ed>
- 2 <https://www.udemy.com/course/mastering-datavisualization/?couponCode=NVDIN35>

## Security & Privacy for Big Data Analytics

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS38**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Explain the various sources of Big Data.
- CO2:** Make use of Big Data analytics principles to build security applications.
- CO3:** Identify security threats and vulnerabilities using security analytics
- CO4:** Develop algorithms for preprocessing Big Data other than the traditional approaches.
- CO5:** Design methodologies to extract data from structured and unstructured data for analytics.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    |      |      | 1    |      |      |      | 1    | 1     |       |
| <b>CO2</b> | 2    | 2    |      |      | 2    |      |      |      | 1    |       |       |
| <b>CO3</b> | 2    | 2    |      | 1    | 2    |      |      |      | 1    | 1     |       |
| <b>CO4</b> | 2    | 1    |      | 1    | 2    |      |      |      | 1    |       |       |
| <b>CO5</b> | 2    | 2    |      | 1    | 2    |      |      |      | 1    | 1     |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 2    |      |

### UNIT – I

#### Introduction to Big Data Acquisition:

Big Data framework fundamental concepts of Big Data management and analytics Current challenges and trends in Big Data Acquisition.

### UNIT – II

**Introduction to Security Analytics:** Introduction to Security Analytics – Techniques in Analytics – Analysis in everyday life – Challenges in Intrusion and Incident Identification – Simulation and Security Process, Analytical Softwares and tools, Malware Analysis – static and dynamic analysis Security Intelligence – Security Breaches.

**Case Study:** Malware analysis

### UNIT – III

#### Applications of Security Analytics :

Access Analytics – Analysis of Log file Security analysis with text mining –Machine Learning and data mining applications for security: Intrusion detection and network



anomaly detection. Big data analytics for security: Analyzing DDOS – Distributed Denial of Service attack: counter based method, and access pattern based method – Machine learning for Ransom ware detection and prevention

**Case Study:**Intrusion detection and network anomaly detection

#### **UNIT – IV**

##### **Data Analytics:**

Predictive Analytics: Regression, Decision Tree, Neural Networks Descriptive Analytics: Association Rules, Sequence Rules, Survival Analysis: Survival Analysis Measurements, Kaplan Meir Analysis, Parametric Survival Analysis Social Network Analytics: Social Network Learning Relational Neighbor Classification.

**Case Study:**Implement neighbor classifications

#### **UNIT – V**

##### **Big Data Privacy and Applications:**

Data Masking – Privately Identified Information (PII) Privacy preservation in Big Data Popular Big Data Techniques and tools Map Reduce paradigm and the Hadoop system – Applications Social Media Analytics Recommender Systems Fraud Detection

**Case Study:**Implement fraud detection algorithm

##### **Text Books:**

- 1 Analytics in a Big Data World: The Essential Guide to Data Science and its Applications ,Bart Baesens, John Wiley & Sons, ISBN-13: 978-1118892701.
- 2 Information Security Analytics: Finding Security Insights, Patterns, and Anomalies in Big Data ,Mark Talabis, Robert McPherson, I Miyamoto and Jason Martin, Syngress Media, U.S., ISBN-13: 978-0128002070 ISBN-10: 0128002077.

##### **Reference Books:**

- 1 Related Technologies, Challenges and Future Prospects, Min Chen, Shiwen Mao, Yin Zhang, Victor CM Leung, Big Data: Springer,. ISBN 978-3-319-06244-0 ISBN 978-3-319-06245-7.
- 2 Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends ,Michael Minelli, Michele Chambers, AmbigaDhiraj ,John Wiley & Sons. 2013 ISBN 9781118147603.

##### **Web Links:**

- 1 <https://archive.nptel.ac.in/courses/106/104/106104189/>
- 2 <https://www.techtarget.com/searchsecurity/definition/securityanalytics>
- 3 <https://iimskills.com/dataanalyticscoursesatnptel/>
- 4 <https://nptel.ac.in/courses/106104189>

**Social Networks & Semantic Web**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501CS40</b> | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Summarize the concepts of semantic web and social network analysis.
- CO2:** Describe the knowledge representation on the Semantic web.
- CO3:** Make use of ontology engineering in social networks.
- CO4:** Identify the architectures and challenges in building social networks
- CO5:** Compare various survey methods of social networks.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    |      | 1    |      |      |      |      | 1    |       |       |
| <b>CO2</b> | 2    | 3    |      |      |      |      |      |      | 1    | 1     |       |
| <b>CO3</b> | 2    | 3    | 2    |      |      |      |      |      |      |       |       |
| <b>CO4</b> | 2    | 2    | 3    |      |      |      |      |      | 1    |       |       |
| <b>CO5</b> | 3    | 2    | 1    |      |      |      |      |      | 1    | 1     |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 1    |
| <b>CO2</b> |      | 1    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 1    |
| <b>CO5</b> |      | 1    |

**UNIT – I**

**Web Intelligence:** Thinking and Intelligent Web Applications, The Information Age, The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, BernersLee www, Semantic Road Map, Logic on the semantic Web.

**Practice:**

1. Plot the trend of Moore's law from 1970 to today. Then project processor performance for the year 2020 based on Moore's law.

**UNIT – II**

**Knowledge Representation for the Semantic Web:** Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web –Resource Description Framework (RDF) / RDF Schema, Ontology Web Language (OWL), UML, XML/XML Schema.

**Practice:**

1. Why is it necessary to consider less powerful expressive languages for the Semantic Web?

## UNIT – III

**Ontology Engineering:** Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines. Practice: Describe an ontology with the domain of your university faculty, with teachers, courses, and departments.

**Practice:**

1. Use an inference engine to validate your ontology and check for inconsistencies.

## UNIT – IV

**Semantic Web Applications, Services and Technology:** Semantic Web applications and services, Semantic Search, elearning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWLS Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods

**Practice:**

1. Why would Semantic Web Services promote open Web standards and a distributed Web?

## UNIT – V

**Social Network Analysis and semantic web:** What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks, Building Semantic Web Applications with social network features.

**Practice:**

1. List three potential applications that would benefit from the Semantic Web environment.

### Text Books:

- 1 Thinking on the Web – Berners Lee, Godel and Turing, Wiley inter science, ISBN-10. 0471768669 ; ISBN-13. 978-0471768661.
- 2 Social Networks and the Semantic Web, Peter Mika, Springer, ISBN-10. 1441943722 ; ISBN-13. 978-1441943729.

### Reference Books:

- 1 Semantic Web Technologies, Trends and Research in Ontology Based Systems, J. Davies, R. Studer, P. Warren, John Wiley & Sons.
- 2 Semantic Web and Semantic Web Services Liyang Lu Chapman and Hall/CRC Publishers, (Taylor & Francis Group)
- 3 Information sharing on the semantic Web – Heiner Stuckenschmidt; Frank Van Harmelen, Springer Publications.
- 4 Programming the Semantic Web, T. Segaran, C. Evans, J. Taylor, O'Reilly, SPD.

### Web Links:

- 1 [https://onlinecourses.nptel.ac.in/noc20\\_cs78/preview](https://onlinecourses.nptel.ac.in/noc20_cs78/preview)
- 2 <https://tinyurl.com/hhywdjx8>
- 3 <https://open.hpi.de/courses/semanticweb>
- 4 <https://core.ac.uk/download/pdf/36753454.pdf>

**Finance & Retail Analytics**  
(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501CS14</b> | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Demonstrate competencies in financial analysis and decision making.
- CO2:** Evaluate and model Risk on various financial assets
- CO3:** Apply retail analytics concepts and data analysis
- CO4:** Explain data integration and modeling techniques.
- CO5:** Recall and identify the importance of retail analytics, data collection and generation in retail business

**Mapping of Course Outcomes with Program Outcomes:**

| CO/ PO     | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | 1    |      |      | 1    | 1    |      | 1    |       |       |
| <b>CO2</b> | 2    |      | 1    | 2    |      | 1    | 1    |      | 1    |       |       |
| <b>CO3</b> | 2    | 1    |      | 2    |      | 1    | 1    |      | 1    |       |       |
| <b>CO4</b> | 2    |      | 1    | 2    |      | 1    | 1    |      |      |       |       |
| <b>CO5</b> | 2    | 2    | 1    |      |      | 1    | 1    |      |      |       |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/ PSO    | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 1    |      |
| <b>CO4</b> | 1    |      |
| <b>CO5</b> | 2    |      |

**UNIT – I**

Corporate Finance Analysis: Basic corporate financial predictive modeling- Project analysis- cash flow analysis- cost of capital using sensitivity analysis, Indifference point and Financial Break even modelling, Capital Budget model-Payback, NPV, IRR, and MIRR. Bankruptcy Modeling Behavior, t test, Ohlson logistic regression and Altman Z score.

**Practice:**

1. Evaluate the projected financials for a new investment project, considering different revenue growth scenarios.

**Case Study:** Analyze a real-world company's project financials and create predictive models based on different assumptions.

**UNIT – II**

Financial Market Analysis: Estimation and prediction of risk and return ( bond investment and stock investment) – adjusting for stock splits, adjusting for mergers, plotting multiple series, data importing from web portal and data cleansing. Time series-examining nature of data, EWMOA, Value at risk, ARMA, ARCH and GARCH.

**Practice:**

Calculate the expected return and standard deviation of a stock based on historical returns using the **CAPM** (Capital Asset Pricing Model).

**UNIT – III**

Introduction to Retail Analytics: Meaning of Retail Analytics – Benefits of retail analytics  
Concept of product terminology – Types of retail analytics – Retail channel and formats,  
Commonly deployed analytics in retail.

**Practice:**

**1:** Write a brief explanation of what retail analytics entails and how data is used to drive decisions in retail

**Case Study:** Analyze a real-world example of a company using retail analytics to improve customer experience (e.g., Amazon, Walmart). Identify the key data points used and the resulting business impact.

**UNIT – IV**

Data: Data Collection - Data Management- Big Data Management - Data Generation Sources  
- Typical RSCA Process - Data in RSCA - Analytical Techniques in RSCA context - Data  
Analytics & Decision-Making Models - Applications of IoT in Retail.

**Practice:**

Perform a customer segmentation analysis using a dataset of customer purchases. Group customers based on their purchasing behavior, frequency, and value (RFM analysis - Recency, Frequency, Monetary).

**UNIT – V**

Retail Analytics Applications: Business Intelligence – Sales forecasting – Demand forecasting – Unified advanced retail analytics - Retail analytics techniques- Trends and statistics of retail analytics.

**Text Books:**

- 1 Financial analytics with R by Mark J. Bennett, Dirk L. Hugen, Cambridge university press. ISBN 978-1107150751
- 2 Haskell Financial Data Modeling and Predictive Analytics Paperback – Import, by Pavel Ryzhov. ISBN 978-1782169437

**Reference Books:**

- 1 Retail Analytics-Emmett Cox-Wiley-2019-ISBN 978-1118099841
- 2 Business Analysis Fundamentals -Haydn Thomas – Demonoid-Pearson-2018. ISBN: 978-3-030-50079-5

### Minor Stream: Mobile Application Development

| Course Code  | Course Name                 | Level | L         | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|-----------------------------|-------|-----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501IT12     | Flutter Fundamentals        | FC    |           |   | 2         | 2         | 50  | 50  | 100   | -             |
| 2501IT14     | Web Technologies            | FC    | 2         |   | 2         | 4         | 50  | 50  | 100   | JP            |
| 2501IT15     | Software Testing            | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | ASE           |
| 2501IT16     | Software Project Management | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | ASE           |
| 2501IT17     | Mobile Operating System     | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS24     | Wireless Networks           | IC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501AI24     | API & Micro Services        | IC    | 2         |   | 2         | 4         | 50  | 50  | 100   | JP            |
| 2501CS25     | Cloud IoT & Edge ML         | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS28     | Ethical Hacking             | AC    | 2         |   | 2         | 4         | 50  | 50  | 100   | -             |
| 2501IT22     | Software Quality Assurance  | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | ASE           |
| <b>Total</b> |                             |       | <b>18</b> |   | <b>14</b> | <b>32</b> |     |     |       |               |

## Flutter Fundamentals

(Common to CSE, IT, AIML & CSE(DS))

**Course Code: 2501IT12**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>2</b> | <b>2</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Identify the steps to set up the Flutter development environment and recall the purpose of basic widgets and layout structures
- CO2:** Demonstrate the use of fundamental Flutter widgets including images, buttons, icons, lists, and forms.
- CO3:** Design and develop user interfaces using responsive layouts and implement navigation, gestures, and animations
- CO4:** Integrate state management techniques (like Provider, BLoC, Riverpod) and handle real-time user input and data changes effectively
- CO5:** Develop a complete Flutter application using backend integration with Firebase and REST APIs, demonstrating optimization, testing, and deployment skills.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    | 2    | 1    | 3    | -    | -    | -    | -    | -     | 2     |
| <b>CO2</b> | 3    | 2    | 3    | 1    | 2    | -    | -    | -    | -    | -     | 2     |
| <b>CO3</b> | 3    | 2    | 3    | 2    | 3    | -    | -    | -    | -    | -     | 2     |
| <b>CO4</b> | 3    | 3    | 3    | 2    | 3    | -    | -    | -    | -    | -     | 2     |
| <b>CO5</b> | 3    | 3    | 3    | 3    | 3    | -    | -    | -    | -    | -     | 3     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | -    | 2    |
| <b>CO2</b> | -    | 2    |
| <b>CO3</b> | -    | 2    |
| <b>CO4</b> | -    | 2    |
| <b>CO5</b> | -    | 2    |

### Practice:

#### 1.Introduction to Flutter

- a. Setup Environment:** Set up the Flutter development environment on both Windows and Mac OS.
- b. First App:** Create and run your first Flutter application in Android Studio.
- c. Hello World:** Create a simple "Hello World" Flutter application and run it on an Android emulator.
- d. Understanding Structure:** Modify the main Dart file to understand the structure of a Flutter app.
- e. Hot Reload and Restart:** Practice using the hot reload and hot restart features to see how changes reflect instantly.

## 2. Flutter Basics

- a. Button Widgets:** Create a Flutter app with various button widgets (Flat Button, Elevated Button, Icon Button).
- b. Image Widget:** Create an app that displays an image using the Image widget and customize its properties.
- c. Icon Widgets:** Use Icon widgets to display different icons in a Flutter app.
- d. Counter App:** Build a simple counter app that increases a number each time a button is pressed using set State.
- e. Gesture Detector:** Implement a gesture detector that changes the color of a container when tapped.

## 3. Flutter Basics Continued

- a. List of Items:** Create an app with a list of items where each item can be clicked to display a toast message.
- b. Input Validation:** Implement form input validation to ensure correct data entry.
- c. Dialogs:** Use Alert Dialog to show a dialog box when a button is pressed.

## 4. Introduction to Layouts

- a. Basic Layouts:** Create a layout using Column, Row, and Stack widgets.
- b. Responsive Layout:** Implement a responsive layout using the Flex widget.
- c. Single and Multiple Child Widgets:** Build a layout with a combination of single child and multiple child widgets.
- d. Nested Layouts:** Design a complex UI using nested layouts (e.g., rows inside columns).
- e. Gesture Detection:** Use Gesture Detector to detect various gestures (tap, double-tap).

## 5. Layouts Continued

- a. Navigation:** Implement navigation between two screens using the Navigator widget.
- b. Grid View:** Create a layout using Grid View to display items in a grid.
- c. List View:** Use List View to display a list of dynamic items.
- d. Scrolling:** Implement scrolling for a long list of items using List View and Scroll View

## 6. State Management (Basic)

- a. Stateful and Stateless Widgets:** Create a simple app to toggle between stateful and stateless widgets and observe the behavior.
- b. Form Input and Display:** Build an app with a form that takes user input and displays it on the same screen using set State.
- c. Responsive Layout with Media Query:** Create a responsive layout that adapts to different screen sizes using Media Query.
- d. To-Do List App:** Create a to-do list app where users can add and remove items dynamically.

## 7. Animation in Flutter

- a. Animated Container:** Create a simple animation using Animated Container.
- b. Fade Transition:** Implement a basic fade transition using Animated Opacity.
- c. Physics-based Animation:** Develop an app that uses a physics-based animation like Draggable.
- d. Hero Animation:** Implement a hero animation for navigating between screens.



## 8. Advanced Animations

- a. **Animated Builder:** Use Animated Builder to create complex animations.
- b. **Animation Controller:** Create animations with fine control using Animation Controller.
- c. **Staggered Animations:** Implement staggered animations to animate multiple widgets in sequence.
- d. **Curved Animations:** Use Curved Animation to create non-linear animations.

## 9. State Management (Advanced)

- a. **Provider Package:** Use the Provider package for state management.
- b. **BLoC Pattern:** Use the BLoC (Business Logic Component) pattern for managing state.
- c. **River pod:** Explore and use the River pod package for state management.

## 10. Networking in Flutter

- a. **HTTP Requests:** Use the http package to make GET and POST requests.
- b. **JSON Parsing:** Parse JSON data received from an API.
- c. **Fetching Data:** Fetch and display data from a remote API.
- d. **Handling Errors:** Implement error handling for network requests.
- e. **REST API:** Create an app that interacts with a REST API

## 11. Firebase Integration

- a. **Firestore Setup:** Set up Firestore for a Flutter project.
- b. **Authentication:** Implement user authentication using Firebase Auth.
- c. **Firestore:** Use Firestore to store and retrieve data.
- d. **Firestore Storage:** Upload and download files using Firestore Storage

## 12. Project Week

- a. **Project Planning:** Plan a small project incorporating concepts learned.
- b. **Project Development:** Develop the project with proper state management, layout, and networking.
- c. **Testing:** Test the project for bugs and ensure all functionalities work as expected.
- d. **Optimization:** Optimize the app for performance and responsiveness

## Additional Practice:

1. Create a Flutter app that displays a list of items using List View. builder and allows users to add new items dynamically.
2. Develop a Flutter app that uses a Bottom Navigation Bar to navigate between different screens.
3. Create a Flutter app that implements basic form validation with input fields for name, email, and password.

## Reference Books:

- 1 Beginning Flutter: A Hands-On Guide to App Development, Marco L. Napoli, ISBN: 1119550823
- 2 Flutter in Action, Eric Windmill, 2020, ISBN: 1617296147
- 3 Flutter for Beginners: An introductory guide to building cross-platform mobile applications with Flutter and Dart 2 by Alessandro Biessek, ISBN: 1788996089

**Web Links:**

- 1 <https://flutter.dev/docs>
- 2 <https://dart.dev/guides>
- 3 <https://codelabs.developers.google.com/?cat=flutter>

## Web Technologies

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501IT14**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

### Course Outcomes:

**At the end of the Course, Student will be able to:**

**CO1:** Develop static web pages using HTML and CSS.

**CO2:** Apply JavaScript for Client side validations and Node.JS to learn server side applications using JavaScript.

**CO3:** Make use of Angular JS for developing dynamic and responsive web pages.

**CO4:** Utilize React JS for developing dynamic and responsive web pages.

**CO5:** Create and deploy secure, usable database driven web applications using PHP and MySQL/MongoDB.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| <b>CO1</b> | 2   |     | 3   |     |     |     |     | 1   | 1   |      |      |
| <b>CO2</b> | 3   | 2   | 2   |     | 2   |     |     | 1   | 1   |      |      |
| <b>CO3</b> | 2   | 2   | 3   |     | 2   |     |     | 1   |     |      |      |
| <b>CO4</b> | 2   | 3   | 2   |     |     |     |     | 1   |     |      |      |
| <b>CO5</b> | 2   |     | 2   |     | 3   |     |     | 1   | 1   |      |      |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 1    |      |
| <b>CO4</b> | 1    |      |
| <b>CO5</b> | 1    |      |

### UNIT I:

HTML, HTML5, CSS, CSS3 HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, HTML styles, Elements, Attributes, Heading, Layouts, HTML Media, Iframes, Images, Links, Lists, Tables, Forms, GET and POST method, HTML 5, Dynamic HTML. CSS: Cascading style sheets, Levels of Style Sheets, Style Specification Formats, Selector Forms, Box Model, Conflict Resolution, CSS3.

### Practice:

1. Write a HTML program, that makes use of basic tags like

<html>, <head>, <title>, <body>, <p>, <hr>, <br>, <h1> to <h6>, <b>, <i>, <u>, <strong>, <sub>, <sup>, <pre> tags

**UNIT II:**

JavaScript & XML Javascript - Introduction, Primitives, Variables – var, let, const, Operations and Expressions, Control Statements, Functions, Objects (Predefined - String, Number, Array, Date, Math, Random, RegExp, User Defined – Definition, Properties, Methods, Display, Accessors, Constructors), Events, Pattern Matching using Regular Expressions, Working with XML: Document type Definition (DTD), XML schemas, XSLT, XML and CSS, Document object model, Parsers - DOM and SAX .

**Practice:**

Write JavaScript programs on Event Handling :

- a. Open a Window from the current window
- b. Change color of background at each click of button or refresh of a page
- c. Display calendar for the month and year selected from combo box
- d. On Mouse over event

**UNIT III:**

Node JS & Angular JS Node.js- Introduction, Advantages, Process Model, Modules, HTTP Module, File system, URL module, NPM, Events, Upload Files, Email. Angular JS – Introduction, Expressions, Modules, Directives, Model, Data Binding, Controllers, Scopes, Filters, Services, HTTP, Tables, Select, Events, Forms, Validation, API, W3.CSS, Includes, Routing, SQL, DOM, Application.

**Practice:**

Write a JavaScript to validate the following fields in a registration page created in

- a. Name (start with alphabet and followed by alphanumeric and the length should not be less than 6 Characters)
- b. Password (it allows alphanumeric, special symbols and should not be less than 6 characters)
- c. E-mail (should not contain invalid email addresses)

**UNIT IV:**

React JS React JS – Introduction, Displaying “Welcome React”, Introducing JSX, Rendering Elements, Components and Props, State and Lifecycle, Handling Events, Conditional Rendering, Lists and Keys, Forms, Lifting State Up, Composition vs Inheritance, Thinking in React.

**Practice:**

Write a program to create a simple calculator Application using React JS

**UNIT V:**

PHP:PHP Programming - Introduction, Creating and Running PHP Script. Variables, Constants, Datatypes, Operators. Controlling Program Flow - Conditional and Loop statements, Arrays, Functions, Client-Server Scripting – XAMPP/LAMP Introduction, Running PHP Script in XAMPP, Super Globals, Working with Form Data, Database Connectivity – MySQL Introduction using XAMPP in Command Mode and GUI, Working with MySQL Queries, Integrating PHP and MySQL to work with Form Data. No SQL Database - MongoDB Introduction, Create and Drop Database, Create and Drop Collection, Data Types, Insert, Query, Update, Delete, Integrating PHP with MongoDB.

**Practice:**

1. Write a PHP program to demonstrate the use of Decision-making control structures using
  - a. If statement
  - b. If-else statement
  - c. Switch statement

**Text Books:**

- 1 Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson, ISBN: 9789332518827.
- 2 Pro Mean Stack Development, Elad Elrom, Apress O'Reilly, 1<sup>st</sup> Edition, ISBN 978-1-4842-2043-6.
- 3 React Explained, Zac Gordon, OS Training, ISBN 1798752980, 2020.
- 4 MongoDB – The Definitive Guide, Kristina Chodorow, O'Reilly, 2<sup>nd</sup> Edition, ISBN: 9781449344689.

**Reference Books:**

- 1 Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, Dream Tech, , 1<sup>st</sup> Edition.
- 2 An Introduction to Web Design, Programming, Paul S Wang, Sanda S Katila, Cengage Learning, 1<sup>st</sup> Edition

**Web Links:**

- 1 <https://www.reactjs.org/docs/getting-started.html>
- 2 <https://www.university.mongodb.com/>

**Software Testing**  
(Common to CSE, IT, AIML & CSE(DS))

**Course Code: 2501IT15**

**L      T      P      C**  
**2      0      1      3**

**Course Outcomes:**

**At the end of the Course, Student will be able to:**

- CO1:** Explain the fundamentals of software testing.
- CO2:** Summarize verification and validation activities.
- CO3:** Design the test cases using different testing strategies.
- CO4:** Outline the importance of static testing and various levels of software testing.
- CO5:** Discuss about various Automation Testing tools.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 3    |      |      |      |      |      |      |      |       |       |
| CO2   | 1    | 3    |      |      |      |      |      |      |      |       |       |
| CO3   | 3    | 2    |      |      |      |      |      |      | 1    |       |       |
| CO4   | 2    |      | 3    |      |      |      |      |      |      |       |       |
| CO5   | 3    | 2    |      |      |      |      |      |      |      | 1     |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    |      |
| CO2    | 1    |      |
| CO3    | 2    |      |
| CO4    | 1    |      |
| CO5    | 2    |      |

**UNIT – I**

**Software Testing:** Introduction, Evolution, Myths & Facts, Goals, Psychology, Definition, Model for testing, Effective Vs Exhaustive Software Testing.

**Software Testing Terminology and Methodology:** Software Testing Terminology, Software Testing Life Cycle, relate STLC to SDLC, Software Testing Methodology.

**Practical Evaluation:**

1. A program written in JAVA language for Matrix Addition ‘Introspect the causes for its failure and write down the possible reasons for its failure.
2. “A program written in JAVA language for Matrix Multiplication fails” Introspect the causes for its failure and write down the possible reasons for its failure.

**UNIT – II**

**Verification and Validation:** Verification & Validation Activities, Verification, Verification of Requirements, High level and low-level designs, how to verify code, Validation.

**Dynamic Testing I:** Black Box testing techniques: Boundary Value Analysis, Equivalence class Testing, State Table based testing, Decision table-based testing, Cause-Effect Graphing based testing, Error guessing.

**Practical Evaluation:**

1. A Program demonstrates the next date in the calendar. Its input is entered in the form of with the following range:  $1 \leq mm \leq 12$   $1 \leq dd \leq 31$   $1900 \leq yyyy \leq 2025$  Its output would be the next date or it will display 'invalid date'. Design test cases for this program using BVC, robust testing, and worst-case testing methods.
2. A program reads three numbers, A, B, and C, with a range [1, 50] and prints the largest number. Design test cases for this program using equivalence class testing technique.

**UNIT – III**

**Dynamic Testing II:** White-Box Testing: need, Logic coverage criteria, Basis path testing, Graph matrices, Loop testing, data flow testing, mutation testing

**Static Testing:** Inspections, Structured Walkthroughs, Technical reviews.

**Practical Evaluation:**

1. Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of decision table-based testing, derive different test cases, execute these test cases, and discuss the test results.
2. Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of dataflow testing, derive different test cases, execute these test cases and discuss the test results.

**UNIT – IV**

**Validation activities:** Unit testing, Integration Testing, Function testing, system testing, acceptance testing. **Regression testing:** Progressives Vs regressive testing, Regression testability, Objectives of regression testing, when regression testing done? Regression testing types, Regression testing techniques.

**Practical Evaluation:**

1. Write the test cases for any known application (e.g. Banking application)
2. Take any system (e.g. ATM system) and study its system specifications and report the various bugs.

**UNIT – V**

**Software Testing Tools:** Introduction to Testing, need for Automation, Categorization, Selection, Cost incurred in Testing tools, Guidelines for Automated testing, Introduction to list of tools like Win runner, Load Runner, JMeter, Selenium.

**Practical Evaluation:**

1. Case Study of any web testing tool (e.g., Selenium)
2. Write an Automation Script for LOGIN Form (Using Selenium Tool)

**Text Books:**

- 1 Software Testing, Principles and Practices, Naresh Chauhan, 2nd Edition, Oxford, ISBN · 9780199465873.
- 2 Software Testing Tools, Dr.KVKK Prasad, Dream tech press, ISBN 10: 8177225324, ISBN 13: 9788177225327.

**Reference Books:**

- 1 Software Testing- Yogesh Singh ,Cambridge.
- 2 Software Testing, Principles, techniques and Tools, MGL imaye ,TMH
- 3 Effective Methods for Software testing, Willian E Perry ,Wiley.

**Web Links:**

- 1 <https://www.guru99.com/software-testing-lifecycle>
- 2 <http://www.softwaretestinghelp.com/what-is-verification-and-validation/>
- 3 <http://nptel.ac.in/courses/106105150/>
- 4 <http://www.cigniti.com/blog/top-3-regression-testing-types-how-to-execute>
- 5 <https://www.utest.com/search-result/tag/Tools>



## Software Project Management

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501IT16**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the Course, Student will be able to:**

- CO1:** Explain Software Project Management fundamentals and Planning activities.
- CO2:** Compare SDLC models in project framework.
- CO3:** Apply various Effort estimation techniques and tools in real time applications
- CO4:** Discuss various Risk categories, Project Monitoring Control and Resource Allocation.
- CO5:** Demonstrate the concept Software Quality.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | 2    | 3    |      |      |      |      | 2    |       | 2     |
| <b>CO2</b> | 2    | 2    | 2    | 2    |      |      |      |      | 3    |       | 3     |
| <b>CO3</b> | 2    | 2    | 3    | 2    |      |      |      |      | 2    |       | 2     |
| <b>CO4</b> | 2    | 2    | 2    | 3    |      |      |      |      | 2    |       | 2     |
| <b>CO5</b> | 2    | 2    | 2    | 2    |      |      |      |      | 2    | 3     | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 2    |      |

### UNIT – I

**SPM concepts-** Definition – components of SPM – challenges and opportunities – tools and techniques – managing human resource and technical resource – costing and pricing of projects – training and development – project management techniques.

**Case Study:** Managing Human and Technical Resources in the Development of Microsoft Windows 10

### UNIT – II

**Software Measurements-** Monitoring & measurement of SW development – cost, size and time metrics – methods and tools for metrics – issues of metrics in multiple projects. Activity planning– project schedules – sequencing and scheduling projects – Network planning model – AON and AOA-identifying critical activities.

**Case Study:** Activity Planning and Scheduling in the Development of the Boeing 787 Dreamliner's Software Systems

### UNIT – III

**Software Quality-** Quality in SW development – quality assurance – quality standards and certifications – the process and issues in obtaining certifications – the benefits and implications for the organization and its customers – change management

**Case Study:** Achieving ISO 9001 Certification at Infosys

### UNIT – IV

**Risk Issues-** The risk issues in SW development and implementation – identification of risks – resolving and avoiding risks – tools and methods for identifying risk management.

**Case Study:** Risk Management in the Development of the London Ambulance Service System

### UNIT – V

**SPM Tools-** Software project management using Primavera & Redmine and case study on SPM tools.

**Case Study:** Using Primavera in the Construction of Dubai's Burj Khalifa

#### Text Books:

- 1 Software Engineering – Concepts and Practices: Ugrasen Suman, Cengage Learning, ISBN-13: 978-8131519301, ISBN-10: 8131519309.
- 2 Fundamentals of Software Engineering, Rajib Mall, Prentice Hall India, ISBN-13: 978-9388028028, ISBN-10: 9789388028028.

#### Reference Books:

- 1 Software Engineering: A Primer, Waman S Javadekar, Tata McGraw-Hill,. ISBN-13. 978-0070667631
- 2 Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press. ISBN-13. 978-0195694840

#### Web Links:

- 1 [https://www.tutorialspoint.com/software\\_engineering/](https://www.tutorialspoint.com/software_engineering/)
- 2 <https://www.coursera.org/learn/software-processes-and-agile-practices>

## Mobile Operating System

(Common to CSE, IT, AIML & CSE(DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501IT17</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Classify types of Mobile Operating Systems.
- CO2:** Demonstrate characteristics of Real-Time Operating System
- CO3:** Analyze and understand Mobile Operating Systems and their components
- CO4:** Evaluate Mobile issues and development strategies
- CO5:** Design a case study of Mobile OS

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO       | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1:</b> | 2    | 2    | 2    |      |      |      |      |      |      |       |       |
| <b>CO2:</b> | 2    | 2    | 2    |      |      |      |      |      | 1    |       |       |
| <b>CO3:</b> | 2    | 2    | 2    | 1    |      |      |      |      |      |       |       |
| <b>CO4:</b> | 3    | 2    | 3    |      |      |      |      | 1    |      |       |       |
| <b>CO5:</b> | 2    | 2    | 3    |      | 1    |      |      |      | 1    |       | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO      | PSO1 | PSO2 |
|-------------|------|------|
| <b>CO1:</b> | 1    |      |
| <b>CO2:</b> | 2    |      |
| <b>CO3:</b> | 1    |      |
| <b>CO4:</b> | 1    |      |
| <b>CO5:</b> | 2    |      |

### UNIT – I

**Fundamentals of Operating System:** Overview, Synchronization Mechanisms, Processes and Threads, Process Scheduling, Deadlocks: Detection, Prevention and Recovery – Models of Resources – Memory Management Techniques

**Case Study:** Process Scheduling in Windows vs. Linux

### UNIT – II

**Type of Mobile Operating Systems:** Introduction, Type of Mobile OS Android OS (Google Inc.), Bada (Samsung Electronics), Black Berry OS (Research In Motion), iPhone OS / iOS (Apple), MeeGo OS (Nokia and Intel) Palm OS (Garnet OS), Windows Mobile (Windows Phone 7)

**Case Study:** Evolution of Android OS

### UNIT – III

**Real Time and Mobile Operating Systems:**

Basic Model of Real Time Systems - Characteristics- Applications of Real Time Systems – Real Time Task Scheduling - Handling Resource Sharing - Mobile Operating Systems –

Micro Kernel Design - Client Server Resource Access – Processes and Threads - Memory Management - File system through interfaces.

**Case Study:** Real-Time Operating Systems in Automotive Applications

## **UNIT – IV**

**Mobile Issues and Development Strategies:** Issues facing Mobile devices, Securing mobile application development, Android Securable IPC Mechanism, Android Security Model, Intents, Activities, Services, Android Security tools

**Case Study:** Security Challenges in Mobile Banking Applications

## **UNIT – V**

### **Advanced Topics in Mobile Operating Systems:**

Mobile Application Development: Development Tools and IDEs, Platform-Specific Development, Cross-Platform Development

**Future Directions in Mobile OS:** Trends and Predictions, Potential Challenges and Solutions.

**Case Study:** Cross-Platform Mobile Application Development Using Flutter

### **Text Books:**

- 1 Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems Mukesh Singhal and Niranjana G. Shivaratri, Tata McGraw-Hill, ISBN-10. 0070472688 · ISBN-13. 978-0070472686.
- 2 Operating System Concepts, Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, Seventh Edition, John Wiley & Sons, ISBN, 8126509627, 9788126509621.

### **Reference Books:**

- 1 Understanding the Linux kernel, Daniel P Bovet and Marco Cesati,, O'Reilly, 3rd edition. **ISBN:** 0-596-00565-2
- 2 Mobile Application Security, Himanshu Dwivedi, Chris Clark, David Thiel, Tata McGraw Hill, 1<sup>st</sup> Edition. **ISBN-13.** 978-0071633567

### **Web Links:**

- 1 [developer.android.com](http://developer.android.com)
- 2 [wiki.linuxfoundation.org/realtime/](http://wiki.linuxfoundation.org/realtime/)

## Wireless Networks

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS24**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Describe evolution of wireless networks and wireless communication technologies.
- CO2:** Simulate Wireless Communication network for analyzing packet transmission using NS3.
- CO3:** Discuss IEEE 802.11 Standards and Protocols.
- CO4:** Explain evolution and architecture of cellular networks.
- CO5:** Summarize Emerging Trends such as cognitive radio networks, VANETs.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    |      |      | 1    |      |      | 1    | 1    |       |       |
| <b>CO2</b> | 2    | 1    | 2    |      | 2    |      |      | 1    | 1    |       |       |
| <b>CO3</b> | 2    | 1    |      |      | 1    |      |      | 1    | 1    |       |       |
| <b>CO4</b> | 2    |      | 2    |      | 2    |      |      | 1    | 1    |       |       |
| <b>CO5</b> | 2    | 2    | 1    |      |      |      |      |      |      |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 1    |      |
| <b>CO4</b> | 1    |      |
| <b>CO5</b> | 1    |      |

### UNIT – I

**Introduction to Wireless Networks:** Evolution of Wireless Networks, Basic Wireless Communication Concepts, Wireless Spectrum and Regulations, Wireless Network Architectures, Infrastructure Networks, Ad-Hoc Networks, Wireless Standards: IEEE 802.11, Bluetooth, Zigbee.

#### Practice:

1. Simulate an ad-hoc network using NS3.

### UNIT – II

**Wireless Communication Technologies:** Radio Propagation Models, Modulation Techniques, Multiple Access Techniques: TDMA, FDMA, CDMA, OFDM Antennas and Diversity Techniques, MIMO (Multiple Input Multiple Output) Systems.

#### Practice:

1. Create multiple nodes, establish peer to peer connections, and analyze packet transmission using NS3.

### UNIT – III

**Wireless LANs and PANs:** IEEE 802.11 Standards and Protocols, WI-FI Network Design and Deployment, Bluetooth and Zigbee Protocols, Security in Wireless LANs: WEP, WPA, WPA2, QoS (Quality of Service) in Wireless Networks.

**Practice:**

1. Simulate a basic GSM network using NS3.

### UNIT – IV

**Cellular Networks:** Evolution from 1G to 5G, GSM, CDMA, and LTE Architectures, 5G Network Architecture and Key Technologies, Handoff and Roaming, Cellular Network Planning and Optimization.

**Practice:**

1. Set up and configure a Wi-Fi network using Wireshark.
2. Explore the signal strength and coverage area of a Wi-Fi network.

### UNIT – V

**Emerging Trends and Future Directions:** Internet of Things (IoT) and Wireless Sensor Networks (WSNs), Cognitive Radio Networks, Vehicular Ad-hoc Networks (VANETs), Wireless Mesh Networks, Security and Privacy Challenges in Wireless Networks.

**Text Books:**

- 1 Wireless Communications: Principles and Practice by Theodore S. Rappaport, Prentice Hall 2nd Edition, ISBN: 9780130422323.
- 2 Wireless Communications by Andrea Goldsmith, Cambridge University Press, ISBN: 9780521837163.

**Reference Books:**

- 1 Principles of Wireless Access and Localization by Kaveh Pahlavan and Prashant Krishnamurthy. Wiley-IEEE Press, ISBN: 9780470697085.
- 2 802.11 Wireless Networks: The Definitive Guide by Matthew S. Gast, O'Reilly Media 2<sup>nd</sup> Edition, ISBN: 9780596100520.
- 3 Wireless Communications, A. Molisch, Wiley, 2005 Haykin & Moher, Modern Wireless Communications, Pearson (Indian Edition).

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc22\\_ee85/preview/](https://onlinecourses.nptel.ac.in/noc22_ee85/preview/)
- 2 Wireshark Network Protocol Analyzer [Wireshark] (<https://www.wireshark.org/>)
- 3 NS3 Network Simulator [NS3] (<https://www.nsnam.org/>)

**API & Micro Services**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501AI24**

**L      T      P      C**  
**2      0      2      4**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Apply Dependency Injection principles using Constructor and Setter Injection.
- CO2:** Analyze Spring Boot fundamentals and Spring AOP
- CO3:** Apply transaction management and custom repository implementation
- CO4:** Explain web services using SOAP and REST
- CO5:** Evaluate the importance of exception handling and data validation in RESTful services

**Mapping of Course Outcomes with Program Outcomes:**

| CO/ PO     | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | 3    |      | 1    |      |      | 1    | 1    |       |       |
| <b>CO2</b> | 3    | 2    | 2    |      | 1    |      |      | 1    | 1    |       |       |
| <b>CO3</b> | 2    | 2    | 2    |      | 1    |      |      | 1    | 1    |       |       |
| <b>CO4</b> | 2    | 2    | 2    |      | 1    |      |      | 1    | 1    |       |       |
| <b>CO5</b> | 2    | 2    | 3    |      | 1    |      |      | 1    | 1    |       |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/ PSO    | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 1    |      |
| <b>CO5</b> | 1    |      |

**UNIT – I**

**Spring 5 Basics:** Why Spring, What is Spring Framework, Spring Framework - Modules, Configuring IoC container using Java-based configuration, Introduction To Dependency Injection, Constructor Injection, Setter Injection, What is Auto Scanning

**Practice:**

1. Setting up Spring Framework
  - a. Create a new Spring project using Spring Initializr.
  - b. Configure the project structure and dependencies.
  - c. Write a simple "Hello World" application using Spring
2. Spring Modules
  - a. Explore Spring Framework modules (e.g., Core, Data Access, Web).
  - b. Implement a simple data access application using Spring JDBC.
  - c. Create a web application using Spring MVC.

## UNIT – II

**Spring Boot:** Creating a Spring Boot Application, Spring Boot Application Annotation, What is Auto wiring, Scope of a bean, Logger, Introduction to Spring AOP, Implementing AOP advices, Best Practices: Spring Boot Application

### Practice:

1. Creating a Spring Boot Application with Auto Wiring and Logging
  - a. Create a new Spring Boot project using Spring Initializr.
  - b. Define two classes: Employee and EmployeeService.
  - c. Annotate EmployeeService with `@Service` and Employee with `@Component`.
  - d. Use `@Autowired` to inject Employee into EmployeeService.
  - e. Configure logging using Logback.
  - f. Write a test class to verify auto-wiring and logging.
2. Implementing AOP Advices in Spring Boot
  - a. Create a new Spring Boot project using Spring Initializr.
  - b. Define two classes: Student and StudentService.
  - c. Annotate StudentService with `@Service` and Student with `@Component`.
  - d. Implement AOP advice using `@Aspect` and `@Before`.
  - e. Apply AOP advice to StudentService methods.
  - f. Write a test class to verify AOP functionality.

## UNIT – III

**Spring Data JPA with Boot:** Limitations of JDBC API, Why Spring Data JPA, Spring Data JPA with Spring Boot, Spring Data JPA Configuration, Pagination and Sorting, Query Approaches, Named Queries and Query, Why Spring Transaction, Spring Declarative Transaction, Update Operation in Spring Data JPA, Custom Repository Implementation, Best Practices-Spring Data JPA

### Practice:

1. Setting up Spring Data JPA with Spring Boot
  - a. Create a new Spring Boot project.
  - b. Add Spring Data JPA dependency.
  - c. Configure database connection properties.
  - d. Create an entity class (e.g., User).
  - e. Create a repository interface (e.g., UserRepository).
  - f. Test CRUD operations
2. Pagination and Sorting with Spring Data JPA
  - a. Create a repository interface with pagination methods.
  - b. Use Pageable and Sort to implement pagination and sorting.
  - c. Test pagination and sorting functionality.
  - d. Implement custom sorting using `@Query`

## UNIT – IV

**Web Services:** Why Web services, SOA-Service Oriented Architecture, What are Web Services, Types of Web Services, SOAP based Web Services, REST ful Web Services, How to create REST ful Services



**Practice:**

1. Creating a Simple RESTful Web Service
  - a. Create a new Spring Boot project.
  - b. Define a resource class (e.g., User).
  - c. Create a REST controller (e.g., UserController).
  - d. Implement CRUD operations.
  - e. Test using Postman or curl.
2. SOAP-based Web Service with Spring Boot
  - a. Create a new Spring Boot project.
  - b. Define a service interface (e.g., UserService).
  - c. Implement service using @Service.
  - d. Create a WSDL file.
  - e. Test using SoapUI.

**UNIT – V**

**Spring REST:** Spring REST - An Introduction, Creating a Spring REST Controller, @RequestBody and Response Entity, Parameter Injection, Usage of @PathVariable, @RequestParam and @MatrixVariable, Exception Handling, Data Validation, Creating a REST Client, Versioning a Spring REST endpoint, Enabling CORS in Spring REST, Securing Spring REST endpoints

**Practice:**

1. Creating a Simple Spring REST Controller
  - a. Create a new Spring Boot project.
  - b. Define a resource class (e.g., User).
  - c. Create a REST controller (e.g., UserController).
  - d. Implement CRUD operations.
  - e. Test using Postman or curl.
2. Using @RequestBody and Response Entity
  - a. Create a REST controller.
  - b. Use @RequestBody to accept JSON data.
  - c. Use Response Entity to return HTTP responses.
  - d. Test using Postman or curl.

**Note:** The student must Complete & Submit Spring5 Basics with Spring Boot, Spring DataJPA with Boot and Spring REST Certificate Course offered by Infosys Spring Board at the end of the Practice Session.

**Text Books:**

- 1 Spring in action, 5th Edition, Author: Craig Walls, Ryan Breidenbach, Manning, ISBN: 978-1617294945

**Web Reference:**

- 1 Dependency Injection in spring-javat point
- 2 Auto wiring in Spring- javat point
- 3 <https://docs.spring.io/spring-boot/docs/2.0.x/reference/html/using-boot-using-spring-boot-application-annotation.html>
- 4 Auto wiring in Spring – javat point, <https://www.baeldung.com/spring-bean-scopes>
- 5 Spring Boot Logging|How does logging works inspring boot with example (educba.com)
- 6 Spring AOP Tutorial|Aspect Oriented Programming-javat point
- 7 Spring Boot Best Practices(javaguides.net)

- 8 Introduction to Spring Data JPA | SpringHow
- 9 <https://asbnotebook.com/spring-data-jpa-crud-example/>  
<https://www.bezkoder.com/spring-boot-jpa-crud-rest-api/>
- 10 Pagination and Sorting using Spring Data JPA – Paging And Sorting Repository (javaguides.net)
- 11 <https://www.javaguides.net/2018/11/spring-data-jpa-query-creation-from-method-names.html>,<https://www.javaguides.net/2022/02/spring-data-jpa-namedqueries-example.html>
- 12 <https://javadeveloperzone.com/spring/spring-declarative-transaction-management/>
- 13 <https://javadeveloperzone.com/spring/spring-declarative-transaction-management/>
- 14 <https://javabeat.net/spring-data-custom-repository/>
- 15 <https://www.jrebel.com/blog/jpa-application-performance-best-practices>
- 16 <https://www.javatpoint.com/service-oriented-architecture>,<https://www.javatpoint.com/web-services-tutorial>
- 17 <https://www.javatpoint.com/soap-web-services>,<https://www.javatpoint.com/restful-web-services>
- 18 RESTful Web Services - javatpoint
- 19 <https://www.javatpoint.com/restful-web-services-spring-boot>
- 20 <https://www.javatpoint.com/restful-web-services-spring-boot><https://dzone.com/articles/lifecycle-of-a-request-response-process-for-a-spring>
- 21 <https://www.ibm.com/docs/en/was/8.5.5?topic=applications-defining-uri-patterns-resources-in-restful>
- 22 <https://www.baeldung.com/exception-handling-for-rest-with-spring>
- 23 <https://howtodoinjava.com/spring-boot2/resttemplate/spring-restful-client-resttemplate-example/>
- 24 <https://www.javatpoint.com/restful-web-services-versioning>

### Web Links:

- 1 [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01296689056211763272\\_shared/overview\[Spring5BasicswithSpringBoot\]](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01296689056211763272_shared/overview[Spring5BasicswithSpringBoot])
- 2 [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_4313461831752789500\\_shared/overview\[SpringDataJPAwithBoot\]](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_4313461831752789500_shared/overview[SpringDataJPAwithBoot])
- 3 [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_012731900963905536190\\_shared/overview\[SpringREST\]](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012731900963905536190_shared/overview[SpringREST])

**Cloud IoT and Edge ML**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS25**

**L      T      P      C**  
**2      0      1      3**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain technologies behind the communication and management of Fog and edge resources.
- CO2:** Discuss techniques for storage and computation in Fog, edge, 5G and cloud
- CO3:** Implement Internet of Everything (IoE) applications through Fog computing architecture.
- CO4:** Illustrate optimization strategies in Fog and Edge Architectures.
- CO5:** Summarize applications in Fog and Edge Computing.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 1    | 2    |      |      | 2    |      |      | 2    | 2    |       | 2     |
| <b>CO2</b> | 2    | 2    |      |      | 2    |      |      | 2    | 2    |       | 2     |
| <b>CO3</b> | 1    | 2    | 3    |      | 2    |      |      | 2    | 2    |       | 2     |
| <b>CO4</b> | 2    | 1    | 1    | 3    | 2    |      |      | 2    | 2    |       | 2     |
| <b>CO5</b> | 2    | 1    | 1    |      | 2    |      |      | 2    | 2    |       | 2     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 1    |      |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

**UNIT – I**

**Internet of Things (IoT) and New Computing Paradigms:**

Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud, Hierarchy of Fog and Edge Computing, Business Models, Edge Computing Platforms, Opportunities and Challenges.

**Practice:**

2. Building a Simple Edge Computing Application with Data Processing and Cloud Integration.

**UNIT – II**

**Challenges in Federating Edge Resources:**

Introduction, Methodology, Integrated C2F2T Literature by Modeling Technique, Integrated C2F2T Literature by Use Case Scenarios, Integrated C2F2T Literature by Metrics, Threads, Standards.

**Practice:**

2. Setting Up a Simple IoT Device with Edge Computing

### **UNIT – III**

#### **Orchestration of Network Slices in Fog, Edge, and Clouds:**

Introduction, Background, Network Slicing, Network Slicing in Software, Defined Clouds, Network Slicing Management in Edge and Fog, Internet of Vehicles (IoV): Architecture, Protocols and Seven-layer security model architecture for Internet of Vehicles, IoV: Network Models, Challenges and future aspects.

#### **Practice:**

2. Implementing a Simple Network Slicing Scenario for Internet of Vehicles (IoV) Using Edge and Fog Computing.

### **UNIT – IV**

#### **Optimization Problems in Fog and Edge Computing:**

Preliminaries, The Case for Optimization in Fog Computing, Formal Modeling Framework

for Fog Computing, Metrics, Further Quality Attributes, Optimization Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle, Toward a Taxonomy of Optimization Problems in Fog Computing.

#### **Practice:**

2. Optimizing Task Scheduling in Fog Computing

### **UNIT – V**

#### **Applications of Fog and Edge Computing:**

Exploiting Fog Computing in Health Monitoring-Smart Surveillance Video Stream Processing at the Edge for Real - Time Human Objects Tracking-Fog Computing Model for Evolving Smart Transportation Applications - Testing Perspectives of Fog - Based IoT Applications - Legal Aspects of Operating IoT Applications in the Fog.

#### **Practice:**

2. Real-Time Human Object Tracking Using Fog Computing in a Smart Surveillance System

#### **Text Books:**

- 1 Fog and Edge computing: Principles and Paradigms, Buyya, Rajkumar, and Satish Narayana Srirama, John Wiley & Sons, USA, 1st edition, ISBN-10. 1119524989 · ISBN-13. 978-1119524984, 2019.
- 2 Internet of Things –From Research and Innovation to Market Deployment, Ovidiu Vermesan, Peter Friess, “River Publishers, India, 1<sup>st</sup> edition, ISBN 10: 8793102941.

#### **Reference Books:**

- 1 Cloud computing: A hands-on approach, Bahga, Arshdeep, and Vijay Madisetti, CreateSpace Independent Publishing Platform, USA, 2<sup>nd</sup> edition. ISBN: 978-1494435141.

#### **Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc24\\_cs66/preview](https://onlinecourses.nptel.ac.in/noc24_cs66/preview)

## Ethical Hacking

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS28**

**L      T      P      C**  
**2      0      2      4**

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Describe the concepts and types of Ethical hacking.
- CO2:** Apply tools and techniques for Social Engineering.
- CO3:** Illustrate concepts of data security for various networking systems.
- CO4:** Analyze techniques to protect Web servers and Communication Systems.
- CO5:** Demonstrate ethical laws and tests related to ethical hacking.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 1    |      |      |      |      |      | 1    | 1    |       | 1     |
| CO2   | 2    | 2    |      | 1    | 2    |      |      | 1    | 1    |       | 2     |
| CO3   | 2    | 2    |      | 2    |      |      |      | 1    | 1    |       | 1     |
| CO4   | 2    | 2    |      |      | 1    |      |      | 1    | 1    |       | 2     |
| CO5   | 2    | 2    |      |      |      |      | 2    | 1    | 1    |       | 1     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PO | PSO1 | PSO2 |
|-------|------|------|
| CO1   |      | 2    |
| CO2   |      | 2    |
| CO3   |      | 2    |
| CO4   |      | 2    |
| CO5   |      | 2    |

## UNIT – I

### Ethical Hacking

Types of Data Stolen From the Organizations, Elements of Information Security, Authenticity and NonRepudiation, Security Challenges, Effects of Hacking, Hacker – Types of Hacker, Ethical Hacker, Hacktivism - Role of Security and Penetration Tester, Penetration Testing Methodology, Networking & Computer Attacks – Malicious Software (Malware), Protection Against Malware, Intruder Attacks on Networks and Computers, Addressing Physical Security – Key Loggers and Back Doors.

### Practice:

1. Create a social networking website login page using phishing techniques.
2. Sniffing tools to analyze traffic on a network and dissect information.

## UNIT – II

### Foot Printing And Social Engineering

Web Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking.

**Practice:**

1. Social Engineering Countermeasures
2. Tools for Foot Printing

**UNIT – III****Data Security**

Physical Security – Attacks and Protection, Steganography – Methods, Attacks and Measures, Cryptography– Methods and Types of Attacks, Wireless Hacking, Windows Hacking, Linux Hacking.

**Practice:**

1. Write a code to demonstrate DoS attacks.
2. Windows ,Linux OS hacking.

**UNIT – IV****Network Protection System & Hacking Web Servers**

Routers, Firewall & Honeypots, IDS & IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking.

**Practice:**

1. Write a script or code to demonstrate SQL injection attacks.
2. Setup a honey pot and monitor the honey pot on network.

**UNIT – V****Ethical Hacking Laws And Tests**

An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking, ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking – Social Engineering, Host Reconnaissance, Session Hijacking, Hacking - Web Server, Database, Password Cracking.

**Practice:**

1. Study of Techniques uses for Web Based Password Capturing.
2. Study on how to register a Cyber Crime Complaint through online.  
( [https://cybercrime.gov.in/Webform/Crime\\_AuthoLogin.aspx](https://cybercrime.gov.in/Webform/Crime_AuthoLogin.aspx))

**Text Books:**

- 1 Hands-On Ethical Hacking and Network Defense, Corley, Michael T. Simpson, Kent Backman, James E., CENGAGE Learning, ISBN 10 1435486099 , ISBN 13 9781435486096.
- 2 Penetration Testing and Network Defense ,Whitaker & Newman , Cisco Press, Indianapolis, ISBN-10. 1587052083 · ISBN-13. 978-1587052088.

**Reference Books:**

- 1 Official Certified Ethical Hacker Review Guide, Steven DeFino, Barry Kaufman, Nick Valenteen, CENGAGE Learning. ISBN: 978-1435488533.
- 2 The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy, Patrick Engebretson, Syngress Basics Series – Elsevier. ISBN: 978-0124116443.

**Web Links:**

- 1 <https://www.springboard.com/blog/cybersecurity/7-free-sources-to-learn-ethical-hacking-from-scratch/>
- 2 <https://hackernoon.com/top-resources-to-learn-ethical-hacking3>
- 3 [https://onlinecourses.nptel.ac.in/noc22\\_cs13/preview](https://onlinecourses.nptel.ac.in/noc22_cs13/preview)

**Software Quality Assurance**  
(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501IT22**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Know role of software quality and its challenges.
- CO2:** Implement quality plans in software development.
- CO3:** Apply strategies in project life cycle
- CO4:** Implement necessary testing techniques for quality assurance.
- CO5:** Choose quality metrics for quality assurance.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    |      |      |      | 1    |      |      |      |      |       |       |
| <b>CO2</b> | 3    | 1    |      | 1    |      |      |      |      |      |       |       |
| <b>CO3</b> | 1    | 3    |      | 1    |      |      |      |      |      |       |       |
| <b>CO4</b> | 3    |      | 1    |      |      |      |      |      |      |       | 3     |
| <b>CO5</b> |      | 1    |      |      |      |      |      |      |      |       | 3     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 1    |      |
| <b>CO3</b> | 1    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 1    |      |

**UNIT – I**

**Introduction to software Quality and Assurance:** The software quality challenge, Software quality, Software quality factors Management and its role in software quality assurance.

**Case Study:** NASA's Mars Climate Orbiter

**UNIT – II**

**Components of SQA:** The components of the software quality assurance system – overview

**Pre-project Software Quality Components:** Contract review, Development and quality plans.

**Case Study:** Boeing 787 Dreamliner Development



### **UNIT – III**

**SQA Components in the Project Life Cycle and Strategies:** Integrating quality activities in the project life cycle, Reviews, Software testing – strategies

**Case Study:** Agile Development at Spotify

### **UNIT – IV**

**Software Testing – Implementation:** Software Quality Implementation, Assuring the quality of software maintenance components, Assuring the quality of external participants' contributions, CASE tools and their effect on software quality.

**Case Study:** Google's Software Maintenance and External Contributions

### **UNIT – V**

**Software Quality Infrastructure Components:** Procedures and work instructions, Staff training and certification, Corrective and preventive actions, Documentation control

#### **Software Quality Metrics**

Software Quality metrics, Cost of Quality.

**Case Study:** Toyota's Software Quality in Automotive Systems

#### **Text Books:**

- 1 Software Quality Assurance, Daniel Galin, Pearson Publication, ISBN, 0201709457, 9780201709452.

#### **Reference Books:**

- 1 Kshirsagar Naik and Priyadarshi Tripathy, Software Testing & Quality Assurance Theory and Practice, Wiley Student edition. **ISBN**-13. 978-0471789116
- 2 William E. Perry, Effective Methods for Software Testing, WILEY, 3rd Edition **ISBN**-13, 978-8126508938
- 3 Alan C. Gillies, “Software Quality: Theory and Management”, International Thomson Computer Press. **ISBN** 0 412 4513 0

#### **Web Links:**

- 1 <https://www.geeksforgeeks.org/software-engineering-software-quality-assurance/>
- 2 <https://nptel.ac.in/courses/106105218>

### Minor Stream in Cyber Security Industry Integrated Program- L&T<sup>#</sup>

| Course Code  | Course Name                                      | Level | L         | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|--------------------------------------------------|-------|-----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501CS32     | Cyber Security Essentials                        | FC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS30     | Information Security Analysis & Audit            | FC    | 2         |   |           | 2         | 50  | 50  | 100   | -             |
| 2501CS42     | Linux Administration                             | IC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501IT03     | Cryptography & Network Security                  | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS43     | Secure Networking                                | AC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS44     | Application Security                             | AC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS45     | Ethical Hacking & Penetration Testing            | AC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS46     | Cyber Forensic                                   | AC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS47     | Malware Analysis & Governance, Risk & Compliance | AC    |           |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS31     | Cyber Laws                                       | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| 2501CS33     | Secure Coding Techniques                         | AC    | 2         |   | 1         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                                                  |       | <b>10</b> |   | <b>22</b> | <b>32</b> |     |     |       |               |

**Minor Stream: Agile Methodology with DevOps Programming  
(Industry Integrated Program - L&T)**

| Course Code  | Course Name                                              | Level | L | T | P  | C  | CIE | SEE | Total | Pre-requisite |
|--------------|----------------------------------------------------------|-------|---|---|----|----|-----|-----|-------|---------------|
| 2501CS48     | IT Infrastructure Management                             | FC    |   |   | 3  | 3  | 50  | 50  | 100   | -             |
| 2501CS49     | Web Engineering                                          | FC    |   |   | 2  | 2  | 50  | 50  | 100   | -             |
| 2501CS50     | Intro to Azure& AWS DevOps                               | FC    |   |   | 3  | 3  | 50  | 50  | 100   | -             |
| 2501CS51     | Intro to Google Cloud DevOps                             | FC    |   |   | 3  | 3  | 50  | 50  | 100   | -             |
| 2501CS52     | Cloud fundamentals& DevOps                               | IC    |   |   | 3  | 3  | 50  | 50  | 100   | -             |
| 2501CS53     | Agile with DevOps fundamentals & Usage                   | IC    |   |   | 3  | 3  | 50  | 50  | 100   | -             |
| 2501IT16     | Software Project Management                              | IC    | 2 |   | 1  | 3  | 50  | 50  | 100   | ASE           |
| 2501CS54     | Agile based project automation with DevOps               | AC    |   |   | 3  | 3  | 50  | 50  | 100   | -             |
| 2501CS55     | DevOps Container Services                                | AC    |   |   | 3  | 3  | 50  | 50  | 100   | -             |
| 2501CS56     | CI &CD (Continuous Integration & Continuous Development) | AC    |   |   | 3  | 3  | 50  | 50  | 100   | -             |
| 2501CS57     | Object Oriented Software Engineering                     | AC    |   |   | 3  | 3  | 50  | 50  | 100   | -             |
| <b>Total</b> |                                                          |       | 2 |   | 30 | 32 |     |     |       |               |

**Minor Stream in Cloud Infrastructure (Certification Programs - CISCO, Red hat, Oracle,  
AWS, Google & Microsoft)**

| Course Code  | Course Name                                   | Level | L        | T | P         | C         | CIE | SEE | Total | Pre-requisite |
|--------------|-----------------------------------------------|-------|----------|---|-----------|-----------|-----|-----|-------|---------------|
| 2501CS68     | Enterprise Linux Fundamentals                 | FC    |          |   | 2         | 2         | 50  | 50  | 100   | -             |
| 2501CS58     | Linux System Administration                   | FC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS59     | Introduction to Cloud Networking              | FC    | 1        |   | 3         | 4         | 50  | 50  | 100   | -             |
| 2501CS60     | Routing & Switching Essentials                | FC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS62     | Advanced Cloud Networking                     | IC    | 1        |   | 3         | 4         | 50  | 50  | 100   | -             |
| 2501CS67     | Introduction to Cloud Computing Core Concepts | IC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS61     | Cloud Architecture & Platform Services        | FC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS63     | Enterprise Cloud Infrastructure               | IC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| 2501CS69     | Cloud Security                                | IC    | 1        |   | 3         | 4         | 50  | 50  | 100   | -             |
| 2501CS64     | Machine Learning Services on Cloud            | IC    |          |   | 3         | 3         | 50  | 50  | 100   | -             |
| <b>Total</b> |                                               |       | <b>3</b> |   | <b>29</b> | <b>32</b> |     |     |       |               |

## Enterprise Linux Fundamentals

(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501CS68</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>0</b> | <b>0</b> | <b>2</b> | <b>2</b> |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Apply basic and advanced Linux commands to install RHEL, manage files, and edit text using the command line.
- CO2:** Explain how to manage users, processes, services, and network settings in a Linux environment.
- CO3:** Describe how file permissions work and how software packages are managed in a Linux system.
- CO4:** Analyze system performance and configure basic network services in a Linux environment.
- CO5:** Implement remote administration and system maintenance tasks to ensure security and stability in a Linux environment.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    |      | 2    |      | 3    |      |      |      |      |       | 2     |
| <b>CO2</b> | 3    | 2    | 2    |      | 2    |      |      |      |      |       | 2     |
| <b>CO3</b> | 3    |      | 2    |      | 2    |      |      |      |      |       | 1     |
| <b>CO4</b> | 3    | 3    | 2    | 2    | 2    |      |      |      |      |       | 2     |
| <b>CO5</b> | 3    | 2    | 2    |      | 3    |      |      |      |      |       | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 1    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 1    |

### Practice:

- 1. Installation and Basic Commands**
  - a. Install RHEL: Set up RHEL on your system, configure installation options, and create user accounts.
  - b. Execute Basic Commands: commands like `ls`, `cd`, `pwd`, and `man`.
- 2. File Management and Text Editing**
  - a. File and Directory Management: Explore `mkdir`, `cp`, `mv`, and `rm`.
  - b. Text Editing: Use `nano` or `vim` to create and modify text files.
- 3. Advanced Command Line Operations**
  - a) Redirection and Pipes: Understand `>`, `>>`, `|`.
  - b) Wildcards: Learn about `\*`, `?`.

4. **User and Group Management**
  - a. User Accounts: Create, modify, and delete users.
  - b. Groups and Permissions: Understand ownership and permissions.
5. **Process and Service Management**
  - a. Process Management: Explore `ps`, `top`, and `kill`.
  - b. Services: Start, stop, and manage services (daemons).
6. **Network Configuration and Security**
  - a. Network Interfaces: Configure network settings (`ifconfig`, `ip`).
  - b. Firewalls and Security: Learn about `firewalld` and network services.
7. **File System Permissions**
  - a. File Permissions: Master `chmod`, `chown`.
  - b. Access Control Lists (ACLs): Understand extended permissions.
8. **Software Packages and Updates**
  - a. Package Management: Use `yum` or `dnf` to install, update, and remove software.
  - b. Repositories and Dependencies: Explore package sources.
9. **Server Analysis and Support**
  - a. Performance Analysis: Use tools like `top`, `htop`, and system logs.
  - b. Seeking Support: Understand how to get help from Red Hat or the community.
10. **Network Services Configuration**
  - a. Static IP Addresses: Configure networking.
11. **Remote Administration with SSH**
  - a. SSH: Secure remote access using key-based authentication.
  - b. Secure Communication: Understand encryption.
12. **System Maintenance and Security**
  - a. Maintenance Tasks: Perform backups, log rotation, and routine maintenance.
  - b. Security Updates: Regularly apply patches and keep the system secure.

### Additional Practice

1. **Basic Shell Commands Practice**

**Objective:** Familiarize yourself with basic shell commands by performing file operations, navigating directories, and manipulating text files.

**Skills:** Command-line proficiency, file management, text processing.
2. **User and Group Management**

**Objective:** Learn to manage users and groups on a Linux system by adding, modifying, and removing users, and setting permissions.

**Skills:** User account management, permission setting, group policies.
3. **Package Management**

**Objective:** Learn to use the package manager of your Linux distribution to install, update, and remove software packages.

**Skills:** Familiarity with `apt`, `yum`, or `pacman`, software lifecycle management.

**Text books:**

- 1 Redhat Enterprise Linux 9, Vishesh kumar, Gitanjali Mehra

**Reference Books:**

- 1 The Linux Command Line: A complete Introduction 1st Edition by William E. Shotts
- 2 Linux command Line and Shell Scripting Bible 4th Edition by Richard Blum, Christine Bresnahan
- 3 Linux Administration: A Beginner's Guide, Eighth Edition by Wale Soyinka
- 4 Red Hat System Administration I (RH 124) by Red Hat Press

**Web Links:**

- 1 <https://www.redhat.com/en/topics/linux>
- 2 <https://www.freecodecamp.org/news/manage-users-and-groups-in-rhel/>
- 3 [https://access.redhat.com/documentation/en-us/red\\_hat\\_enterprise\\_linux/9/html-single/configuring\\_and\\_managing\\_networking/index](https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/9/html-single/configuring_and_managing_networking/index)
- 4 [https://access.redhat.com/documentation/en-us/red\\_hat\\_enterprise\\_linux/9/html/configuring\\_basic\\_system\\_settings/managing-file-system-permissions\\_configuring-basic-system-settings](https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/9/html/configuring_basic_system_settings/managing-file-system-permissions_configuring-basic-system-settings)
- 5 <https://www.cyberciti.biz/faq/redhat-network-interface-configuration/>
- 6 <https://www.koenig-solutions.com/red-hat-enterprise-linux-diagnostics-troubleshooting-training-certification>

## Linux System Administration

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS58**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>3</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Execute basic Bash scripts to automate simple tasks.
- CO2:** Schedule and manage automated tasks using cron jobs, systemd timers, and the at command.
- CO3:** Configure time synchronization and secure file transfer, and apply performance monitoring tools to optimize system operations
- CO4:** Analyze SELinux policies and network storage configurations to evaluate and improve system security and accessibility
- CO5:** Implement firewall rules and deploy containerized applications to ensure system security and scalability

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 3    | 2    |      | 2    |      |      |      |      |       | 1     |
| <b>CO2</b> | 2    | 3    | 2    |      | 3    |      |      |      |      |       | 1     |
| <b>CO3</b> | 2    | 2    | 3    |      | 3    |      |      |      |      |       | 1     |
| <b>CO4</b> | 2    | 2    | 3    |      | 2    |      |      |      |      |       | 1     |
| <b>CO5</b> | 2    | 3    | 3    |      | 3    |      |      |      |      |       | 1     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 1    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 1    |
| <b>CO5</b> |      | 1    |

### Practice:

#### 1. Bash Scripting Basics

- a. Learn basic Bash scripting syntax and commands.
- b. Write a simple Bash script.

#### 2. Advanced Bash Scripting

- a. Explore functions, loops, and conditionals in Bash.
- b. Automate directory backup with timestamped archive file.

#### 3. Regular Expressions and Text Processing

- a. Understand regular expressions and their use in text processing.
- b. Parse log files and extract information using regular expressions.



- 4. Cron Jobs and Scheduled Tasks**
  - a. Learn and understand the importance of Cron Jobs
  - b. Exercise: Schedule a cron job to clean up temporary files.
- 5. Systemd Timers and At Command**
  - a. Compare systemd timers with cron jobs.
  - b. Use systemd timers for recurring tasks and at command for one-time tasks.
- 6. Log Analysis with Syslog and Journalctl**
  - a. Analyze system logs using syslog and journalctl.
  - b. Troubleshoot common system issues using log analysis tools.
- 7. Time Synchronization and Secure File Transfer**
  - a. Configure NTP for time synchronization.
  - b. Set up SSH for secure file transfer using SCP or SFTP.
- 8. Performance Monitoring and Tuning**
  - a. Monitor system performance with tools like top, iotop, or vmstat.
  - b. Identify bottlenecks and optimize system performance.
- 9. SELinux Policies and Contexts**
  - a. Configure SELinux for enhanced security.
  - b. Troubleshoot SELinux denials and configure policies.
- 10. Network Configuration with NFS or Samba**
  - a. Set up network storage using NFS or Samba.
  - b. Verify connectivity and access permissions for NAS.
- 11. Firewall Management**
  - a. Manage server firewalls with firewalld or iptables.
  - b. Define rules for traffic management and ensure network security.
- 12. Container Deployment with Docker or Podman**
  - a. Deploy containers using Docker or Podman.
  - b. Create containerized applications and manage container images.

#### **Additional Practice:**

##### **1. Disk Usage Analysis Script**

**Objective:** Write a script that analyzes disk usage by directories and outputs a report of the top 5 directories consuming the most disk space.

**Skills:** Bash scripting, disk usage commands (du, sort, head), output formatting

##### **2. System Backup and Recovery**

**Objective:** Set up an automated system backup process using tools like rsync or tar, and test system recovery from the backup.

**Skills:** Backup tools, cron scheduling, disaster recovery planning

##### **3. File System Management**

**Objective:** Experiment with different Linux file systems (e.g., ext4, xfs, btrfs) by creating, mounting, and managing file system volumes, and compare their performance and features.

**Skills:** File system operations, performance benchmarking, feature comparison

**Reference Books:**

- 1 The Linux Command Line: A Complete Introduction 1<sup>st</sup> Edition by William E. Shotts
- 2 Advanced Bash Scripting Guide – Volume 1: An in-depth exploration of the art of shell scripting by Mendel Cooper
- 3 Linux Debugging and Performance Tuning: Tips and Techniques by Steve Best
- 4 Podman in Action: Secure, rootless containers for Kubernetes, microservices, and more by Daniel Walsh

**Web Links:**

- 1 <https://www.gnu.org/software/bash/manual/>
- 2 <https://hackersvanguard.com/establishing-persistence-systemd-timers/>
- 3 <https://www.pcmatic.com/blog/how-to-secure-your-linux-server/>
- 4 [https://access.redhat.com/documentation/en-us/red\\_hat\\_enterprise\\_linux/4/html/reference\\_guide/index](https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/4/html/reference_guide/index)
- 5 <https://docs.azul.com/prime/RHEL-Performance-Tuning-Options>
- 6 [https://access.redhat.com/documentation/en-us/red\\_hat\\_enterprise\\_linux/8/html-single/building\\_running\\_and\\_managing\\_containers/index](https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/8/html-single/building_running_and_managing_containers/index)

## Introduction to Cloud Networking

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS59**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>1</b> | <b>0</b> | <b>3</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Explain different network topologies and transmission types, and access network settings in Windows and Linux.
- CO2:** Implement tools like Packet Tracer and Wireshark to design networks and analyze traffic and device details
- CO3:** Identify network device addresses, build switch/router networks, and calculate and design IPv4 subnet schemes using FLSM.
- CO4:** Configure IP addressing using VLSM and IPv6, and verify network connectivity and DNS resolution.
- CO5:** Secure network devices by researching threats and configuring encrypted remote access using SSH.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | -    | -    |      | 2    |      |      |      | 1    |       |       |
| <b>CO2</b> | 2    | 2    | 2    |      | 3    |      |      |      | 1    |       |       |
| <b>CO3</b> | 2    | -    | 3    |      | 2    |      |      |      | 1    |       |       |
| <b>CO4</b> | 3    | 2    | 2    |      | 2    |      |      |      | 1    |       |       |
| <b>CO5</b> | 3    | -    | -    |      | 2    | 1    |      |      | 2    |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 1    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 1    |

### Practice:

1.
  - a. Navigate the IOS by Using Tera Term for Console Connectivity
  - b. Working with network topologies.
2.
  - a. Basic Switch and End Device Configuration
  - b. Unicasting vs Multicasting vs Broadcasting
3.
  - a. Understand and explore Half duplex and full duplex devices.
  - b. Accessing Network settings in Windows and Linux OS
4.
  - a. Install and work with Cisco Packet tracer
  - b. Design a Communications System

5.
  - a. Install and configure Wireshark.
  - b. Use Wireshark to Monitor Network Traffic
6.
  - a. View Wired and Wireless NIC Information
  - b. Use Wireshark to Examine Ethernet Frames
7.
  - a. View Network Device and Switch MAC Addresses
  - b. Build a Switch and Router Network
8.
  - a. Calculate IPv4 Subnets
  - b. Design and Implement a FLSM Addressing Scheme
9.
  - a. Design and Implement a VLSM Addressing Scheme
  - b. Identify and configure IPv6 Addresses
10.
  - a. Use Ping and Traceroute to Test Network Connectivity
  - b. Understand and observe DNS Resolution
11.
  - a. Research Network Security Threats
  - b. Configure Network Devices with SSH
12.
  - a. SSH vs Telnet connections
  - b. Secure Network Devices

**Additional Practice:**

1. Test Network Latency with Ping and Traceroute
2. Troubleshoot Connectivity Issues
3. Design and Build a Small Network

**Text Books:**

- 1 CCNA Routing and Switching study guide, Todd Lammle

**Reference Books:**

- 1 CCNA 200-301 Official Cert Guide Network Simulator, Wendell Odom & Sean Wilkins from Cisco Press

**Web Links:**

- 1 <https://learningnetwork.cisco.com/s/ccna>
- 2 <https://netacad.com>

## Routing & Switching Essentials

(Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501CS60</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>0</b> | <b>0</b> | <b>3</b> | <b>3</b> |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Explain how switches and routers are connected and configured in a basic network setup.
- CO2:** Implement static and dynamic routing, VLANs, and trunking to enable efficient network communication.
- CO3:** Recall the concepts of Inter-VLAN routing, EtherChannel, and Spanning Tree Protocol used in network configuration
- CO4:** Explain the concepts of port security, DHCP configuration, and switch security in a network environment.
- CO5:** Implement remote access, wireless networks, and static routing using IPv4 and IPv6 for secure and efficient network communication.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    | -    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO2</b> | 3    | 2    | 3    | 2    | 3    | -    | -    | -    | -    | -     | 2     |
| <b>CO3</b> | 2    | 1    | -    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO4</b> | 3    | 2    | 2    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO5</b> | 3    | 2    | 3    | -    | 3    | -    | -    | -    | -    | -     | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | -    | 2    |
| <b>CO2</b> | -    | 1    |
| <b>CO3</b> | -    | 1    |
| <b>CO4</b> | -    | 2    |
| <b>CO5</b> | -    | 1    |

### Practice:

1.
  - a. Basic Switch Configuration
  - b. Connecting switches to network
2.
  - a. Switch cabling and topology
  - b. Configure Basic Router Settings
3.
  - a. Connecting router to network
  - b. Router connections and setup
4.
  - a. Static routing configuration
  - b. Configure and setup dynamic routing

5.
  - a. Understanding Dynamic Trunking Protocol
  - b. Configure VLANs and Trunking
6.
  - a. Implement VLANs and Trunking
  - b. Implement Inter-VLAN Routing
7.
  - a. Configuring Inter-VLAN using Router on Stick
  - b. Working with router sub interfaces
8.
  - a. Implementing Etherchannel
  - b. Configure and Setup Spanning Tree Protocol
9.
  - a. Port security in switches
  - b. Configuring DHCPv6
10.
  - a. Implementing DHCPv4
  - b. Switch Security Configuration
11.
  - a. Remote connections to switches.
  - b. Configure a Wireless Network
12.
  - a. Configure IPv4 and IPv6 Static and Default Routes
  - b. Wireless security setup and implementation

**Additional Practice:**

1. Troubleshoot Inter-VLAN Routing
2. Troubleshoot IPv4 and IPv6 Static and Default Routes
3. Troubleshoot wireless issues

**Textbooks:**

- 1 CCNA Routing and Switching study guide, Todd Lammle

**Reference Books:**

- 1 CCNA 200-301 Official Cert Guide Network Simulator, Wendell Odom & Sean Wilkins from Cisco Press

**Web Links:**

- 1 <https://learningnetwork.cisco.com/s/ccna>
- 2 <https://netacad.com>

## Advanced Cloud Networking

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS62**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>1</b> | <b>0</b> | <b>3</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Identify basic concepts of virtualization, cloud computing, and virtual machine setup using Azure and Linux.
- CO2:** Recognize the basic functions of virtual networks, storage accounts, and load balancers in a cloud environment.
- CO3:** Recall the basic concepts of auto scaling and resource monitoring in Azure.
- CO4:** Explain the use of app services, databases, and Active Directory for managing cloud applications and access.
- CO5:** Implement backup, site recovery, and ARM templates to manage cloud infrastructure and protect data.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | -    | 2    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO2</b> | 3    | -    | 2    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO3</b> | 2    | -    | 2    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO4</b> | 3    | 2    | 2    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO5</b> | 3    | 2    | 3    | -    | 3    | -    | -    | -    | -    | -     | -     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | -    | 1    |
| <b>CO2</b> | -    | 2    |
| <b>CO3</b> | -    | 2    |
| <b>CO4</b> | -    | 1    |
| <b>CO5</b> | -    | 1    |

### Practice:

1.
  - a. Introduction to Virtualization.
  - b. Oracle virtual box installation and setup ubuntu.
  - c. Operating systems introduction and Linux commands.
  - d. Networking fundamentals & Storage classes.
2. Basics of Cloud Computing.
  - a. Cloud introduction & overview.
  - b. Azure global infrastructure.
  - c. Cloud deployment models & services.
3. Virtual Machines.
  - a. Microsoft Azure account creation.
  - b. Azure VM's exploration.

- c. Ubuntu VM creation and working.
  - d. Static website hosting using linux os.
4. Virtual Networking.
- a. Virtual Network setup.
  - b. Virtual Network peering with different regions.
  - c. Nat gateway setup.
  - d. Security groups creation.
5. Storage Accounts.
- a. Introduction to storage.
  - b. Storage Accounts creation.
  - c. Static website hosting in SA.
  - d. Working with file shares.
6. Load Balancers.
- a. Setting up Regional Load Balancer among different vm's.
  - b. Setting up Global Load Balancer among different Regions.
7. Auto Scaling.
- a. Creating auto scale set vm for the application by using load balancers.
8. Monitoring.
- a. Monitor the resources using azure monitor.
  - b. Creating notifications using notification services.
9. App Services & Databases.
- a. Creation of serverless service apps.
  - b. Creating SQL database.
  - c. Creating cosmos database.
10. Active Directory.
- a. IAM user's creation.
  - b. Accessing services with AD.
11. Backup & Site recovery.
- a. Data backup concepts & implementation.
  - b. Site recovery with Azure.
12. ARM Templates.
- a. Creation of vm's with arm templates.
  - b. Creation of vnet's with arm templates.



**Reference Books:**

1. Microsoft Azure Fundamentals AZ-900 Exam Reference, Jim Cheshire, Microsoft press, ISBN: 9780137905923

**Web Links:**

1. <https://azure.microsoft.com/en-in/get-started/azure-portal>

## Introduction to Cloud Computing Core Concepts (Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code: 2501CS67</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>0</b> | <b>0</b> | <b>3</b> | <b>3</b> |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Apply cloud cost estimation, user management, and security concepts using AWS tools and services.
- CO2:** Explain the components and configuration of Virtual Private Cloud (VPC) and its security features in AWS.
- CO3:** Describe how network access control, EC2 instances, and VPC peering are used to manage and secure cloud networks
- CO4:** Implement serverless functions, website deployment, and storage services using AWS tools.
- CO5:** Apply AWS services like EC2 snapshots, autoscaling, load balancing, and CloudFormation to manage cloud infrastructure.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | -    | 2    | -    | 3    | 1    |      |      | 1    |       | 2     |
| <b>CO2</b> | 2    | -    | -    | -    | 2    | -    |      |      | 1    |       | 2     |
| <b>CO3</b> | 2    | 1    | 2    | -    | 2    | -    |      |      | 1    |       | 2     |
| <b>CO4</b> | 2    | -    | 3    | -    | 3    | -    |      |      | 1    |       | 2     |
| <b>CO5</b> | 3    | 2    | 3    | -    | 3    | -    |      |      | 1    |       | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 1    |
| <b>CO2</b> |      | 1    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 1    |

### Practice:

1.
  - a. Calculate Total Cost of Ownership
  - b. Use AWS Pricing calculator to estimate multiple pricing models.
2.
  - a. Differentiate between AWS and customer responsibilities using Shared Responsibility Model
  - b. User Management using Identity and Access Management
3.
  - a. Securing IAM user accounts.
  - b. IPv4 and IPv6 implementation in cloud

4.
  - a. Design Virtual Private Cloud
  - b. Configure NAT gateway.
5.
  - a. Implementing Internet Gateway in AWS Cloud
  - b. Working with bastion host.
6.
  - a. Create and manage Private & Public subnets.
  - b. Secure VPC using Security Groups
7.
  - a. Implement Network Access Control lists to control traffic.
  - b. Build VPC and launch a web server.
8.
  - a. Launch EC2 instances in two different regions and connect.
  - b. Create multiple VPCs and peer them using VPC peering.
9.
  - a. Create and trigger AWS Lambda functions.
  - b. Use AWS lambda to automate EC2 instance behavior.
10.
  - a. Website deployment using AWS Elastic Beanstalk
  - b. Working with Elastic Block Storage
11.
  - a. Creating and working with EC2 snapshots.
  - b. Configure autoscaling for application deployed in AWS Cloud
12.
  - a. Load balance application deployed in AWS Cloud
  - b. Basic implementation of Infrastructure as Code using AWS CloudFormation

**Additional Practice:**

1. Working with Elastic File System
2. Working with S3 Buckets and Objects
3. Build a database server

**Textbooks:**

- 1 AWS Certified Cloud Practitioner study guide, Ben Piper & David Clinton

**Reference Books:**

- 1 AWS Certified Cloud Practitioner cert guide, Anthony J Sequeira, by Pearson Education

**Web Links:**

- 1 <https://skillbuilder.aws/>
- 2 <https://aws.amazon.com/training/awsacademy/>

## Cloud Architecture & Platform Services (Common to CSE, IT, AIML & CSE (DS))

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
| <b>Course Code:</b> 2501CS61 | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | <b>0</b> | <b>0</b> | <b>3</b> | <b>3</b> |

### Practice:

1.
  - a. Introduction to Virtualization.
  - b. Oracle virtual box installation and setup ubuntu.
  - c. Operating systems introduction and Linux commands.
  - d. Networking fundamentals & Storage classes.
2. Basics of Cloud Computing.
  - a. Cloud introduction & overview.
  - b. Azure global infrastructure.
  - c. Cloud deployment models & services.
3. Virtual Machines.
  - a. Microsoft Azure account creation.
  - b. Azure VM's exploration.
  - c. Ubuntu VM creation and working.
  - d. Static website hosting using linux os.
4. Virtual Networking.
  - a. Virtual Network setup.
  - b. Virtual Network peering with different regions.
  - c. Nat gateway setup.
  - d. Security groups creation.
5. Storage Accounts.
  - a. Introduction to storage.
  - b. Storage Accounts creation.
  - c. Static website hosting in SA.
  - d. Working with file shares.
6. Load Balancers.
  - a. Setting up Regional Load Balancer among different vm's.
  - b. Setting up Global Load Balancer among different Regions.
7. Auto Scaling.
  - a. Creating auto scale set vm for the application by using load balancers.
8. Monitoring.
  - a. Monitor the resources using azure monitor.
  - b. Creating notifications using notification services.
9. App Services & Databases.
  - d. Creation of serverless service apps.
  - e. Creating SQL database.

- f. Creating cosmos database.
- 10. Active Directory.
  - c. IAM user's creation.
  - d. Accessing services with AD.
- 11. Backup & Site recovery.
  - c. Data backup concepts & implementation.
  - d. Site recovery with Azure.
- 12. ARM Templates.
  - c. Creation of vm's with arm templates.
  - d. Creation of vnet's with arm templates.

**Web Links:**

- 1 <https://azure.microsoft.com/en-in/get-started/azure-portal>

## Enterprise Cloud Infrastructure

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS63**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>3</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Recall the basic concepts of cloud computing, Oracle Cloud Infrastructure, and its core networking components.
- CO2:** Identify basic concepts of Oracle Cloud and its main networking parts.
- CO3:** Explain the basics of Oracle database services, backup and security features in Oracle Cloud Infrastructure.
- CO4:** Describe how monitoring, alerts, and security features like MFA are used in Oracle Cloud
- CO5:** Implement infrastructure automation and resource optimization using Terraform and Oracle Cloud tools.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | -    | 2    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO2</b> | 3    | -    | 2    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO3</b> | 3    | 2    | 2    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO4</b> | 3    | 2    | 2    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO5</b> | 3    | 2    | 3    | 2    | 3    | -    | -    | -    | -    | -     | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | -    | 2    |
| <b>CO2</b> | -    | 2    |
| <b>CO3</b> | -    | 2    |
| <b>CO4</b> | -    | 2    |
| <b>CO5</b> | -    | 2    |

### Practice:

1.
  - a. Introduction to Cloud Computing and Oracle Cloud Infrastructure (OCI).
  - b. Understanding Cloud Service Models: IaaS, PaaS, SaaS.
2.
  - a. Oracle Cloud Global Infrastructure: Regions and Availability Domains.
  - b. Core Concepts: Tenancy, Compartments, and Resource Management.
3.
  - a. Networking in Oracle Cloud: Virtual Cloud Networks (VCNs).
  - b. Configuring and Managing Subnets, Gateways, and Route Tables.
4.
  - a. Identity and Access Management (IAM) in Oracle Cloud.
  - b. Implementing Policies and Managing Access.
5.
  - a. Compute Services: Managing Virtual Machines and Bare Metal Instances.
  - b. Auto Scaling and Load Balancing in Oracle Cloud.

6.
  - a. Storage Solutions in Oracle Cloud: Block, Object, and File Storage.
  - b. Configuring and Managing Storage Volumes.
7.
  - a. Database Services: Oracle Autonomous Database, Oracle DB Systems.
  - b. Backup, Recovery, and High Availability in Oracle Databases.
8.
  - a. Security in Oracle Cloud: Understanding Security Zones and Policies.
  - b. Data Encryption and Key Management in OCI.
9.
  - a. Monitoring and Logging in Oracle Cloud.
  - b. Setting Up Alerts and Notifications for Resource Management.
10.
  - a. Oracle Cloud Identity and Security Operations.
  - b. Implementing Multi-Factor Authentication (MFA) and Secure Access.
11.
  - a. Managing and Orchestrating Cloud Resources with Terraform on OCI.
  - b. Automating Infrastructure Deployment using OCI Resource Manag.
12.
  - a. Oracle Cloud Governance: Budgets, Cost Management, and Tags.
  - b. Using Oracle Cloud Advisor for Resource Optimization.

**Additional Practice:**

1. Configuring and Managing an Oracle Autonomous Database.
2. Implementing a Secure VCN in Oracle Cloud.
3. Automating Resource Deployment with Terraform on Oracle Cloud.

**Textbooks:**

1. **Oracle Cloud Infrastructure Foundations**, Rohit Gupta, by Packt Publishing.

**Reference Books:**

1. **Oracle Cloud Infrastructure Architect Associate**, Roopesh Ramklass, by Oracle Press.

**Web Links:**

1. <https://www.oracle.com/cloud/>
2. <https://cloud.oracle.com/tryit>

## Cloud Security

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS69**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>1</b> | <b>0</b> | <b>3</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Explain basic cloud security principles, attack vectors, and access control methods in cloud environments.
- CO2:** Illustrate IAM roles, policies, and resource-based permissions used to secure cloud infrastructure.
- CO3:** Apply AWS security services and configurations to monitor, protect, and manage cloud network resources.
- CO4:** Implement data protection methods and access controls to secure cloud storage and network resources using AWS services.
- CO5:** Analyze monitoring, vulnerability assessment, and threat protection techniques to secure applications and resources in AWS.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | -    | -    | -    | 2    | 1    | -    | -    | 1    | -     | 2     |
| <b>CO2</b> | 2    | 1    | -    | -    | 2    | 1    | -    | -    | 1    | -     | 2     |
| <b>CO3</b> | 3    | 2    | 2    | -    | 3    | -    | -    | -    | 1    | -     | 2     |
| <b>CO4</b> | 3    | 2    | 2    | -    | 3    | -    | -    | -    | 1    | -     | 2     |
| <b>CO5</b> | 3    | 3    | 2    | -    | 3    | -    | -    | -    | 2    | -     | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 1    |
| <b>CO4</b> |      | 1    |
| <b>CO5</b> |      | 2    |

### Practice:

1.
  - a. Analyze cloud security design principals
  - b. Implementation of shared responsibility model in cloud
2.
  - a. Understanding attack vectors on cloud resources
  - b. Case studies on Cloud security and compliance
3.
  - a. Securing access to cloud resources.
  - b. Configuring IAM Authentication
4.
  - a. Authorize with Identity and Access Management
  - b. Amazon S3 Cross-Account Resource-Based Policy



5.
  - a. Using Resource-Based Policies to Secure an S3 Bucket
  - b. Implementing IAM assume role in AWS.
6.
  - a. Securing infrastructure in cloud.
  - b. Testing IAM policies with IAM policy simulator
7.
  - a. Using AWS Cloud Trail to log and track actions.
  - b. Threat Intelligence with Amazon guard Duty
8.
  - a. Setting up private and public subnets.
  - b. Securing VPC Resources by Using Security Groups
9.
  - a. Working with Network Access Control Lists
  - b. Best practices for protecting data in Amazon S3
10.
  - a. Understanding client-side and server-side encryption
  - b. Encrypting Data at Rest by Using AWS KMS
11.
  - a. Monitoring and Alerting CloudWatch
  - b. Using Amazon Inspector to assess application vulnerabilities.
12.
  - a. Securing web applications in AWS using Web Application Firewall
  - b. Protecting cloud resources from DDoS attacks using AWS Shield

**Additional Practice:**

1. Remediating an Incident by Using AWS Config and Lambda
2. Best practices for handling an incident
3. Responding to and Managing an Incident

**Textbooks:**

- 1 AWS Certified security study guide, Marcello Zillo Neto, Gustavo AA Santana, by Sybex Press

**Reference Books:**

- 1 AWS Certified Security exam guide, Stuart Scott, by O'REILLY press

**Web Links:**

- 1 <https://skillbuilder.aws/>
- 2 <https://aws.amazon.com/training/awsacademy/>

## Machine Learning Services on Cloud

(Common to CSE, IT, AIML & CSE (DS))

**Course Code: 2501CS64**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>3</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Describe machine learning challenges, problem formulation, and data preparation using AWS SageMaker.
- CO2:** Recall basic AWS services for model training, forecasting, image analysis, and NLP tasks
- CO3:** Apply machine learning techniques for text extraction, sentiment analysis, and NLP tasks.
- CO4:** Describe information extraction and topic modeling using NLP tools and Amazon Comprehend.
- CO5:** Use AWS services and LLMs to develop multi-lingual NLP solutions for translation, transcription, and text generation

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    | -    | -    | 2    | -    | -    | -    | -    | -     | 2     |
| <b>CO2</b> | 3    | 2    | -    | -    | 2    | -    | -    | -    | -    | -     | 2     |
| <b>CO3</b> | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | 1    | 2     | 2     |
| <b>CO4</b> | 3    | 2    | -    | -    | 2    | -    | -    | -    | -    | -     | 2     |
| <b>CO5</b> | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | 1    | 2     | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | -    | 2    |
| <b>CO2</b> | -    | 1    |
| <b>CO3</b> | -    | 1    |
| <b>CO4</b> | -    | 2    |
| <b>CO5</b> | -    | 1    |

### Practice:

1.
  - a. Solving business problems with machine learning
  - b. Exploring Machine Learning challenges
2.
  - a. Machine Learning with AWS Sagemaker
  - b. Formulating Machine Learning problems
3.
  - a. Creating and Importing data with Amazon Sagemaker
  - b. Encoding categorical data
4.
  - a. Training a Model with AWS Services
  - b. Creating a Forecast with Amazon Forecast

5.
  - a. Video analysis with Amazon Rekognition
  - b. Labelling images with Amazon Ground Truth
6.
  - a. Facial Recognition with AWS Services
  - b. Understanding common Natural Language Processing tasks.
7.
  - a. Applying ML to an NLP problem.
  - b. Extracting text from web
8.
  - a. Implementing sentiment analysis
  - b. Understanding types of information extraction
9.
  - a. Implementing information extraction
  - b. Working with entities
10.
  - a. Implementing topic modelling with Amazon Comprehend
  - b. Implementing topic modelling NTM
11.
  - a. Detecting and translating languages
  - b. Transcribing and vocalizing text with AWS Services
12.
  - a. Implementing a multi-lingual solution
  - b. Using LLMs to perform NLP tasks

**Additional Practice:**

1. NLP with Amazon Comprehend and Polly
2. Create a chatbot using Amazon Lex
3. Creating a Linear Regression Model Using Amazon Code Whisperer

**Textbooks:**

1. AWS Certified Machine Learning study guide, S Subramanian, by Sybex Press

**Reference Books:**

1. AWS Certified Machine learning Speciality certification guide, Somanath Nanda, Wesley Moura, by O'REILLY press

**Web Links:**

- 1 <https://skillbuilder.aws/>
- 2 <https://aws.amazon.com/training/awsacademy/>

### UNIVERSITY ELECTIVE COURSES

| Branch | Course Code | Course Name                                                    | Level | L | T | P | C | CIE | SEE | Offered to                                      | Pre-requisite |
|--------|-------------|----------------------------------------------------------------|-------|---|---|---|---|-----|-----|-------------------------------------------------|---------------|
| CE     | 2501CE66    | Natural Disaster Management & Mitigation                       |       | 3 | 0 | 0 | 3 |     |     | EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| CE     | 2501CE81    | Wastewater Management                                          |       | 3 | 0 | 0 | 3 |     |     | EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| CE     | 2501CE82    | Integrated Solid Waste Management for a Smart City             |       | 3 | 0 | 0 | 3 |     |     | EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| CE     | 2501CE83    | Watershed Management                                           |       | 3 | 0 | 0 | 3 |     |     | EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| EEE    | 2501EE53    | Electric Power Generation, Transmission & Distribution Systems | AC    | 3 | 0 | 0 | 3 | 50  | 50  | CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E   |               |
| EEE    | 2501EE36    | Electric Energy Storage Systems                                | FC    | 3 | 0 | 0 | 3 | 50  | 50  | CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E   |               |
| EEE    | 2501EE43    | Electrical safety                                              | IC    | 3 | 0 | 0 | 3 | 50  | 50  | CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E   |               |
| EEE    | 2501EE54    | Hybrid & Electric Vehicles                                     | IC    | 3 | 0 | 0 | 3 | 50  | 50  | CE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E       |               |
| ME     | 2501ME37    | Solar Energy Systems                                           | FC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| ME     | 2501ME58    | Industry 5.0 for Engineers                                     | AC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| ME     | 2501ME73    | Organizational Behavior                                        | FC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| ME     | 2501ME36    | Sustainable Energy Systems                                     | FC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E  |               |
| ECE    | 2501EC97    | Biomedical Electronics                                         | FC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E |               |
| ECE    | 2501EC98    | Fundamentals of Wireless Communications                        | FC    | 3 |   |   | 3 | 50  | 50  | CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E |               |

|       |                       |                                                  |    |   |  |   |   |    |    |                                                 |              |
|-------|-----------------------|--------------------------------------------------|----|---|--|---|---|----|----|-------------------------------------------------|--------------|
| ECE   | 2501EC99              | Principles of Embedded Systems                   | FC | 3 |  |   | 3 | 50 | 50 | CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E  |              |
| ECE   | 2501ECA0              | Electronics for Healthcare                       | FC | 3 |  |   | 3 | 50 | 50 | CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E  |              |
| ECE   | 2501ECA1              | Basics of VLSI Design                            | FC | 3 |  |   | 3 | 50 | 50 | CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E |              |
| ECE   | 2501ECA2              | System on Chip Design                            | FC | 3 |  |   | 3 | 50 | 50 | CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E |              |
| ECE   | 2501ECA3              | Introduction to Quantum Computing                | FC | 3 |  |   | 3 | 50 | 50 | CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E  |              |
| CSE   | 2501CS03/<br>2601DS02 | Data Structures* /<br>Data Structures using C++# | FC | 2 |  | 2 | 4 | 50 | 50 | CE, ME, PT, Min.E                               | PPSC         |
| CSE   | 2501CS13              | Operating Systems                                | IC | 2 |  | 1 | 3 | 50 | 50 | CE, EEE, ME, ECE, PT, Min.E, Ag.E               | -            |
| IT    | 2501IT05              | Database Management Systems                      | IC | 2 |  | 2 | 4 | 50 | 50 | CE, EEE, ME, ECE, PT, Min.E, Ag.E               | PPSC / CP&DS |
| IT    | 2501CS07              | Computer Networks                                | AC | 2 |  | 1 | 3 | 50 | 50 | CE, EEE, ME, ECE, PT, Min.E, Ag.E               | -            |
| AI&ML | 2501AI02              | Artificial Intelligence                          | FC | 2 |  | 1 | 3 | 50 | 50 | CE, EEE, ECE, PT, Min.E                         | -            |
| AI&ML | 2501AI05              | Machine Learning                                 | AC | 2 |  | 2 | 4 | 50 | 50 | CE, ECE, PT, Min.E                              | DAUP         |
| DS    | 2501CS34              | Fundamental of Data Science                      | FC | 2 |  | 1 | 3 | 50 | 50 | CE, EEE, ME, ECE, PT, Min.E, Ag.E               | PPSC / CP&DS |

## Natural Disaster Management & Mitigation

(EEE,ME,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

**Course Code: 2501CE66**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

**CO1:** Explain the aspects of disaster management and adopt remedial measures.

**CO2:** Explain disaster risk assessment and coping measures.

**CO3:** Explain the vulnerability conditions.

**CO4:** Assess the impact of hazards on structures.

**CO5:** Adopt the rehabilitation procedures.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| <b>CO1</b> | 2   |     |     |     |     |     |     |     | 2   |      |      |
| <b>CO2</b> |     | 1   |     |     |     |     | 3   |     | 2   |      |      |
| <b>CO3</b> |     | 1   |     |     |     |     |     |     | 2   |      |      |
| <b>CO4</b> | 2   |     |     |     |     |     | 3   |     | 2   |      |      |
| <b>CO5</b> | 2   |     |     |     |     |     | 3   |     | 2   |      |      |

### UNIT – I

#### Introduction:

Introduction Concept of Disaster Management. Types of Disasters. Disaster mitigating agencies and their organizational structure at different levels.

### UNIT – II

#### Overview of Disaster Situations:

Overview of Disaster Situations in India Vulnerability of profile of India and Vulnerability mapping including disaster – prone areas, communities, places. Disaster preparedness – ways and means; skills and strategies; rescue, relief reconstruction. Case Studies: Lessons and Experiences from Various Important Disasters in India and Biological disasters – SARS-spread and transmissions -pandemic, endemic and epidemic.

### UNIT – III

#### Flood:

Flood and Drought Disaster Raising flood damage, assessing flood risk, flood hazard assessment, flood impact assessment, flood risk reduction options. Drought and development, relief management and prevention, drought mitigation and management-integrating technology and people.

## **UNIT – IV**

### **Overview of Disaster Situations:**

Landslide and Earthquake Disaster Land slide hazards zonation mapping and geo environmental problems associated with the occurrence of landslides. The use of electrical resistivity method in the study of landslide. Causes and effects of earthquakes. Secondary effects. Criteria for earthquake resistant design.

## **UNIT – V**

### **Cyclone and Fire Disaster:**

Cyclone and Fire Disaster Cyclone occurrence and hazards. Cyclone resistant house for coastal areas. Disaster resistant construction role of insurance sector. Types of fire. Fire safety and firefighting method, fire detectors, fire extinguishers. Rehabilitation: Rehabilitation programmes, Management of Relief Camp.

### **Text Books**

1. Disaster Management, RB Singh (Ed), Rawat Publications. (ISBN: 13-978-8131600337).
2. Disaster Management Future Challenges and Opportunities, Jagbir Singh, I.K International publishing house. (ISBN: 13-978-8189866464).

### **Reference Books:**

1. Natural Hazards in the Urban habitat by Iyengar, CBRI, Tata McGraw Hill. (ISBN:13-9780074631881).
2. Natural Disaster management, Jon Ingleton (Ed), Tulor Rose. (ISBN:13-978-0953614011).
3. Anthropology of Disaster management, Sachindra Narayan, Gyan Publishing house. (ISBN: 13-978-8121206839).

### **Web Links:**

1. [https://www.iare.ac.in/sites/default/files/lecture\\_notes/dm%20notes.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/dm%20notes.pdf)

## Waste Water Management

(EEE,ME,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

**Course Code: 2501CE81**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain the importance of sanitation and wastewater management.
- CO2:** Explain the various methods of sewage flow estimation and pumping systems.
- CO3:** Identify the various characteristics of sewage and the treatment system.
- CO4:** Outline the various secondary treatment technologies for waste water
- CO5:** Explain the different tertiary and effluent disposal methods.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 3    |      |      |      |      |      |      |      |       |       |
| CO2   | 2    | 3    |      |      |      | 1    |      |      |      |       |       |
| CO3   | 3    | 3    | 1    |      |      | 2    |      |      |      |       |       |
| CO4   | 2    | 2    | 1    | 2    |      | 2    |      |      |      |       |       |
| CO5   | 2    | 2    | 1    |      |      | 2    |      |      |      |       |       |

### UNIT – I

**Introduction:**

Introduction to sanitation–systems of sanitation–relative merits and demerits –need for waste water management–basic terminology in waste water–generation of waste water–types – collection and conveyance of waste water– classification of sewerage systems.

### UNIT – II

**Sewage Flow and Pumping:**

Estimation of sewage flow and storm water drainage–fluctuations. Types of sewers–hydraulics of sewers– appurtenances in sewerage. Pumping of waste water:pumping stations–location–components– types of pumps and their suitability with regards to waste waters.

### UNIT – IV

**Secondary Treatment:**

Aerobic and anaerobic treatment process-comparison. Aerobic units: Activated sludge process, principles, modifications of activated sludge processes–Oxidation ponds–Trickling filters– Rotating biological contactors. Anaerobic units: UASB Reactor, principle and working.

### UNIT – V

**Tertiary Treatment and Disposal:**

Removal of Nutrients–Nitrification and Denitrification–Ion exchange–membrane processes –MF, UF, NF, RO. Disposal of sewage–Methods of disposal–Effluent Standards. Need, Scope and demand for waste water recycling.



**Text Books:**

1. Wastewater Engineering: Treatment and Resource Recovery, Metcalf & Eddy, McGraw-Hill, New York, 5<sup>th</sup> Edition. (ISBN: 13-978-0073401188).
2. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, Tata McGraw-Hill , 2018. (ISBN: 13-978-0070495395).

**Reference Books:**

1. Environmental Engineering-II: Sewage disposal and Air pollution Engineering, Garg & S.K., Khanna Publications. (ISBN:978-81-7409-230-4)
2. Environmental Engineering by D. Srinivasan, PHI Learning private Limited, New Delhi. (ISBN:13-9788120336001)
3. Elements of Environmental Engineering, K.N. Duggal, S.Chand& Company Ltd. New Delhi. (ISBN: 13-978-8121915472).
4. Wastewater Treatment for pollution control and Reuse, Soli J Areivala, Sham R Asolekar, Mc- GrawHill, New Delhi. (ISBN:9780070620995).

**Web Links:**

1. [https://web.iitd.ac.in/~arunku/files/CVL100\\_Y16/LecSep1220.pdf](https://web.iitd.ac.in/~arunku/files/CVL100_Y16/LecSep1220.pdf)
2. <http://www.civil.iitm.ac.in/dwwm/sites/default/files/presentations>
3. [https://www.researchgate.net/publication/221911472\\_Wastewater\\_Management](https://www.researchgate.net/publication/221911472_Wastewater_Management)

## Integrated Solid Waste Management for A Smart City

(EEE,ME,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

**Course Code: 2501CE82**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Understand Fundamental Concepts of Solid Waste Management
- CO2:** Analyze Municipal Solid Waste Management Practices
- CO3:** Evaluate Disposal Methods and Technologies
- CO4:** Apply Knowledge of Construction and Demolition (C&D) Waste Management
- CO5:** Examine E-Waste and Hazardous Waste Management

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|------|-------|
| CO1   | 1    |      |      |      |      | 3    | 2    |      |      |      |       |
| CO2   | 1    |      |      |      |      | 3    | 2    |      |      |      |       |
| CO3   | 1    |      |      |      |      | 3    | 2    |      |      |      |       |
| CO4   | 1    |      |      |      |      | 3    | 2    |      |      |      |       |
| CO5   | 1    |      |      |      |      | 3    | 2    |      |      |      |       |

### UNIT – I

#### Introduction:

Solid Waste Management- Definition, Concept of 4Rs (reduce, reuse, recycle and recover) of waste management, Elements of a waste management system, Issues in Solid Waste Management, Integrated Waste Management Hierarchy: Source reduction, Recycling, Waste-to-Energy and Landfilling, Review of waste management under Swachh Bharat Mission and Smart Cities Program.

### UNIT – II

#### Municipal Solid Waste:

Waste Composition and Quantities, Collection, Transportation, Segregation, and Processing.

### UNIT – III

#### Disposal of Municipal Solid Waste:

Landfill, Biochemical Processes and Composting, Energy Recovery from Municipal Solid Waste, Municipal Solid Waste (MSW) Rules 2016, Current Issues in Solid Waste Management and Review of MSW Management

### UNIT – IV

#### Construction and Demolition (C&D) Waste Management:

Overview, Components; C&D Waste Management Rules 2016, Beneficial Reuse of C & D Waste Materials.

### UNIT – V

#### Electronic Waste (E-Waste) Management:

Issues and Status in India and Globally, E-Waste Management Rules 2016 and Management Challenges.

**Hazardous Wastes:**

Definition, Classification, Risk assessment, Transportation of hazardous waste, Current Management Practices: Environmental audit, Containment, Remedial alternatives.

**Text Books:**

1. Solid Waste Engineering, William A Worrell and P. Aarne Vesilind, Cengage Learning, 2<sup>nd</sup> Edition (SI Edition). (ISBN: 13-978-8131520420).
2. Integrated Solid Waste management, George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Tata McGraw Hill. (ISBN: 13-978-0070632370).

**Reference Books:**

1. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization (CPHEEO), India.
2. MSW Management Rules 2016, Govt. of India, available online at CPCB website
3. Construction and Demolition Waste Management Rules, 2016, MoEF&CC
4. Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website.

**Web Links:**

1. <https://nptel.ac.in/courses/105/105/105105160/>
2. <http://swachhbharatmission.gov.in/sbmcms/index.html>
3. <http://swachhbharaturban.gov.in/>

## Watershed Management

(EEE,ME,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

**Course Code: 2501CE83**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain the objectives and characteristics of watershed management.
- CO2:** Classify the types of soil erosion and control methods.
- CO3:** Explain different water harvesting techniques.
- CO4:** Organize the land and drought management techniques.
- CO5:** Create hydrological models

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    |      |      | 2    | 1    | 1    |      | 1    |      | 2     |       |
| CO2   | 1    |      |      | 1    | 1    | 1    |      |      |      |       |       |
| CO3   | 2    | 1    |      | 1    | 2    | 2    |      |      |      |       |       |
| CO4   | 2    | 1    | 1    | 2    | 1    | 2    |      | 1    |      | 2     |       |
| CO5   | 2    | 2    | 2    | 1    | 2    | 1    |      |      |      |       |       |

### UNIT – I

**Introduction:**

Introduction - Concept of watershed development – objectives of watershed development – need for watershed development - integrated and multidisciplinary approach for watershed management. Characteristics of Watershed: Size – shape – physiography – slope – climate – drainage – land use – vegetation – geology and soils – hydrology and hydrogeology – socio-economic characteristics – Application of artificial intelligence technology for identification of watershed characteristics.

### UNIT – II

**Principles of Erosion:** Types and causes of erosion – factors affecting erosion– estimation of soil loss due to erosion- Universal soil loss equation. Measures to Control Erosion: Contour techniques – ploughing – furrowing – trenching – bunding – terracing – gully control – check dams – rock-fill dams – brushwood dam – Gabion.

### UNIT – III

**Water Harvesting:** Techniques of rainwater harvesting – rainwater harvesting from rooftop – surface flow harvesting – subsurface flow harvesting – stop dams – farm ponds and dugout ponds – percolation tanks.

### UNIT – IV

**Land Management:** Land use and Land capability classification – management of forest – agricultural – grassland and wild land land grading operation –reclamation of saline and alkaline soils. Drought Management: Drought assessment and classification – drought analysis techniques – drought mitigation planning.

## **UNIT – V**

### **Beyond BIM - Emerging Trends**

**Watershed Modelling:** Data of watershed for modelling – application and comparison of watershed models – model calibration and validation – advances of watershed models.

#### **Text Books:**

1. Watershed Management, Das MM and M.D Saikia, PHI Learning Pvt. Ltd.(ISBN:13-978-8120346765).
2. Land and Water Management, Murthy.VVN, Kalyani Publications. (ISBN: 13-978-9327214659)

#### **Reference Books:**

1. Water Resource Engineering, Wurbs R A and James R A, Prentice Hall Publishers. (ISBN: 13-978-8120321519 ).
2. Watershed Hydrology, Black P E, Prentice Hall. (ISBN: 13-978-1575040271).
3. Watershed Management, Murthy J V S, New Age International Publishers. (ISBN:13-978-8122435184).

#### **Web Links:**

1. [https://www.ct.gov/deep/cwp/view.asp?a=2719&q=325622&depNav\\_GID=1654](https://www.ct.gov/deep/cwp/view.asp?a=2719&q=325622&depNav_GID=1654)
2. [http://agritech.tnau.ac.in/agriculture/agri\\_majorareas\\_watershed\\_watershedmgt.html](http://agritech.tnau.ac.in/agriculture/agri_majorareas_watershed_watershedmgt.html)
3. <https://yourstory.com/2017/11/watershed-management/>

## Electric Power Generation, Transmission & Distribution Systems

(CE,ME,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

**Course Code: 2501EE53**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Identify the different components of various power plants.
- CO2:** Analyze the performance of short, medium and long transmission lines.
- CO3:** Identify various factors related to sag and corona.
- CO4:** Distinguish between AC/ DC distribution systems and also estimate voltage drops of distribution systems.
- CO5:** Analyze the different economic factors of power generation and tariffs.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|------|-------|
| CO1   | 3    | 1    | -    | -    | -    | 2    | -    | -    | -    | -    | -     |
| CO2   | 2    | 3    | 1    | -    | -    | -    | -    | -    | -    | -    | -     |
| CO3   | 2    | 1    | 3    | -    | -    | 1    | -    | -    | -    | -    | -     |
| CO4   | 2    | 3    | 1    | -    | -    | 1    | -    | -    | -    | -    | -     |
| CO5   | 2    | 3    | 1    | -    | -    | -    | -    | -    | -    | -    | -     |

### UNIT – I

**Power Stations:** Principle of power generation, site selection and layout of Thermal, Nuclear, Hydro power plant, Components of Thermal and Nuclear power plant

### UNIT – II

**Performance of Transmission Lines:** Classification of Transmission Lines –Short, medium, long and their model representations –End condenser method, Nominal-T–Nominal-Pie, and A, B, C, D Constants, Surge Impedance and SIL of Long Lines.

### UNIT – III

**Corona and Sag:** Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss –Radio Interference. Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor

### UNIT – IV

**Distribution Systems:** Classification of distribution systems, design features of distribution systems, radial distribution, ring main distribution, voltage drop calculations: DC distributors for following cases - radial DC distributor fed at one end and at both ends (equal / unequal voltages), ring main distributor, stepped distributor and AC distribution, comparison of DC and AC distribution.

## UNIT – V

**Economic Aspects of Power Generation and Tariff Methods:** Types of load, Load curve, load duration and integrated load duration curves, Important terms and factors in Load Curve. Costs of Generation and their division into Fixed, Semi-fixed and Running Costs, Characteristics and types of Tariff.

### Text Books:

1. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U. S. Bhatnagar & A. Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd (ISBN: 978817700207).
2. Generation, Distribution & Utilization of Electric Energy by C. L. Wadhawa, Newage International (P) Limited, Publishers (ISBN: 9789393159175).

### Reference Books:

1. Principles of Power System by V. K. Mehta & Rohit Mehta, S Chand & Company Limited, Publishers (ISBN: 9788121924962).
2. Electrical Power Distribution Systems by V. Kamaraju, Tata McGraw Hill, New Delhi (ISBN: 978070151413).

### Web Links:

1. <https://www.slideshare.net/ntpc-project-korbasuper-themal-power-plant>
2. <https://www.euronuclear.org/1-information/energy-uses.html>
3. <https://www.slideshare.net/9anku/electrical-distribution-system>

**Electric Energy Storage Systems**  
(CE,ME,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Code:2501EE36**

**Course Outcomes:**

**At the end of the course, student will be able to:**

**CO1** Analyze the characteristics of electrical energy storage technologies.

**CO2** Analyze the needs for electrical energy storage.

**CO3** Analyze the needs for electrical energy storage.

**CO4** Understand the various types of electrical energy storage systems.

**CO5** Identify various real time applications of energy storage systems.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 3    | 1    | -    | -    | -    | -    | -    | -    | -     | -     |
| CO2   | 3    | 2    | 1    | -    | -    | -    | -    | -    | -    | -     | -     |
| CO3   | 2    | 1    | 3    | -    | -    | -    | -    | -    | -    | -     | -     |
| CO4   | 3    | 1    | 1    | -    | -    | -    | -    | -    | -    | -     | -     |
| CO5   | 3    | 2    | 2    | -    | -    | -    | -    | -    | -    | -     | -     |

**UNIT – I**

**Electrical Energy Storage (EES) Technologies:** Characteristics of electricity, Electricity & the roles of EES, High generation cost during peak-demand periods, Need for continuous & flexible supply, Long distance between generation & consumption, Congestion in power grids, Transmission by cable.

**UNIT – II**

**Needs for Electrical Energy Storage:** Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

**UNIT – III**

**Features of Energy Storage Systems:** Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H<sub>2</sub>), Synthetic natural gas (SNG).

**UNIT – IV**

**Types of Electrical Energy Storage systems:** Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

**UNIT – V**



**Applications:** Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management & control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems & distributed generation (Virtual Power Plant), Battery SCADA aggregation of many dispersed batteries.

**Text Books:**

1. Energy Storage Benefits & Market Analysis, by James M. Eyer, Joseph J. Iannucci & Garth P. Corey Sandia National Laboratories.
2. The Electrical Energy Storage by IEC Market Strategy Board.

**Reference Boks:**

1. Energy Storage for the Electricity Grid: Benefits & Market Potential Assessment Guide, Jim Eyer, Garth Corey, Sandia National Laboratories.
2. Energy Storage by Mullick & Garg (ISBN: 9789027719300)

**Web Links:**

1. <https://nptel.ac.in/courses/112/105/112105221/>
2. <https://nptel.ac.in/courses/112/107/112107283/>
3. <https://nptel.ac.in/content/storage2/courses/10810309>

## Electrical Safety

(CE,ME,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

**Course Code: 2501EE43**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

### Course Outcomes:

**At the end of the Course, Student will be able to:**

- CO 1:** Describe electrical hazards & safety equipment.
- CO 2:** Analyze & apply various grounding & bonding techniques
- CO 3:** Select appropriate safety method for low, medium equipment's & high voltage equipment.
- CO 4:** Participate in a safety team & Carry out proper maintenance of electrical equipment by understanding various standards.
- CO 5:** Analyze the safety method for high voltage equipment's.

### Mapping of course outcomes with program outcomes:

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1   | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    |
| CO2   | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    |
| CO3   | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    |
| CO4   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    |
| CO5   | 1   | 3   | 1   | -   | -   | -   | -   | -   | -   | -    | -    |

### UNIT-I:

**Hazards of Electricity & Electrical Safety Equipment:** Primary & secondary hazards- arc, blast, shocks causes & effects-safety equipment flash & thermal protection, head & eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers & signs, safety tags, locking devices-voltage measuring instruments- proximity & contact testers-safety electrical one line diagram-electrician's safety kit.

### UNIT-II:

**Grounding of Electrical Systems & Equipment:** General requirements for grounding & bonding-definitions grounding of electrical equipment-bonding of electrically conducting materials & other equipment connection of grounding & bonding equipment- system grounding- purpose of system grounding-grounding electrode system- grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage & high voltage systems.

**UNIT-III:**

**Safety Procedures & Methods:** The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation & approach distances-calculating the required level of arc protection-safety equipment, procedure for low, medium & high voltage systems- the one-minute safety audit

**UNIT-IV:**

**Safety Management & Organizing Structure:** Electrical safety program structure, development-company safety team- safety policy program implementation- employee electrical safety teams-safety meetings- safety audit accident prevention- first aid- rescue techniques-accident investigation.

**UNIT-V:**

**Electrical Maintenance & Legal Safety Requirements & Standards:** Safety related case for electrical maintenance- reliability centred maintenance (RCM) - eight step maintenance program-frequency of maintenance- maintenance requirement for specific equipment & location- regulatory bodies- national electrical safety code standard for electrical safety in work place- occupational safety & health administration standards, Indian Electricity Acts related to Electrical Safety

**Text Books:**

1. 'Electrical Safety Handbook' by John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, McGraw-Hill Education, 4<sup>th</sup> Edition (ISBN: 978071745130)
2. "Electric Safety Practice & Standards", Khaled Ismail, CRC Press, Taylor & Francis (ISBN: 9781138073999).

**Reference Books**

1. 'Electrical Safety- a guide to the causes & prevention of electric hazards', Maxwell Adams.J, The Institution of Electric Engineers, IET (ISBN: 9780852968062).
2. 'Electrical Safety in the Workplace', Ray A. Jones, Jane G. Jones, Jones & Bartlett Learning (ISBN: 9780877655800).

**Web Links:**

1. <http://nptel.ac.in/courses/103106071/5>
2. <https://www.electricalsafetyfirst.org.uk>

## Hybrid & Electric Vehicles

(CE,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

**Course Code:2501EE54**

|          |          |          |          |
|----------|----------|----------|----------|
| L        | T        | P        | C        |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### Course Outcomes:

**At the end of the Course, Student will be able to:**

- CO1:** Describe the History of Hybrid Electric vehicles  
**CO2:** Classify the various electric drivetrain topologies  
**CO3:** Articulate the Energy Storage Requirements in Hybrid & Electric Vehicles  
**CO4:** Illustrate the Charging Infrastructure  
**CO5:** Evaluate Energy Management Strategies used in hybrid & electric vehicle

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| <b>CO1</b> | 1   | -   | 1   | -   | -   | 1   | -   | -   | -   | -    | 1    |
| <b>CO2</b> | 1   | 1   | 1   | -   | 1   | 1   | -   | -   | -   | -    | 1    |
| <b>CO3</b> | 3   | 2   | 3   | 2   | 2   | 2   | -   | -   | -   | -    | 1    |
| <b>CO4</b> | 2   | 1   | 2   | 1   | 1   | 2   | -   | -   | -   | -    | 1    |
| <b>CO5</b> | 3   | 3   | 3   | 3   | 3   | 2   | -   | -   | -   | -    | 1    |

### UNIT – I

#### Introduction:

Introduction to Hybrid Electric Vehicles: History of hybrid & electric vehicles, social & environmental importance of hybrid & electric vehicles, impact of modern drive-trains on energy supplies-Challenges & Key Technologies of EVs – Challenges for EV Industry in India

### UNIT – II

#### Electric Drive-trains:

Basic concept of electric traction - introduction to various electric drivetrain topologies - Power flow control in electric drive-train topologies - fuel efficiency analysis

#### Electric Propulsion unit:

Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC Motor drives, configuration and control of Induction Motor drives, configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency

### UNIT – III

#### Energy Storage:

Introduction to Energy Storage Requirements in Hybrid & Electric Vehicles -Battery based energy storage & its analysis - Fuel Cell based energy storage & its analysis - Super Capacitor based energy storage- Flywheel based energy storage & its analysis.

## **UNIT – IV**

### **Sizing the drive system:**

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

## **UNIT – V**

### **Energy Management Strategies**

Introduction to Energy Management Strategies used in hybrid & electric vehicle, Classification of different Energy Management strategies - Comparison of different Energy Management Strategies - Implementation issues of energy strategies - Effect of charging infrastructure on grid protection & control.

### **Text Books:**

1. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley-Blackwell (ISBN: 9781119942733).
2. Energy Management Strategies for Electric & Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, Springer (ISBN: 9781493955237).

### **Reference Books:**

1. Electric Vehicle Battery Systems, Sandeep Dhameja, Elsevier (ISBN: 9780750699167).
2. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press (ISBN: 9781138072855).
3. Hybrid electric Vehicles Principles & applications with practical perspectives, Chris Mi, M. Abul Masrur, D. Wenzhong Gao, A Dearborn, John Wiley & Sons Ltd (ISBN: 9781118970560).

**Solar Energy Systems**  
(CE,EEE,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

**Course Code: 2501ME37**

**L      T      P      C**  
**3      0      0      3**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain the concept of solar radiation and its measurement
- CO2:** Describe the working principle of different types of collectors and its types
- CO3:** Explain the various solar thermal energy technologies and their applications
- CO4:** Analyze the various solar PV cell materials and conversion techniques.
- CO5:** Apply solar passive building techniques for cooling and heating applications.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 1    | -    | -    | -    | 3    | -    | -    | -    | -     | -     |
| <b>CO2</b> | 2    | 1    | -    | -    | -    | 3    | -    | -    | -    | -     | -     |
| <b>CO3</b> | 2    | 1    | -    | -    | -    | 3    | -    | -    | -    | -     | -     |
| <b>CO4</b> | 2    | 1    | -    | -    | -    | 3    | -    | -    | -    | -     | -     |
| <b>CO5</b> | 2    | 1    | -    | -    | -    | 3    | -    | -    | -    | -     | -     |

**UNIT – I**

**Solar Radiation and its measurement:** Solar angles, Sun path diagrams, Radiation, extra terrestrial characteristics, Solar energy measuring instruments: Pyranometer, Pyrheliometer, Sunshine recorder. Estimation of average solar radiation and estimation on horizontal and tilted surfaces

**UNIT – II**

**Solar Collectors for Industrial process heat: Flat plate collector,** Materials for flat plate collector and their properties, classification, evacuated tubular collectors, concentrator collectors, tracking systems, compound parabolic concentrators, parabolic trough concentrators, concentrators with point focus, Heliostats.

**UNIT – III**

**Solar Thermal Technologies:** Working principle, types, design, and operation, Solar heating and cooling systems, Thermal Energy storage systems, Solar Desalination, Solar cooker, Solar Pond, Solar drying, Solar chimney, Solar water disinfection (SODIS), Solar furnaces.

**UNIT – IV**

**Solar Cells:** Semiconductor materials, Doping, PN junction and characteristics, Photovoltaic effect, Photovoltaic material, Parameters of solar cells, Effects of cell temperature on cell efficiency, Types of solar cells, Solar modules and arrays, Solar cell power plant, Silicon, thin film and polymer processing, Silicon wafer based solar cells, Hybrid organic- inorganic solar cells.

**UNIT – V**

**Solar Passive Architecture:** Thermal comfort, bioclimatic classification. Passive heating concepts: direct heat gain, indirect heat gain, isolated gain and sunspaces  
Passive cooling concepts: evaporative cooling, Radiative cooling, shading - paints and cavity walls for cooling, roof radiation traps, thermal comfort.

**Text Books:**

1. Solar Energy-Principles of Thermal Collection and Storage, S P Sukhatme & J K Nayak, McGraw Hill Education, 3<sup>rd</sup> Edition, 2009, ISBN : 9780070142961.
2. Principles of Solar Engineering, D.Yogi Goswami, Frank Kreith and Jan F. Kreider Taylor and Francis, 2<sup>nd</sup> Edition, 2000, ISBN : 9781560327141.

**Reference Books:**

1. Solar Energy- Fundamentals, Design, Modelling and Applications, G.N.Tiwari, Narosa publishing house. 1<sup>st</sup> Edition, 2002, ISBN : 9780849325093.
2. Solar Energy and Non-conventional Energy Sources, Domkundwar, Dhanpat Rai & Co, (P) Ltd., 2<sup>nd</sup> Edition, ASIN : B0BQWR83GF

**Web Links:**

1. <https://archive.nptel.ac.in/courses/115/103/115103123/>
2. <https://www.nrel.gov/research/re-solar.html>

## Industry 5.0 for Engineers

(CE,EEE,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

**Course Code: 2501ME58**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Explain the basic concept of Industry 5.0.
- CO2:** Explain the concepts of Industrial IOT, IOS and Predictive Analytics
- CO3:** Explain the cyber physical systems and AI technologies
- CO4:** Analyse the applications of Industry 5.0 in various sectors
- CO5:** Analyse case studies on automation and healthcare services

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 1    | -    | -    | -    | -    | -    | -    | -    | -    | -     | -     |
| <b>CO2</b> | 1    | 1    | 1    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO3</b> | 1    | 1    | 1    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO4</b> | 1    | 3    | 1    | -    | 2    | -    | -    | -    | -    | -     | -     |
| <b>CO5</b> | 1    | 3    | 1    | -    | 2    | -    | -    | -    | -    | -     | -     |

### UNIT – I

**Introduction to Industry 5.0:** Introduction of Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 5.0, Comparison of Industry 5.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Automation and Transformation Processes.

### UNIT – II

**Importance of Internet of Things (IOTs):** Introduction to Internet of Things (IoT), Industrial Internet of Things (IIoT), Internet of Services, Fundamental of Predictive Analytics, Smart Logistics, Smart Devices and Products.

### UNIT – III

**Technology Evolution:** Basics of cyber Physical Systems, Process Automations and Collaborative robots, Fundamental to artificial Intelligence, Mobile Computing, Cyber Security, Ethical technology, Responsive and distributed supply chain system, Human-centric and Value-oriented approaches.



## **UNIT – IV**

**Technology Implementation and Case Studies:** 3D printing, Solar energy sector, Healthcare sector, Maintain records related to education, finance, clean bioenergy generation and Intelligent NextG Wireless Networks.

## **UNIT – V**

**Case studies on CNC/NC automation** - Benefits, challenges, and industry applications. In-house, Healthcare services-Examples of innovations improving patient care and operational efficiency.

### **Text Books:**

1. Uthayan Elangovan, Industry 5.0, “The Future of the Industrial Economy”, First Edition, Taylor & Francis, ISBN: 978-1-032-04127-8, 2022.
2. Alessandro Massaro, “Electronics in Advanced Research Industries: Industry 4.0 to Industry 5.0 Advances”, Wiley-IEEE Press, 2021, ISBN: 2021028944.

### **Reference Books:**

1. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 2016.
2. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
3. Hans Bernhard Kief, Helmut Roschiwal, Karsten Schwarz, “The CNC Handbook: Digital Manufacturing and Automation from CNC to Industry 4.0”, Industrial Press Inc., U.S. ISBN 0831136367, Nov 2021.
4. Janya Chanchaichujit, Albert Tan, Fanwen Meng, Sarayoot Eaimkhong, “Healthcare 4.0 Next Generation Processes with the Latest Technologies”, Palgrave Pivot, 2019, ISBN 978-981-13-8113-3.

### **Web Links:**

1. <http://www.mqtt.org/>
2. <https://opcfoundation.org/about/opc-technologies/opc-ua/>
3. <https://www.etherncat.org/default.htm>

## Organizational Behaviour

(CE,EEE,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

**Course Code: 2501ME73**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>P</b> | <b>T</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Explain the roles, approaches of organizational behaviour models.
- CO2:** Summarize the behaviour of individuals and groups in organizations in terms of organizational behaviour.
- CO3:** Illustrate various stress and emotional organizational behaviour concepts, models and theories to real life management situations.
- CO4:** Analyze the functions of organizational communication and culture for effective communication and managing cultural diversity
- CO5:** Organize different groups and teams in the organization for better results.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | -    | -    | -    | -    | -    | -    | 1    | 3    | 2    | -     | -     |
| CO2   | -    | -    | -    | -    | -    | -    | 1    | 3    | 2    | -     | -     |
| CO3   | -    | -    | -    | -    | -    | -    | 1    | 2    | 3    | -     | -     |
| CO4   | -    | -    | -    | -    | -    | -    | 1    | 2    | 3    | -     | -     |
| CO5   | -    | -    | -    | -    | -    | -    | 1    | 3    | 2    | -     | -     |

### UNIT – I

**Organizational Behaviour:** Concept of Organizational Behaviour (OB)- Importance of Organizational Behaviour- Key Elements of Organizational Behaviour, Role of Managers in OB- Interpersonal Roles-Informational Roles- Decisional Roles, Approaches to Organizational Behaviour

### UNIT – II

**Interpersonal Behaviour:** Nature and meaning of Interpersonal Behaviour, Concept of Self, Transaction Analysis (TA), Benefits and uses of Transactional Analysis, Johari Window Model  
**Personality:** Definition and Meaning of Personality - Importance of Personality, Determinants of Personality, Theories of Personality, Personality Traits Influencing OB.

### UNIT – III

**Emotions:** Nature and Meaning of Emotions - Characteristics of Emotions, Theories of Emotions, Emotions in the Context of OB. **Organizational Stress:** Definition and Meaning, Sources of Stress, Types of Stress, Impact of Stress on Organizations, Stress Management Techniques.

### UNIT – IV

**Organizational Communication:** Meaning and Importance of Communication, Functions, process, types, Interpersonal Communication, Organizational Communication, Tips for Effective Communication.

**Organization Culture:** Meaning and Nature of Organization Culture – Origin of Organization Culture, Functions of Organization Culture, Types of Culture, Creating and Maintaining Organization Culture, Managing Cultural Diversity

## **UNIT – V**

**Groups and Teams:** Meaning and Importance of Groups, Reasons for Group Formation, Types of Groups, Stages of Group Development, Meaning and Importance of Teams, Types of Teams, Creating an Effective Team.

### **Text Books:**

1. Organizational Behaviour, K. Ashwathappa, Himalaya Publishing House, ISBN-13. 978-8184889390.
2. Management and Organizational Behaviour - (Text and Cases), Dr.P.Subba Rao and Prof. N.Sambasiva Rao, Himalaya Publishing House, Mumbai, ISBN: 978-93-5025-951-2.

### **Reference Books:**

1. Understanding Organisational Behaviour, Udai Pareek, Oxford Higher Education, 2nd Edition, ISBN-13: 978-0195690866
2. Mc Shane & Von Glinov, Organisational Behaviour, Tata McGraw Hill, 4th Edition, ISBN-13, 978-1259927676.

### **Web Links:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_mg51/preview](https://onlinecourses.nptel.ac.in/noc20_mg51/preview)
2. <https://www.udemy.com/course/organisational-behaviour/>

**Sustainable Energy Systems**  
(CE,EEE,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

**Course Code: 2501ME36**

**L      T      P      C**  
**3      0      0      3**

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Demonstrate the various components of solar thermal energy systems.
- CO2:** Describe the working of Wind turbines.
- CO3:** Explain the principle and working of Biomass and Geothermal Energy systems
- CO4:** Explain the Ocean, Tidal, Wave and hydro energy conversion systems.
- CO5:** Illustrate working of hybrid energy systems.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | -    | -    | -    | -    | 3    | -    | -    | -    | -     | -     |
| <b>CO2</b> | 2    | -    | -    | -    | -    | 3    | -    | -    | -    | -     | -     |
| <b>CO3</b> | 2    | -    | -    | -    | -    | 3    | -    | -    | -    | -     | -     |
| <b>CO4</b> | 2    | -    | -    | -    | -    | 3    | -    | -    | -    | -     | -     |
| <b>CO5</b> | 2    | -    | -    | -    | -    | 3    | -    | -    | -    | -     | -     |

**UNIT – I**

**Introduction to Renewable energy sources:** Energy demand and availability, energy crisis, renewable and non-renewable energy resources, environmental impact of conventional energy usage.

**Solar Energy:** Overview of the fundamental physics of solar radiation. Solar energy collectors.

**Solar energy storage:** Stratified storage, well mixed storage, comparison, Hot water system, solar ponds, non-convective solar pond, extraction of thermal energy and application of solar ponds. Solar PV systems and its applications. Solar cell, module, and array.

**UNIT – II**

**Wind Energy:** Wind data and energy estimation – Betz limit - Site selection for windfarms. Horizontal and vertical axis wind mills, Wind farms- offshore, Onshore, various methods of control, and Environmental issues – Applications.

**UNIT – III**

**Biomass:** Bio-resources, Conversion process, Biomass gasifier - Types of biomass gasifiers, Biodiesel production – Ethanol production -Applications.

**Geothermal Energy:** Origin and types of geothermal energy and utilisation, Power generation from Geothermal energy, Environmental impact.

**UNIT – IV**

**Ocean, Wave & Tidal Energy:** Introduction - Resource Assessment - Power generation through OTEC systems. Wave and Tidal energy- Working principle, Availability, and energy conversion systems.

**Mini & Micro Hydropower:** Introduction, Power from water, System components of Mini and Micro Hydropower, Micro Hydropower plant in India, Potential Hydropower plant projects identified in India.

## **UNIT – V**

**Hybrid Energy Systems:** Systems for processes and power applications – solar – wind – Biomass hybrid technologies

**Fuel cell:** Working principle- types - construction and applications. Solar – Fuel cell hybrid systems.

### **Text Books:**

1. Renewable Energy: Power for a Sustainable Future, Boyle, G, Oxford University Press, 3<sup>rd</sup> Edition, 2012, ISBN : 9780199681273.
2. Non-Conventional Energy Sources, G.D.Rai, Khanna Publishers, 6<sup>th</sup> edition, ISBN : 9788174090737.

### **Reference Books:**

1. Renewable Energy Resources, John Twidell, Tony Weir, and Anthony D. Weir, Taylor & Francis, 3<sup>rd</sup> edition, 2015, ISBN : 9780415584388.
2. Non-Conventional Energy Resources, B H Khan, TMH Publishers, 3<sup>rd</sup> Edition, 2017, ISBN : 9789352601882.

### **Web Links:**

1. [https://onlinecourses.nptel.ac.in/noc22\\_ch27/preview](https://onlinecourses.nptel.ac.in/noc22_ch27/preview)
2. <https://www.energy.gov/eere/renewable-energy>

**Biomedical Electronics**  
(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

**Course Code: 2501EC97**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Course Outcomes: At the end of the course, students will be able to:**

- CO1:** Understand the basic medical instrumentation system and bioelectric potentials.
- CO2:** Illustrate different types of electrodes to acquire bio-signals.
- CO3:** Demonstrate clinical laboratory measurements and assistive devices.
- CO4:** Discuss the latest developments in medical imaging systems.
- CO5:** Outline patient care and safety while using biomedical equipment.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    |      |      | 1    |      |      |      |      |       |       |
| <b>CO2</b> | 3    | 3    | 1    | 2    | 2    |      |      |      |      |       |       |
| <b>CO3</b> | 3    | 3    | 2    | 2    | 2    |      |      |      |      |       |       |
| <b>CO4</b> | 3    | 2    | 2    | 2    | 3    |      |      |      |      |       |       |
| <b>CO5</b> | 3    | 3    | 1    | 2    | 2    |      |      |      |      |       |       |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 2    |      |

## **UNIT – I**

### **Components of Medical Instrumentation Systems**

Basic Medical Instrumentation System, Static and dynamic characteristics of medical instruments, Bio-signals and characteristics. Problems encountered with measurements from human beings. Sources of Bioelectric Potentials, Resting and Action Potentials.

## **UNIT – II**

### **Bio-Potential Electrodes and Physiological Transducers:**

Electrode potential and its equivalent circuit, Types of Electrodes: Surface Electrodes, Needle Electrodes, Micro Electrodes. Biochemical Transducers.

### **Bio-Signal Acquisition:**

Electrical Conduction system of the heart, Electrocardiogram, ECG leads, Einthoven triangle, Plethysmography, EEG 10-20 lead system and EMG. basics of biomedical signal acquisition, common signal artifacts and simple noise reduction techniques.

### UNIT – III

#### **Clinical laboratory Measurements:**

Blood cell Counter, Blood flow meters- Electromagnetic blood flow meter, Ultrasonic Doppler blood flow meter, automated blood pressure measurements.

#### **Physiological Assist Devices & Therapeutic Equipment:**

Pacemakers - External & internal, Defibrillators- External & internal, Hemodialysis machine.

### UNIT – IV

#### **Monitory and Imaging Equipment:**

Spirometry, Ventilators, Arrhythmia Monitor, Foetal Monitor and Incubator. X-ray machine, Computed Tomography (CT), Magnetic Resonance Imaging System, Ultrasound Imaging system.

### UNIT – V

#### **Patient Care and Safety:**

The elements of Intensive Care Monitor, Diagnosis, Calibration and reparability of Patient Monitoring equipment, Shock Hazards and Prevention, Physiological Effects and Electrical Current, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, and Isolated Power Distribution System.

#### **Text Books:**

1. Leslie Cromwell, F.J. Weibell, E.A. Pfeiffer, *Biomedical Instrumentation and Measurements*. 2nd Edition, PHI, 2004.
2. Dr. M. Arumugam, *Biomedical Instrumentation*. 2nd Edition, Anuradha publications, 2002.

#### **Reference Books:**

1. R.S. Khandpur, *Hand-book of Biomedical Instrumentation*. 2nd Edition, TMH, 2003.
2. John G. Webster, *Medical Instrumentation, Application and Design*. John Wiley, 3rd Edition, 2009.
3. Onkar N. Pandey, Rakesh Kumar, *Bio-Medical Electronics and Instrumentation*. 3rd Edition, Katson Books, 2002.

#### **Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/e-learning/preview/noc25\\_bt49](https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_bt49).
- 2 [https://www.youtube.com/watch?v=Qq3t01LytkU&list=PLnsf\\_0i\\_t0FC4EdRdhLwjQgp5cYytJ5Oe](https://www.youtube.com/watch?v=Qq3t01LytkU&list=PLnsf_0i_t0FC4EdRdhLwjQgp5cYytJ5Oe).

**Fundamentals of Wireless Communications**  
(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

**Course Code:2501EC98**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Course Outcomes:**

**At the end of the course, student will be able to:**

- CO1:** Explain the fundamentals of wireless communication systems, spectrum allocation, and wireless standards.
- CO2:** Understand Analog ,digital and multicarrier OFDM modulation techinques.
- CO3:** Compare multiple access techniques used in wireless communication systems.
- CO4:** Explain the architecture and standards of WPAN, WLAN, and WMAN technologies.
- CO5:** Compare cellular generations and LTE network architecture for modern mobile communications.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 2    |      |      |      |      |      |      |      |       | 1     |
| <b>CO2</b> | 3    | 3    | 2    | 1    | 1    |      |      |      |      |       | 2     |
| <b>CO3</b> | 3    | 3    | 2    |      |      |      |      |      |      |       | 1     |
| <b>CO4</b> | 3    | 2    | 1    | 1    | 1    |      |      |      |      |       | 1     |
| <b>CO5</b> | 3    | 3    | 2    | 2    | 1    |      |      |      |      |       | 2     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

**UNIT – I**

**Overview of Wireless Communication:**

History of wireless communication, Current Wireless Systems: Cellular Telephone Systems, Generations, Cordless Phones, Wireless LANs, Wide Area Wireless Data Services, Broadband Wireless Access, Paging systems, Satellite Networks, Bluetooth, ZigBee, Ultra-wideband Radios. The Wireless Spectrum: Methods for Spectrum Allocation, Spectrum Allocations for Existing Systems, Standards.

**UNIT – II**

**Modulation for Wireless Communication:**

Need for Modulation, Analog Modulation, Amplitude modulation, Double sideband Supressed carrier, single sideband supressed carrier, Angle modulation, Digital modulation: Amplitude Shift Keying, Frequency Shift Keying Techniques, Phase-Shift Keying Techniques,BPSK and QPSK. Multicarrier-Modulation, Orthogonal Frequency Division Multiplexing.



### **UNIT – III**

#### **Multiple Access Techniques:**

Contention-free multiple access schemes, Frequency-Division Multiple Access (FDMA), Time-Division Multiple Access (TDMA), Code-Division Multiple Access (CDMA), Space-division, contention-based multiple access schemes (ALOHA and CSMA).

### **UNIT – IV**

#### **Wireless Personal Area Networks:**

Bluetooth, UWB and ZigBee, wireless local area networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), wireless metropolitan area networks (WiMAX).

### **UNIT – V**

#### **Wireless Mobile Networks and Applications:**

Principles of Cellular Networks, First- Generation Analog, Second- Generation TDMA, CDMA, Third- Generation Systems, Fourth Generation Systems, LTE Architecture, Evolved Packet Core, LTE Resource Management.

#### **Text Books:**

1. Wireless communications- Goldsmith Andrea, Cambridge university press, 2005, ISBN: 9780511841224.
2. Wireless communication networks and systems-Cory Beard, and William Stallings, Pearson education (Global Edition), 2015, ISBN: 978-1292108728

#### **Reference Books:**

1. Wireless Communication the Fundamental and Advanced Concepts-Sanjay Kumar River Publishers, Denmark, 2015 ISBN: 9781000795325
2. Wireless communications: Principles and Practice, 2nd Edition, Theodore S. Rappaport, Pearson education, 2010.
3. Fundamentals of wireless communication.- Tse, David, and Pramod Viswanath. Cambridge university press, 2005.

#### **Web Links:**

1. <https://nptel.ac.in/courses/106106167> by Prof. David Koilpillai, IIT Madras
2. <https://nptel.ac.in/courses/117104115> by Aditya K. Jagannatham, IIT Kanpur

## Principles Of Embedded Systems

(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

**Course Code: 2501EC99**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Course Outcomes: At the end of the Course, Students will be able to:**

- CO1:** Summarize the building blocks of an embedded system.
- CO2:** Interpret the hardware modules required to design an embedded system.
- CO3:** Infer the firmware design approaches for an embedded system.
- CO4:** Illustrate the hardware integration with firmware.
- CO5:** Outline the process of embedded system development and choose the tools for embedded system implementation and testing.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| <b>CO1</b> | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    |
| <b>CO2</b> | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    |
| <b>CO3</b> | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    |
| <b>CO4</b> | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    |
| <b>CO5</b> | 2   | 3   | 1   | -   | -   | -   | -   | -   | -   | -    | -    |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      |      |
| <b>CO2</b> |      |      |
| <b>CO3</b> |      |      |
| <b>CO4</b> |      |      |
| <b>CO5</b> |      |      |

### UNIT – I

Introduction: Embedded system-Definition, History of Embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system, core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

### UNIT – II

Embedded Hardware Design: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, multi processors architectures.

### **UNIT – III**

Embedded Firmware Design: Embedded Firmware design approaches, Embedded Firmware development languages, Interrupt sources, ISR concept, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C.

### **UNIT – IV**

RealTime Operating System: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization.

Hardware Software Co-Design:

Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware.

### **UNIT – V**

Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Deassembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools. Embedded System Implementation and Testing: The main software utility tool, CAD and the hardware, Translation tools-Pre-processors, Interpreters, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine.

#### **Text Books:**

1. Introduction to Embedded Systems, Shibu.K.V, Tata McGraw Hill Education Private Limited, 2nd Edition, 2016.
2. Embedded Systems – SoC, IoT, AI and Real-Time Systems, Raj Kamal, McGraw Hill Education India 4th Edition, 2020.

#### **Reference Books:**

1. Embedded System Design, Frank Vahid and Tony Givargis, John Wiley Publications, 2013.
2. Hardware Software Co-Design Principles and Practice, J.Staunstrup, Springer Publications, 2013
3. Embedded Systems Architecture, Tammy Noergaard, Elsevier Publications, 3rd Edition, 2013.

#### **Web Links:**

1. <https://www.coursera.org/learn/introduction-embedded-systems>
2. <https://www.linkedin.com/learning/introduction-to-embedded-systems-with-rust>
3. <https://www.udemy.com/course/embedded-systems-and-microcontrollers/>

**Electronics For Health Care**  
(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

**Course Code: 2501ECA0**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**At the end of the course, student will be able to:**

- CO1:** Know about health care data and its conversion to information and to knowledge.  
**CO2:** Acquire knowledge on (Electronic Health Records) EHRs and their Implementation.  
**CO3:** Understand the working of electronic devices used for the patient monitoring.  
**CO4:** Know the concepts of Telemedicine and therapeutic devices used inside the human body.  
**CO5:** Understand and analyse the working principles, design, and clinical applications of therapeutic devices.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    | -    | 1    | -    | -    | -    | -    | 1    | -     | 1     |
| <b>CO2</b> | 1    | 1    | -    | 1    | -    | -    | -    | -    | 1    | -     | 1     |
| <b>CO3</b> | 1    | 1    | -    | 1    | -    | -    | -    | -    | 1    | -     | 1     |
| <b>CO4</b> | 1    | 1    | -    | 1    | -    | -    | -    | -    | 1    | -     | 1     |
| <b>CO5</b> | 1    | 1    | -    | 1    | -    | -    | -    | -    | 1    | -     | 1     |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 2    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

**UNIT-I:**

Health care data, Information and Knowledge: Definitions and Concepts, Converting Data to Information to Knowledge, Clinical Data Warehouses, what makes Health Informatics Difficult, Why Health IT fails Sometimes, Terminology of Analytics, Challenges to Data Analytics, Research and application of analytics, Role of Informatics in analytics.

**UNIT-II:**

Electronic Health Records: Introduction, Need for Electronic Health Records, Institute of Medicine's Vision for EHRs, Electronic Health Record Key Component, Electronic Prescribing, Electronic Health Record Adoption, Electronic Health Record Adoption and Meaningful use Challenges, Electronic Health Record Examples, Logical Steps to Selecting and Implementing an HER.

**UNIT-III:**

Patient Monitoring Systems: System Concepts, Cardiac Monitor, Bedside Patient Monitoring Systems, Central Monitors, Measurement of Heart Rate, Measurement of Pulse Rate, Blood Pressure Measurement, Measurement of Temperature, Measurement of Respiration Rate, Catheterization Laboratory Instrumentation.

**UNIT-IV:**

Biomedical Telemetry and Telemedicine: Wireless Telemetry, Single Channel Telemetry Systems, Multi-channel Wireless Telemetry Systems, Multi-patient Telemetry, Implantable Telemetry Systems, Transmission of Analog Physiological Signals, Over Telephone, Telemedicine.

**UNIT-V:**

Therapeutic Devices: Need for Cardiac Pacemaker, Implantable Pacemakers, DC Defibrillator, Electronics in the Anaesthetic Machine.

**Text Books:**

1. Robret E. Hoyt MD FACP “Health Informatics” sixth edition 2007.
2. R. S. Kandpur “Biomedical Instrumentation Technology and Applications” second edition Tata McGraw-Hill.

**Reference Books:**

1. Edward H. Shortliffe, James J. Cimino “Biomedical Informatics, Computer applications in Health care and Biomedicine” third edition Springer.
2. G.V.R.K. Acharyulu, Bhimaraya Metri, L. Kalyan Viswanath REDDY “Health care and Hospital Management Contemporary Issues and Strategies”.

**Web Links:**

1. [https://onlinecourses.nptel.ac.in/e-learning/preview/noc26\\_ge25](https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge25).
2. [https://onlinecourses.nptel.ac.in/e-learning/preview/noc26\\_hs82](https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_hs82).
3. [https://onlinecourses.nptel.ac.in/e-learning/preview/noc26\\_bt09](https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_bt09).

## Basics of VLSI Design

(CE,EEE,ME,CSE,IT,DS,AIIML,PT,Min.E, Ag.E)

**Course Code: 2501ECA1**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**Course Outcomes: At the end of the Course, Students will be able to:**

- CO1:** Outline the fundamental concepts related to MOS and Bi-CMOS Circuits fabrication.
- CO2:** Analyze the electrical properties of MOS and Bi-CMOS Circuits.
- CO3:** Make use of design rules for developing stick and layout diagrams.
- CO4:** Interpret the issues related to subsystem design.
- CO5:** Interpret FPGA and ASIC design approaches for semi-custom design.

**Mapping of Course Outcomes with Program Outcomes:**

| CO/PO      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| <b>CO1</b> | 3   | 2   | 2   |     |     |     |     |     |     |      | 1    |
| <b>CO2</b> | 2   | 3   | 2   |     |     |     |     |     |     |      | 1    |
| <b>CO3</b> | 2   | 1   | 3   |     |     |     |     |     |     |      | 1    |
| <b>CO4</b> | 2   | 2   | 1   |     |     |     |     |     |     |      | 1    |
| <b>CO5</b> | 3   | 2   | 1   |     |     |     |     |     |     |      | 1    |

**Mapping of Course Outcomes with Program Specific Outcomes:**

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      |      |
| <b>CO2</b> |      |      |
| <b>CO3</b> |      |      |
| <b>CO4</b> |      |      |
| <b>CO5</b> |      |      |

### UNIT – I

**Introduction:** Introduction to IC Technology, MOS and related VLSI Technology, Basic MOS Transistors, Enhancement and Depletion modes of transistor action, IC production process, MOS and CMOS Fabrication processes, Bi-CMOS Technology, Comparison between CMOS and Bipolar technologies.

### UNIT – II

**Basic Electrical Properties of MOS and Bi-CMOS Circuits:**  $I_{ds}$  versus  $V_{ds}$  Relationships, Threshold Voltage, MOS transistor Trans-conductance, Output Conductance and Figure of Merit, The Pass transistor, NMOS Inverter, Alternative forms of the pull-up, The CMOS Inverter, Bi- CMOS Inverter, Transistor switches, Schematics of Inverter, NAND, NOR gates using NMOS, PMOS, and CMOS technologies.

### UNIT – III

**MOS Circuit Design Processes:** MOS Layers, Design Rules, General observations of design rules, 2 $\mu$ m Double Metal, Double Poly, CMOS rules, 1.2 $\mu$ m Double Metal, Double Poly CMOS rules, Stick Diagrams, Layout Diagrams of NAND and NOR gates and CMOS inverter.

### UNIT – IV

**Basic Circuit Concepts:** Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitances.

### UNIT – V

**IC Design:** PLAs, PLDs, FPGA, ASIC, Selection of an Appropriate Integrated Circuit.

**FPGA Design Process:** Architectures of Popular FPGAs, Choosing an FPGA, FPGA Design Process, FPGA Families of Different Vendors, FPGA Design Examples.

#### Text Books:

1. Essentials of VLSI Circuits and Systems by Kamran Eshraghian, Douglas and A. Pucknell, Sholeh Eshraghian, Prentice-Hall of India Private Limited, ISBN: 978-8120327726
2. VLSI Design, Black Book by Dr. K.V.K.K. Prasad, Kattula Shyamala, Kogent Learning Solutions Inc, ISBN: 978-9350048047

#### Reference Books:

1. **CMOS Digital Integrated Circuits Analysis & Design, Sung-Mo (Steve) Kang, Yusuf Leblebici, Tata McGraw-Hill, 3rd Edition, ISBN: 978-0072460537**
2. **Modern VLSI Design-Wolf Wayne, Pearson Edition, 3rd Edition, ISBN: 978-0130619709**
3. VLSI Design, K. LalKishore, V.S.V.Prabhakar, I.K. International Publishing House Private Limited, 1st Edition, ISBN: 978-9380026671

#### Web Links:

1. **NPTEL – VLSI Physical Design-** <https://nptel.ac.in/courses/106105161>
2. **NPTEL – Advanced VLSI Design** <https://nptel.ac.in/courses/117/101/117101004>.

## System on Chip Design

(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

|                              |          |          |          |          |
|------------------------------|----------|----------|----------|----------|
|                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>Course Code: 2501ECA2</b> | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course student will be able to:**

- CO1:** Explain all the building blocks of SoC.
- CO2:** Classify the concept of processors and instruction handling.
- CO3:** Analyze vector, VLIW and superscalar processors.
- CO4:** Develop a Memory as part of SoC.
- CO5:** Illustrate the concepts of interconnect optimization and configuration in SoC.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 1    | -    | -    | -    | -    | -    | -    | -    | -     | 1     |
| <b>CO2</b> | 3    | 2    | -    | -    | -    | -    | -    | -    | -    | -     | 1     |
| <b>CO3</b> | 2    | 2    | 1    | -    | -    | -    | -    | -    | -    | -     | 1     |
| <b>CO4</b> | 2    | 2    | 2    | -    | -    | -    | -    | -    | -    | -     | 1     |
| <b>CO5</b> | 2    | 2    | 1    | -    | -    | -    | -    | -    | -    | -     | 1     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | -    | 2    |
| <b>CO2</b> | -    | 2    |
| <b>CO3</b> | -    | 2    |
| <b>CO4</b> | -    | 2    |
| <b>CO5</b> | -    | 2    |

## UNIT – I

### Introduction to the System Approach:

System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

## UNIT – II

### Processors:

Introduction , Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers:minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.



### **UNIT – III**

#### **Memory Design for SOC:**

Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.

### **UNIT – IV**

#### **Interconnect Customization:**

Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor.

### **UNIT – V**

#### **Interconnect Configuration:**

Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism.

#### **Text Books:**

1. Computer System Design System-on-Chip, Michael J. Flynn and Wayne Luk, Wiley India Pvt. Ltd, ISBN: 978-0470643365.
2. ARM System on Chip Architecture, Steve Furber, Addison Wesley Professional, 2<sup>nd</sup> Edition, ISBN : 9780201675191 .

#### **Reference Books:**

1. Design of System on a Chip: Devices and Components, Ricardo Reis, Springer 1<sup>st</sup> Edition, ISBN: 978-1441954541.
2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology), Jason Andrews, Newnes, BK and CDROM, ISBN: 978-0750677301.
3. System on Chip Verification–Methodologies and Techniques, Prakash Rashinkar, Peter Paterson and Leena Singh L, Kluwer Academic Publishers, ISBN: 978-0792372790.

#### **Web Links:**

1. <https://www.peterindia.net/System-On-ChipLinks.html>
2. <https://www.ieee-socc.org/>
3. <http://nptel.ac.in/courses/108102045/10> (Prof. Santanu Chaudhary, IIT Delhi)

## Introduction to Quantum Computing

(CE,EEE,ME,CSE,IT,DS,AIIML,PT,Min.E, Ag.E)

**Course Code: 2501ECA3**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

**CO1:** Understand the fundamentals of quantum computing and qubits.

**CO2:** Build simple quantum circuits.

**CO3:** Analyze quantum circuits and algorithms.

**CO4:** Identify different quantum hardware technologies and their challenges.

**CO5:** Outline real time applications of quantum computing in various fields

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    |      |      |      |      | 2    |      |      |      |       |       |
| <b>CO2</b> | 2    | 2    |      |      | 3    |      | 2    | 1    |      | 1     | 2     |
| <b>CO3</b> | 2    |      | 1    |      |      | 2    | 2    | 1    |      | 2     | 2     |
| <b>CO4</b> | 2    | 2    | 3    |      |      | 2    | 2    | 2    |      | 2     |       |
| <b>CO5</b> | 3    | 3    | 3    | 2    |      | 2    | 2    | 3    |      | 2     |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 2    |      |
| <b>CO2</b> | 2    |      |
| <b>CO3</b> | 2    |      |
| <b>CO4</b> | 2    |      |
| <b>CO5</b> | 2    |      |

## UNIT – I

### Fundamentals of Quantum Computing:

Evolution from Classical Computing to Quantum Computing, Need for Quantum Computing, Classical Bits vs Qubits, Principles of Quantum Mechanics for Computing, Superposition and Measurement, Quantum States and Bloch Sphere Representation, Introduction to Quantum Gates, Quantum Computing Platforms and Ecosystem.

## UNIT – II

### Quantum Circuits and Computing Concepts:

Quantum Circuit Model, Single Qubit and Multi-Qubit Systems, Common Quantum Gates: Pauli, Hadamard, Phase, CNOT, Quantum Entanglement, Quantum Parallelism, Quantum Teleportation (Conceptual Understanding), Basic Quantum Circuit Design, Introduction to Quantum Simulators.

### **UNIT – III**

#### **Quantum Algorithms:**

Introduction to Quantum Algorithms, Deutsch–Jozsa Algorithm, Grover’s Search Algorithm, Shor’s Factorization Algorithm (Overview), Quantum Fourier Transform (Basic Idea), Quantum Speedup and Computational Advantage, Hybrid Quantum-Classical Computing, Introduction to Quantum Machine Learning.

### **UNIT – IV**

#### **Quantum Hardware and Programming:**

Overview of Quantum Hardware Technologies: Superconducting Qubits, Trapped Ion Systems, Photonic Quantum Computing. Noise and Decoherence, Quantum Error Correction (Basic Concepts), Introduction to NISQ Devices, Basics of Quantum Programming using Python and Qiskit, Introduction to IBM Quantum Experience.

### **UNIT – V**

#### **Applications of Quantum Computing:**

Quantum Cryptography and Cybersecurity, Quantum Computing in Healthcare and Drug Discovery, Optimization Problems and Smart Systems, Quantum in Finance & Logistics, Quantum computing for Industrial Applications and Future Scope, Ethical and Societal Impact of Quantum Technologies.

#### **Text Books:**

1. Quantum Computation and Quantum Information – Michael A. Nielsen & Isaac L. Chuang.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, First Edition, 2011.

#### **Reference Books:**

1. Eric R. Johnston, Nic Harrigan, and Mercedes Gimeno-Segovia, Programming Quantum Computers: Essential Algorithms and Code Samples, O'Reilly Media, First Edition, 2019.

#### **Web Links:**

1. [https://quantum.cloud.ibm.com/?utm\\_source=chatgpt.com](https://quantum.cloud.ibm.com/?utm_source=chatgpt.com)
2. <https://quantum.cloud.ibm.com/docs/en/guides>

## Data Structures

(CE, ME, PT, Min.E.)

**Course Code:** 2501CS03

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Utilize structure, union to handle heterogeneous data.
- CO2:** Illustrate Time and Space complexities for different sorting Algorithms
- CO3:** Demonstrate various operations on Linked Lists
- CO4:** Explain different operations on Stack and Queue with applications.
- CO5:** Demonstrate the importance and various operation on non-linear data structures

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 1    | 1    | 2    |      |      |      |      | 1    | 1    |       |       |
| CO2   | 1    | 1    | 2    | 2    |      |      |      | 1    | 1    |       |       |
| CO3   | 1    | 2    | 2    | 1    |      |      |      | 1    | 1    |       |       |
| CO4   | 1    | 1    | 2    | 1    |      |      |      | 1    | 1    |       |       |
| CO5   | 1    | 1    | 2    | 2    |      |      |      | 1    | 1    |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 3    | -    |
| CO2    | 2    | -    |
| CO3    | 2    | -    |
| CO4    | 2    | -    |
| CO5    | 2    | -    |

### UNIT – I

**Structures and Unions:** Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type - enum variables, Using Typedef keyword, Bit Fields.

**Data Structures:** Introduction to Data Structures, Types of Data Structures.

#### Practice:

7. Write a C program to find the total, average of n students using structures
8. Copy one structure variable to another structure of the same type.
9. Read student name and marks from the command line and display the student details along with the total.

### UNIT – II

**Introduction to Linear Data Structures:** Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Overview of time and space complexity analysis for linear data structures.

Sorting Techniques: Quick sort, Merge sort, Radix sort

#### Practice:

5. Implement Merge sort using arrays.  
<https://www.hackerrank.com/contests/hw1/challenges/merge-sort>
6. Implement Quick sort using arrays

<https://www.hackerrank.com/challenges/quicksort1/problem>

7. Implement Radix Sort using arrays

[https://www.hackerrank.com/contests/hw1/challenges/radix-sort?utm\\_source](https://www.hackerrank.com/contests/hw1/challenges/radix-sort?utm_source)

### UNIT – III

**Linked Lists:** Singly linked lists: representation and operations, doubly linked lists and its operations and circular linked lists and its operations, Comparing arrays and linked lists, Applications of linked lists.

**Practice:**

4. Single Linked List: Perform different operations in single linked list.  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
5. Perform different operations in double linked list  
[https://leetcode.com/problems/design-linked-list/?utm\\_source](https://leetcode.com/problems/design-linked-list/?utm_source)
6. Circular Linked List  
[https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm\\_source](https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source)

### UNIT – IV

**Stacks:** Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, applications of stacks.

**Queues:** Introduction to queues: properties and operations, Types of Queues, implementing queues using arrays and linked lists, applications of queues.

**Practice:**

5. Stack and its operations using arrays and Linked List  
<https://www.hackerrank.com/challenges/balanced-brackets/problem>  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
6. Implement a program to evaluate a postfix expression.  
<https://leetcode.com/problems/evaluate-reverse-polish-notation/description/>
7. Queue and its operations using arrays and Linked List  
<https://leetcode.com/problems/implement-queue-using-stacks/description/>  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
8. Implement Circular Queue using Arrays  
<https://leetcode.com/problems/design-circular-queue/description/>

### UNIT – V

**Non-linear Data Structures:**

**Trees:** Definition of tree, Tree Terminology, types of trees, Binary tree traversals, Binary Search Tree – Insertion, Deletion.

**Graphs:** Definition and Terminology – Representation of Graphs-Adjacency Matrix and Linked list, Graph Traversals (BFT & DFT)

**Practice:**

7. Implement Binary search tree (BST).  
<https://leetcode.com/problems/insert-into-a-binary-search-tree/description/>  
<https://leetcode.com/problems/delete-node-in-a-bst/description/>
8. Implement Binary search Tree (BST) Traversals.  
<https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>  
<https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>  
<https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>
9. Graph Traversal using Breadth First Search (BFS)  
<https://www.hackerrank.com/challenges/bfsshortreach/problem>

#### 10. Graph Traversal using Depth First Search (DFS)

<https://leetcode.com/problems/number-of-islands/description/>

#### Text Books:

4. Data Structures using C, Rema Theraja, Oxford University Press, 3rd Edition. ISBN: 978-9354979453
5. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

#### Reference Books:

6. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
7. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, ISBN: 978-0716782506
8. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407
9. Data Structures Using C, Reema Thareja, Oxford University Press, 2nd Edition. ISBN: 978-0198099307

#### Web Links:

7. <https://nptel.ac.in/courses/106102064>
8. <https://archive.nptel.ac.in/courses/106/105/106105225/>
9. <https://www.udemy.com/topic/data-structures/>
10. <https://www.coursera.org/specializations/data-structures-algorithms>
11. <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>

#### Additional Practice:

| SNO | Difficulty | Problem Name          | URL                                                                                                                                                                                               |
|-----|------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Easy       | Structs and enums     | <a href="https://www.hackerrank.com/challenges/too-high-boxes/problem">https://www.hackerrank.com/challenges/too-high-boxes/problem</a>                                                           |
| 2   | Easy       | Structs and enums     | <a href="https://www.codechef.com/problems/HS08TEST?tab=statement">https://www.codechef.com/problems/HS08TEST?tab=statement</a>                                                                   |
| 3   | Medium     | Structs and enums     | <a href="https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem">https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem</a>                         |
| 4   | Easy       | Arrays and Hashtables | <a href="https://leetcode.com/problems/two-sum/description/">https://leetcode.com/problems/two-sum/description/</a>                                                                               |
| 5   | Easy       | Arrays and Pointers   | <a href="https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source">https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source</a> |
| 6   | Medium     | Arrays and Pointers   | <a href="https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source">https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source</a>       |
| 7   | Easy       | Linked List           | <a href="https://leetcode.com/problems/merge-two-sorted-lists/description/">https://leetcode.com/problems/merge-two-sorted-lists/description/</a>                                                 |
| 8   | Medium     | Arrays and Matrix     | <a href="https://leetcode.com/problems/diagonal-traverse/description/">https://leetcode.com/problems/diagonal-traverse/description/</a>                                                           |
| 9   | Easy       | Linked List           | <a href="https://www.hackerrank.com/challenges/compare-two-linked-lists/problem">https://www.hackerrank.com/challenges/compare-two-linked-lists/problem</a>                                       |
| 10  | Medium     | Stack applications    | <a href="https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm">https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm</a>                                       |
| 11  | Medium     | Binary Tree           | <a href="https://leetcode.com/problems/binary-tree-right-side-view/description/">https://leetcode.com/problems/binary-tree-right-side-view/description/</a>                                       |

|    |        |                    |                                                                                                                                                         |
|----|--------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12 | Medium | Stack applications | <a href="https://leetcode.com/problems/remove-k-digits/description/">https://leetcode.com/problems/remove-k-digits/description/</a>                     |
| 13 | Medium | Graph Theory       | <a href="https://www.hackerrank.com/challenges/journey-to-the-moon/problem">https://www.hackerrank.com/challenges/journey-to-the-moon/problem</a>       |
| 14 | Medium | Graph Traversals   | <a href="https://leetcode.com/problems/number-of-provinces/description/">https://leetcode.com/problems/number-of-provinces/description/</a>             |
| 15 | Medium | Graph Theory       | <a href="https://www.hackerrank.com/challenges/torque-and-development/problem">https://www.hackerrank.com/challenges/torque-and-development/problem</a> |

|                            | Basic Programs | Aditya's Internal coding Platform(Maya) | Code chef | Hacker rank | Leet code | Geek for Geeks |
|----------------------------|----------------|-----------------------------------------|-----------|-------------|-----------|----------------|
| <b>Unit-1</b>              | 3              | 0                                       | 0         | 0           | 0         | 0              |
| <b>Unit-2</b>              | 0              | 0                                       | 0         | 3           | 0         | 0              |
| <b>Unit-3</b>              | 0              | 0                                       | 1         | 0           | 2         | 0              |
| <b>Unit-4</b>              | 0              | 0                                       | 0         | 1           | 5         | 0              |
| <b>Unit-5</b>              | 0              | 0                                       | 0         | 4           | 3         | 0              |
| <b>Additional Practice</b> | 0              | 0                                       | 1         | 5           | 8         | 1              |
| <b>Total</b>               | <b>3</b>       | <b>0</b>                                | <b>2</b>  | <b>13</b>   | <b>18</b> | <b>1</b>       |

## Data Structures using C++

(Common to EEE, ECE, CSE, AIML & CSE (DS))  
(Revised Syllabus for batches admitted from 2026 Onwards)

|                       | L | T | P | C |
|-----------------------|---|---|---|---|
| Course Code: 2601DS02 | 2 | 0 | 2 | 4 |

### Course Outcomes:

At the end of the course, student will be able to:

- CO1:** Apply C++ features for problem solving.
- CO2:** Apply various sorting techniques to solve computing problems.
- CO3:** Make use of linear data structures to solve real time problems.
- CO4:** Develop applications using Tree data structures.
- CO5:** Solve problems using Graph algorithms.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 1    | 1    | 1    |      |      |      |      | 1    | 1    |       |       |
| CO2   | 1    | 1    | 2    | 2    |      |      |      | 1    | 1    |       |       |
| CO3   | 1    | 2    | 2    | 1    |      |      |      | 1    | 1    |       |       |
| CO4   | 1    | 1    | 2    | 1    |      |      |      | 1    | 1    |       |       |
| CO5   | 1    | 1    | 2    | 2    |      |      |      | 1    | 1    |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    | -    |
| CO2    | 2    | -    |
| CO3    | 2    | -    |
| CO4    | 2    | -    |
| CO5    | 2    | -    |

### UNIT – I

**An Overview of C++:** Structure of C++ program, Input and output in C++, Class, Objects, Members Functions, Access Specifiers, Introduction to Constructors and Destructor.

**Overview of Standard Template Library:** Introduction, STL Programming Model, Containers, Sequence Containers, Associative Containers, Algorithms, Iterators, Vectors, Lists, Maps.

### Practice:

- Find the roots of a quadratic equation.
- Find factorial of a given number using recursion
- Palindrome Number  
<https://leetcode.com/problems/palindrome-number/description/>
- Class and Objects  
<https://www.hackerrank.com/challenges/classes-objects/problem?isFullScreen=true>
- Program to illustrate the use of Constructors and Destructors.



6. C++ Class Templates  
<https://www.hackerrank.com/challenges/cpp-class-template-specialization/problem?isFullScreen=true>

## UNIT – II

**Data Structures:** Introduction to Data Structures, Types of Data Structures.

**Linear Data Structures:** Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation.

**Linked Lists:** Singly linked lists: Representation and operations, Doubly linked lists and its operations and Circular linked lists and its operations, applications of linked list

### Practice:

1. Single Linked List: Perform different operations in single linked list.  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
2. Perform different operations in double linked list  
[https://leetcode.com/problems/design-linked-list/?utm\\_source](https://leetcode.com/problems/design-linked-list/?utm_source)
3. Circular Linked List  
[https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm\\_source](https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source)
4. Reversing a Linked List

## UNIT – III

**Stacks:** Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, applications of stacks.

**Queues:** Introduction to queues: properties and operations, Types of Queues, implementing queues using arrays and linked lists, applications of queues.

### Practice:

1. Stack and its operations using arrays and Linked List  
<https://www.hackerrank.com/challenges/balanced-brackets/problem>  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
2. Implement a program to evaluate a postfix expression.  
<https://leetcode.com/problems/evaluate-reverse-polish-notation/description/>
3. Queue and its operations using arrays and Linked List  
<https://leetcode.com/problems/implement-queue-using-stacks/description/>  
[https://leetcode.com/problems/design-linked-list/description/?utm\\_source](https://leetcode.com/problems/design-linked-list/description/?utm_source)
4. Implement Circular Queue using Arrays  
<https://leetcode.com/problems/design-circular-queue/description/>

## UNIT – IV

**Trees:** Definition of tree, Tree Terminology, Representation of tree, Types of trees-Binary Tree, BST, Binary tree traversals-Inorder,Preorder,Postorder Traversals.

**Binary Search Trees** – Definition, Operations: Searching, Insertion, Deletion.

**Practice:**

1. Implement Binary search tree (BST).  
<https://leetcode.com/problems/insert-into-a-binary-search-tree/description/>  
<https://leetcode.com/problems/delete-node-in-a-bst/description/>
2. Implement Binary search Tree (BST) Traversals.  
<https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>  
<https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>  
<https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>

**UNIT – V**

**Graphs:** Definition and Terminology, Types of Graph, Representation of Graphs-Adjacency Matrix and Adjacency list, Graph Traversals (BFS & DFS), Bi-Connected Components.

**Practice:**

1. Graph Traversal using Breadth First Search (BFS)  
<https://www.hackerrank.com/challenges/bfsshortreach/problem>
2. Graph Traversal using Depth First Search (DFS)  
<https://leetcode.com/problems/number-of-islands/description/>

**Text Books:**

1. The Complete Reference C++, Herbert Schildt, TMH, Fourth Edition, ISBN-10. 0070411832.
2. Fundamentals of Data Structures in C++, Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, ISBN: 81-7515-278-8
3. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

**Reference Books:**

1. The C++ Programming Language, Bjarne Stroustrup, Pearson, Fourth Edition, ISBN : 9780133522884.
2. Object oriented programming in C++, Joyce Farrell, Cengage, ISBN : 978-1418836269
3. Data structures and algorithms in C++, 3rd edition, Adam Drozdek, Thomson, ISBN: 9788131521267
4. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
5. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407

**Web Links:**

1. <http://nptel.ac.in/courses/106105151/>
2. <https://nptel.ac.in/courses/106102064>
3. <https://archive.nptel.ac.in/courses/106/105/106105225/>
4. <https://www.udemy.com/topic/data-structures/>
5. <https://www.coursera.org/specializations/data-structures-algorithms>
6. <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>

**Additional Practice:**

| SNO | Difficulty | Problem Name          | URL                                                                                                                                                                                               |
|-----|------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Easy       | Arrays and Hashtables | <a href="https://leetcode.com/problems/two-sum/description/">https://leetcode.com/problems/two-sum/description/</a>                                                                               |
| 2   | Easy       | Arrays and Pointers   | <a href="https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source">https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source</a> |
| 3   | Medium     | Arrays and Pointers   | <a href="https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source">https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source</a>       |
| 4   | Easy       | Linked List           | <a href="https://leetcode.com/problems/merge-two-sorted-lists/description/">https://leetcode.com/problems/merge-two-sorted-lists/description/</a>                                                 |
| 5   | Medium     | Arrays and Matrix     | <a href="https://leetcode.com/problems/diagonal-traverse/description/">https://leetcode.com/problems/diagonal-traverse/description/</a>                                                           |
| 6   | Easy       | Linked List           | <a href="https://www.hackerrank.com/challenges/compare-two-linked-lists/problem">https://www.hackerrank.com/challenges/compare-two-linked-lists/problem</a>                                       |
| 7   | Medium     | Stack applications    | <a href="https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm">https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm</a>                                       |
| 8   | Medium     | Binary Tree           | <a href="https://leetcode.com/problems/binary-tree-right-side-view/description/">https://leetcode.com/problems/binary-tree-right-side-view/description/</a>                                       |
| 9   | Medium     | Stack applications    | <a href="https://leetcode.com/problems/remove-k-digits/description/">https://leetcode.com/problems/remove-k-digits/description/</a>                                                               |
| 10  | Medium     | Graph Theory          | <a href="https://www.hackerrank.com/challenges/journey-to-the-moon/problem">https://www.hackerrank.com/challenges/journey-to-the-moon/problem</a>                                                 |
| 11  | Medium     | Graph Traversals      | <a href="https://leetcode.com/problems/number-of-provinces/description/">https://leetcode.com/problems/number-of-provinces/description/</a>                                                       |
| 12  | Medium     | Graph Theory          | <a href="https://www.hackerrank.com/challenges/torque-and-development/problem">https://www.hackerrank.com/challenges/torque-and-development/problem</a>                                           |

|                     | Basic Programs | Aditya's Internal coding Platform(Maya) | Code chef | Hacker rank | Leet code | Geek for Geeks |
|---------------------|----------------|-----------------------------------------|-----------|-------------|-----------|----------------|
| Unit-1              | 3              | 0                                       | 0         | 2           | 1         | 0              |
| Unit-2              | 0              | 0                                       | 1         | 3           | 2         | 0              |
| Unit-3              | 0              | 0                                       | 0         | 1           | 5         | 0              |
| Unit-4              | 0              | 0                                       | 0         | 3           | 2         | 0              |
| Unit-5              | 0              | 0                                       | 0         | 1           | 1         | 0              |
| Additional Practice | 0              | 0                                       | 0         | 3           | 8         | 1              |
| Total               | 3              | 0                                       | 1         | 13          | 19        | 1              |

## Operating Systems

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

**Course Code: 2501CS13**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Describe basic concepts of Operating Systems and its structure.
- CO2:** Analyse various issues related to inter process communication like process scheduling, resource management and deadlocks.
- CO3:** Interpret the issues and challenges of memory management.
- CO4:** Illustrate concepts of Disk management and file system implementation.
- CO5:** Explain issues related to protection and security mechanisms.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 3    |      |      |      |      |      |      |      | 1    |       |       |
| CO2   | 1    | 3    |      | 1    |      |      |      |      | 2    |       | 1     |
| CO3   | 1    | 3    |      | 1    |      |      |      |      | 2    |       | 1     |
| CO4   | 1    | 3    |      | 1    |      |      |      |      | 1    |       | 1     |
| CO5   | 2    | 2    |      |      |      |      |      |      | 1    |       |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 1    |      |
| CO2    | 2    |      |
| CO3    | 2    |      |
| CO4    | 2    |      |
| CO5    | 2    |      |

### UNIT – I

**Operating Systems Overview:** Operating system functions, Operating system structure, Operating systems operations, Computing environments, Open-Source Operating Systems. System Structures: Operating System Services, User and Operating-System Interface, systems calls, Types of System Calls, system programs, operating system structure, System Boot.

**Case Study:** The above topics are discussed as case study in Windows/ Unix OS

#### Practice:

1. Basic Linux commands
2. Implementation of System calls
3. Multiprogramming-Memory management-Implementation of fork (), wait (), exec() and exit (), System calls

### UNIT – II

**Process Concept:** Process scheduling, Operations on processes, Inter-process communication.

**Process Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling.

**Multithreaded Programming:** Multithreading models, Thread libraries, Threading issues

**Case Study:** The above topics are discussed as case study in Windows/ Unix OS

**Practice:**

1. Simulate the following CPU scheduling algorithms: FCFS and SJF
2. Simulate the following CPU scheduling algorithms: Priority and Round Robin

**UNIT – III**

**Inter-process Communication:** Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Classical IPC Problems - Dining philosophers problem, Readers and writers problem.

**Deadlocks:** Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection and recovery, Deadlock avoidance, Deadlock prevention.

**Case Study:** The above topics are discussed as case study in Windows/ Unix OS

**Practice:**

1. Simulate Bankers Algorithm for Dead Lock Avoidance
2. Write a C program that illustrates two processes communicating using shared memory.
3. Write C program to create a thread using pthreads library and let it run its function.
4. Write a C program to illustrate concurrent execution of threads using pthreads library

**UNIT – IV**

**Memory-Management Strategies:** Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation.

**Virtual Memory Management:** Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation.

**File Systems:** Files, Directories, File system implementation, management and optimization.

**Case Study:** The above topics are discussed as case study in Windows/ Unix OS

**Practice:**

1. Simulate the Multiprogramming with a fixed number of tasks (MFT)
2. Simulate the Multiprogramming with a variable number of tasks (MVT)
3. Simulate the FIFO page replacement algorithm
4. Simulate the LRU page replacement algorithm
5. Simulate the following File allocation strategies: Sequenced, Indexed and Linked

**UNIT – V**

**Secondary-Storage Structure:** Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.

**System Protection:** Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights.

**System Security:** Introduction, Program threats, System and network threats.

**Practice:**

1. The above topics are discussed as case study in Windows/ Unix OS

**Text Books:**

- 1 Operating System Concepts, Abraham Silberschatz, Peter B Galvin and Greg Gagne, John Wiley and Sons Inc., 12<sup>th</sup> Edition. ISBN: 978-0470128725
- 2 William Stallings, Operating Systems: Internals and Design Principles. Prentice-Hall, 7<sup>th</sup> Edition. ISBN: 978-9332518803

**Reference Books:**

- 1 Modern Operating Systems, Tanenbaum A S, Pearson Education, 3<sup>rd</sup> Edition. ISBN: 978-0136006633
- 2 Operating Systems A Concept Based Approach, Dhamdhare D M, Tata McGraw-Hill, 3<sup>rd</sup> Edition. ISBN: 978-1259005589
- 3 Operating Systems, Nutt G, Pearson Education, 3<sup>rd</sup> Edition, . ISBN: 978-8131723593

**Web Links:**

- 1 <https://archive.nptel.ac.in/courses/106/106/106106144/>
- 2 <https://archive.nptel.ac.in/courses/106/105/106105214/>
- 3 <https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems>
- 4 <https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923>

## Database Management Systems

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

**Course Code: 2501IT05**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Describe the Fundamental concepts of DBMS.
- CO2:** Interpret relational database using SQL.
- CO3:** Make use of normalization techniques for database design.
- CO4:** Illustrate the mechanisms of transaction management.
- CO5:** Optimize database performance with advanced indexing, query optimization, and recovery strategies.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    | 3    | 3    |      | 1    |      |      | 1    |      |       |       |
| <b>CO2</b> | 3    | 3    | 3    | 2    | 2    | 1    |      | 1    |      |       |       |
| <b>CO3</b> | 3    | 3    | 3    | 3    | 3    | 2    |      |      |      |       | 1     |
| <b>CO4</b> | 3    | 3    | 3    | 1    | 2    | 1    |      |      |      |       |       |
| <b>CO5</b> | 3    | 3    | 3    | 3    | 3    | 2    |      |      |      |       | 2     |

### UNIT – I

Introduction to DBMS: History and Architecture, Data Independence, Data Models, Levels of abstraction, structure of DBMS.

Data Models : Concepts of Schema, Instance and data independence, Three tier schema architecture for data independence, Database system structure, environment, Centralized and Client Server architecture for the database.

#### Practice

1. Familiarization with installation of any DBMS.
2. Implementing a University Database System.

### UNIT – II

**Relational Model:** Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance

**BASIC SQL:** Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion).

#### Practice

1. Querying and modifying the database using Data Manipulation Language commands -select, insert, update, delete.
2. Implementation of Aggregate Functions – sum, avg, min, max, count. Use group-by and having clause.

### UNIT – III

**Entity Relationship Model:** Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

**SQL:** Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(uptable and nonuptable), relational set operations.

**Practice**

1. Perform join operations – natural join, equi-join, outer join, left outer join, right outer join, inner join and assess the impact of query plans on the performance of join heavy queries.
2. Perform set operations - union, intersection, set difference.
3. Implementation of corelated sub-queries and nested queries.
4. Creating and querying views and materialized views.

**UNIT – IV**

**Normalization:** Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF), Fifth Normal Form (5NF).

**Transaction Concept:** Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Storage, Recovery and Atomicity, Recovery algorithm.

**Practice**

1. Implement SQL queries on a normalized database schema based on the provided schema. For this example: use the schema for a university database, which includes:

- Students (StudentID, StudentName, Major)
- Courses (CourseID, CourseName, Credits)
- Enrollments (StudentID, CourseID, EnrollmentDate)
- Instructors (InstructorID, InstructorName, Phone)
- Course\_Instructors (CourseID, InstructorID)

2. (A)Implementation of Data Control Language commands – grant and revoke.

(B)Implementation of Transaction Control Language commands - commit, save point, and rollback.

**UNIT – V**

**Indexing Techniques:** Introduction, B+ Trees: Search, Insert, delete algorithms, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing: Tree base Indexing, Comparison of File Organizations.

**Database Tuning:** Introduction, Database Performance Tuning, Query Optimization: Introduction, Query Optimization algorithms, Backup and Recovery.

**Practice**

1. Create a Primary , Secondary Index on a Column.
2. Retrieve Data Using an Index.
3. Insert Data and Update Indexes.
4. Delete Data and Impact on Indexes.

**\* Note:**The student must Complete & Submit a Database Foundations Certificate Course offered by Oracle Academy at the end of the Practice Session.

**Text Books:**

- 1 Database System Concepts ,Abraham Silberschatz, Henry Korth, and S. Sudarshan, McGraw-Hill , 8<sup>th</sup> Edition., ISBN-13: 978-1260230508.
- 2 Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Mc Graw-Hill, 4<sup>th</sup> Edition, ISBN: 978-1260091195.

**Reference Books:**

1. Database Systems, RamezElmasri, Shamkant B. Navathe, 7<sup>th</sup> Edition, Pearson, ISBN: 978-0137504277.



2. Database Systems, Carlos Coronel, Steven Morris, Peter Rob, 10<sup>th</sup> Edition, Cengage, ISBN: 978-0357517864.
3. Introduction to Database Systems, C J Date, Pearson, 9<sup>th</sup> Edition, ISBN: 978-0133970777.

**Web Links:**

- 1 <https://academy.oracle.com/pages/coursedescription/Oracle%20Academy%20Database%20Foundations%20Course%20Description.pdf>
- 2 <https://www.w3schools.com/sql/>
- 3 [https://onlinecourses.nptel.ac.in/noc22\\_cs91/](https://onlinecourses.nptel.ac.in/noc22_cs91/)

## Computer Networks

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

**Course Code: 2501CS07**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Describe network topologies, reference models and media for data transmission
- CO2:** Analyze error and flow control issues in data link layer
- CO3:** Classify MAC protocols and channelization techniques
- CO4:** Apply routing algorithms and congestion control techniques for effective data transmission
- CO5:** Analyze protocols Transport and Application Layers

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 3    | 1    |      |      |      |      |      |      |      |       |       |
| CO2   |      | 2    |      |      |      |      |      |      |      |       |       |
| CO3   |      | 2    |      |      |      |      |      |      | 1    | 1     |       |
| CO4   | 1    | 2    | 2    |      |      |      |      |      | 2    |       | 1     |
| CO5   |      | 1    |      |      | 1    |      |      |      |      |       | 1     |

### UNIT – I

**Network Overview:** interfaces, protocols and services, connection-oriented and connectionless services, OSI & TCP/IP Reference Models. Local Area Networks: Topologies - star, bus, ring, media access control - deterministic and probabilistic, IEEE 802.x. wireless networking.

#### Practice:

1. Study of Network devices in detail and connect the computers in Local Area Network

### UNIT – II

**Data Link Protocols:** framing and data transparency, error detection & correction, flow control.

#### Practice:

1. Write a Program to implement the data link layer framing methods such as i) Character stuffing  
ii) bit stuffing.

### UNIT – III

**Media Access Control:** Random Access: ALOHA, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance, Controlled Access: Reservation, Polling, Token Passing, Channelization: frequency division multiple Access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA).

#### Practice:

1. Write a Program to implement Sliding window protocols

## UNIT – IV

**Routing Algorithms:** The Optimality principle, Shortest path, Flooding, Distance vector, Link state, Hierarchical

**Congestion Control algorithms:** General principles of congestion control, Congestion prevention policies, Approaches to Congestion Control, Traffic Aware Routing, Admission **Control, Traffic Throttling:** Load Shedding

Traffic Control Algorithm: Leaky bucket & Token bucket.

### Practice:

1. Programs to implements routing protocols like shortest path.

## UNIT – V

**IP Protocols:** IP Addressing, IP & ICMP.

Transmission Control Protocol: UDP & TCP.

Application Layer: World Wide Web, HTTP, Electronic mail, Architecture, web based mail, email security, TELENET, local versus remote Logging, Domain Name System: Name Space, DNS, SNMP.

### Practice:

1. NS2 Simulator i. NS2 Simulator-Introduction ii. Simulate to Find the Number of Packets Dropped iii. Simulate to Find the Number of Packets Dropped by TCP/UDP

### Capstone Project:

Simulate and implement data link layer protocols and network routing strategies using NS2 (Network Simulator 2). It includes configuring network topologies, setting up routing protocols like AODV, DSDV, and OLSR, and analyzing their performance through metrics such as throughput, delay, and packet delivery ratio. Additionally, explore the simulation of data link layer functionalities, including MAC addressing and error detection. You may use NS2's capabilities, that insights into the behaviour of network protocols, aiding in the design and optimization of efficient communication systems.

### Text Books:

- 1 Computer Networks — Andrew S Tanenbaum and David J Wetherall, Pearson Education, 5th Edition. ISBN: 978-0132126953
- 2 Data Communications and Networking – Behrouz A.Forouzan, McGraw Hill Education, 5th Edition ISBN: 978-1259064753

### Reference Books:

- 1 Data Communications and Networks- Achut S Godbole, AtulKahate, McGraw-Hill Education (India) Pvt Limited, 2<sup>nd</sup> Edition. ISBN: 978-0-07-123110-7
- 2 Computer Networks, Mayank Dave, CENGAGE India, 6<sup>th</sup> Edition ISBN: 978-8131509869

### Web Links:

- 1 <https://nptel.ac.in/courses/106105081>
- 2 <https://www.coursera.org/learn/fundamentals-network-communications>

## Artificial Intelligence

(CE, EEE, ECE, PT, Min.E.)

**Course Code: 2501AI02**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Illustrate the historical development of AI, key milestones and contributors.
- CO2:** Apply the basic principles of AI in problem solving
- CO3:** Apply Local Search Algorithms and Optimization Techniques.
- CO4:** Choose the appropriate representation of Knowledge.
- CO5:** Summarise the expert systems and real time applications

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 3    |      |      | 1    |      |      |      | 1    | 1    |       | 1     |
| <b>CO2</b> | 3    | 2    |      | 2    |      |      |      | 1    | 1    |       | 1     |
| <b>CO3</b> | 3    | 2    | 1    | 2    | 1    |      |      | 1    | 1    |       | 1     |
| <b>CO4</b> | 2    |      | 1    |      |      |      |      | 1    | 1    |       |       |
| <b>CO5</b> | 2    | 2    | 1    | 1    | 1    |      |      | 1    | 1    |       | 1     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> | 1    |      |
| <b>CO2</b> | 2    | 1    |
| <b>CO3</b> | 1    | 1    |
| <b>CO4</b> | 1    |      |
| <b>CO5</b> | 1    | 1    |

## UNIT – I

### Introduction:

What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

### Practice :

3. Introduction to LISP : To demonstrate simple recursive functions and list manipulation in LISP
4. Introduction to Prolog : Provide a brief introduction to Prolog syntax, including facts, rules, and queries.

## UNIT – II

### Problem formulation:

Problem Definition Production systems, Control strategies, Search strategies. Problem characteristics, ProblemSolving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies

**Practice :**

3. Implementation of DFS for water jug problem using LISP/PROLOG
4. Implementation of BFS for tictactoe problem using LISP/PROLOG

**UNIT – III****Problem solving methods**

Problem graphs, Matching, Indexing and Heuristic functions Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions, , Constraints satisfaction – Measure of performance and analysis of search algorithms. Game playing.

**Practice :**

3. Implementation of TSP using heuristic approach using LISP/Prolog
4. Implementation of Hillclimbing to solve 8 Puzzle Problem

**UNIT – IV****Knowledge representation**

Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logicStructured representation of knowledge Basic plan generation systems – Strips Advanced plan generation systems – K strips Strategic explanations Why, why not and how explanations.

**Practice :**

3. Design a semantic network to represent knowledge about a specific domain, such as animals or transportation systems. Experiment with different node types, relationships, and attributes to encode information effectively. Implement a Python / LISP code for this program.
4. Create a framebased representation for a simple domain like a restaurant. Define frame templates for entities like menu items, customers, and orders, along with slots for attributes such as price, ingredients, and customer preferences.

**UNIT – V****Expert Learning**

Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.

**Practice :**

3. Using PYTHON / LISP , develop an expert system to help users plan travel itineraries, including transportation, accommodation, and activities. Utilize knowledge about travel destinations, transportation options, and user preferences to generate personalized travel plans.
4. Using PYTHON / LISP , create an expert system to assist students in selecting courses, majors, or career paths based on their interests, skills, and academic performance. Use knowledge about educational programs, career prospects, and academic requirements to make personalized recommendations.

**Text Books:**

- 1 Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig , Pearson, 3rd Edition, ISBN: 978-9332543515
- 2 Artificial Intelligence: Structures and Strategies for Complex Problem Solving by George F. Luger, 2<sup>nd</sup> Edition, ISBN: 978-0805347807

**Reference Books:**

- 1 Artificial Intelligence, Saroj Kaushik, Cengage Learning India, ISBN: 978-8131510995
- 2 Artificial Intelligence, Elaine Rich and Kevin Knight, Tata McGraw Hill, ISBN: 978-0-07-052263-3
- 3 Artificial Intelligence: Foundations for Computational Agents, David Poole and Alan Mackworth, Cambridge University Press, ISBN: 978-1107195394

**Web Links:**

- 1 <https://nptel.ac.in/courses/106105077>
- 2 <https://nptel.ac.in/courses/106106126>
- 3 <https://aima.cs.berkeley.edu>

## Machine Learning

(CE, ECE, PT, Min.E.)

**Course Code: 2501AI05**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>2</b> | <b>4</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Outline the Concepts of Machine Learning and Statistical Learning
- CO2:** Build Regression and Classification models for given data.
- CO3:** Apply Instance based Learning techniques and SVM techniques linear and nonlinear data.
- CO4:** Apply clustering techniques on high dimensional data to group the similar entities.
- CO5:** Make use of ensemble learning techniques to improve the performance of a model.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO      | PO 1 | PO 2 | PO3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|------------|------|------|-----|------|------|------|------|------|------|-------|-------|
| <b>CO1</b> | 2    | 2    |     |      | 2    | 2    |      | 1    | 1    |       |       |
| <b>CO2</b> | 2    | 2    | 3   |      | 2    | 2    |      | 1    | 1    |       |       |
| <b>CO3</b> | 3    | 2    | 3   |      | 2    |      |      | 1    | 1    |       | 2     |
| <b>CO4</b> | 3    | 2    | 3   |      | 2    |      |      | 1    | 1    |       |       |
| <b>CO5</b> | 2    | 2    | 2   |      | 2    |      |      | 1    | 1    |       | 2     |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO     | PSO1 | PSO2 |
|------------|------|------|
| <b>CO1</b> |      | 1    |
| <b>CO2</b> |      | 2    |
| <b>CO3</b> |      | 2    |
| <b>CO4</b> |      | 2    |
| <b>CO5</b> |      | 2    |

## UNIT – I

### Introduction:

Machine Learning, Types of Machine Learning Systems, Main Challenges of Machine Learning. Statistical Learning: Introduction, Supervised and Unsupervised Learning, The Learning Problem, Feasibility of Learning.

### Practice :

3. Installation of Jupiter/Spider notebook and working on basic commands.
4. Loading and apply key preprocessing techniques on the dataset and also analyse the dataset.

## UNIT – II

### **Supervised Learning(Regression/Classification):Basic Methods:**

**Concept Learning:** General-to-Specific Hypotheses Ordering, Find-S and Candidate Elimination Algorithm, Version Space, and Inductive Bias.

**Bayesian Learning:** Probability Overview, MLE and MAP Estimates, Gaussian Naive Bayes Classifier, Bayesian Networks.

**Instance-based Learning:** k-Nearest Neighbour (kNN) Classifier, Voronoi Diagram and Distance-Weighted kNN, Distance Metrics and Curse of Dimensionality.

### **Practice :**

5. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
6. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
7. Exercises to solve the real-world problems using Binary Classifier
8. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.

## UNIT – III

**Linear Models and Regression:** Linear Classification, Linear Regression, Non-linear Transformation, Logistic Regression.

**Support Vector Machines:** Decision Boundary and Support Vector: Optimization and Primal-Dual Problem, Soft Margin and Non-linear Decision Boundary, Kernel Functions and Radial Basis Functions introduction.

### **Practice :**

4. Exercises to solve the real-world problems using Linear Regression
5. Exercises to solve the real-world problems using Logistic Regression
6. Consider Patient Dataset. Apply linear classification technique(SVM) to identify the rate of heart patients.

## UNIT – IV

**Classifier / Hypothesis Evaluation:** Accuracy, Precision, Recall and F-Measures, Scores, Sampling, Bootstrapping and ROC, Hypotheses Testing and Cross-validation.

### **Unsupervised Learning:**

**Clustering :** Partitional Clustering and Hierarchical Clustering, Cluster Types, Attributes and Salient Features, Hierarchical and Density-based Clustering Algorithms, Inter and Intra Clustering Similarity, Cohesion and Separation. MST and DBSCAN Clustering Algorithms.

### **Practice :**

4. Develop a program for Bias, Variance, Remove duplicates , Cross Validation
5. Write a program to implement One-hot Encoding.
6. Write a program to implement Categorical Encoding.



## UNIT – V

### Ensemble Learning :

Bagging and Boosting, Adaboost and Random Forest ,

**Computational Learning Theory :** Error and Noise Formalisms, Training vs. Testing, Theory of Generalization, PAC Learnability and VC Dimensions , Overfitting, Regularization and Validation.

### Practice :

3. Write a program to demonstrate the working of Random Forest classifier. Use appropriate dataset for Random Forest Classifier.
4. Use a sentiment analysis dataset from Twitter or other social media platforms, available on platforms like Kaggle and apply bagging and boosting techniques for prediction.

### Additional Practice:

3. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
4. Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using kMeans algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

### Capstone Project:

#### Student Performance Prediction System

**Objective:** Predict a student's performance (pass/fail or score range) based on input features like study time, attendance, past grades, family background, etc.

**Domain:** Education

#### Techniques & Concepts Used:

- Supervised learning (Classification – Logistic Regression, SVM)
- Data preprocessing (handling nulls, encoding categorical variables)
- Evaluation metrics (accuracy, precision, recall)

### Text Books:

- 1 Hands On Machine Learning with ScikitLearn, Keras, and TensorFlow, 2nd Edition, O'Reilly Publications, 2019, ISBN: 978-1492032649
- 2 Data Science and Machine Learning Mathematical and Statistical Methods, Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, 2019, ISBN: 978-1138492530

### Reference Books:

- 1 Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, ISBN: 9780262018029
- 2 Machine Learning Tools, Dr Muddafa Maruli Krishna, Dr A Vanathi, Final Thawaksr, Dr Lokesh P. Gangani, publisher: Book Rivers, ISBN: 978-93-5515-730-0

### Web Links:

- 1 <https://www.deeplearning.ai/machinelearningyearning/>
- 2 <https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html>

## Fundamentals of Data Science

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

**Course Code: 2501CS34**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>0</b> | <b>1</b> | <b>3</b> |

### Course Outcomes:

**At the end of the course, student will be able to:**

- CO1:** Explain fundamental concepts of Data Science.
- CO2:** Implement Data Collection and Preprocessing Techniques.
- CO3:** Demonstrate Proficiency in Data Loading, Storage, and File Handling
- CO4:** Conduct Exploratory Data Analysis (EDA) using Visualization and Statistical Techniques.
- CO5:** Make use of Neo4j, Cypher tools to manage and analyze graph data.

### Mapping of Course Outcomes with Program Outcomes:

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 |
|-------|------|------|------|------|------|------|------|------|------|-------|-------|
| CO1   | 2    | 3    |      |      |      |      |      |      | 2    | 2     |       |
| CO2   | 2    |      |      |      |      |      |      |      | 1    | 2     |       |
| CO3   | 2    | 2    | 2    |      |      |      |      |      | 2    | 2     |       |
| CO4   | 2    | 2    |      |      | 2    |      |      |      | 2    | 1     |       |
| CO5   | 3    |      |      |      |      |      |      |      | 1    | 1     |       |

### Mapping of Course Outcomes with Program Specific Outcomes:

| CO/PSO | PSO1 | PSO2 |
|--------|------|------|
| CO1    | 2    |      |
| CO2    | 1    |      |
| CO3    | 2    |      |
| CO4    | 2    |      |
| CO5    | 1    |      |

### UNIT – I

**Introduction To Data Science:** Definition and Scope of Data Science, History and Evolution of Data Science, Applications of Data Science, Data Science Lifecycle, Data Types and Structures, Tools and Technologies in Data Science.

#### Practice:

3. Importing and Exploring Datasets - Loading datasets using libraries and performing basic exploration.
4. Basic Data Structures - Working with data structures such as arrays, lists, data frames, and matrices

### UNIT – II

**Data Collection and Preprocessing:** Data Collection Methods, Data Cleaning and Handling Missing Values, Data Transformation: Normalization and Standardization, Feature Engineering and Feature Scaling, Data Integration and Aggregation.

#### Practice:

3. Computing summary statistics like mean, median, mode, and standard deviation for a sample dataset.

4. Handling missing values and outliers in a dataset using techniques like imputation and filtering.

### UNIT – III

**Data Loading, Storage, and File Formats :** Reading and Writing Data in Text Format, Reading Text Files in Pieces, Writing Data Out to Text Format, Manually Working with Delimited Formats, JSON Data, XML and HTML: Web Scraping, Binary Data Formats, Using HDF5 Format, Reading Microsoft Excel Files, Interacting with Databases, Storing and Loading Data in Mongo DB.

**Practice:**

3. Read data from a JSON file into a DataFrame using Pandas (pd.read\_json) or R (jsonlite). Parse nested JSON structures and convert them into a flat table format.
4. Perform web scraping on an HTML page using BeautifulSoup in Python or rvest in R. Extract data from HTML tables and convert it into a DataFrame.

### UNIT – IV

**Exploratory Data Analysis (EDA):** Descriptive Statistics, Data Visualization Techniques, Correlation and Covariance Analysis, Univariate, Bivariate, and Multivariate Analysis, Pattern Detection and Anomaly Identification.

**Practice:**

3. Plotting histograms and box plots to understand the distribution of a single variable.
4. Creating scatter plots and calculating correlation coefficients to study the relationship between two variables.

### UNIT – V

**Data Science Tools:** Neo4j for dealing with graph databases, graph query language Cypher, libraries like nltk and SQLite for handling Text mining and analytics.

**Practice:**

3. Get hands-on experience with Neo4j to understand how to manage and query graph databases.
4. Practice writing Cypher queries to interact with graph data in Neo4j.

**Text Books:**

- 1 Python for Data Analysis ,Wes McKinney, O'REILLY, ISBN:978-1-449-31979-3, 1<sup>st</sup> edition, ISBN · 9781449319793.
- 2 Doing Data Science ,Rachel Schutt & O'neil, O'REILLY, ISBN:978-1-449-35865-5, 1<sup>st</sup> edition, ISBN: 9781449358655.

**Reference Books:**

- 1 Data Science from Scratch: First Principles with Python ,Joel Grus, O'Reilly Media. ISBN: 9781492041139.
- 2 Learning the Pandas Library: Python Tools for Data Munging ,Matt Harrison, Analysis, and Visualization , O'Reilly. ISBN: 9781787123137

**Web Links:**

- 1 [https://onlinecourses.nptel.ac.in/noc24\\_cs68/preview](https://onlinecourses.nptel.ac.in/noc24_cs68/preview)
- 2 [https://onlinecourses.nptel.ac.in/noc24\\_cs133/preview](https://onlinecourses.nptel.ac.in/noc24_cs133/preview)
- 3 <https://www.geeksforgeeks.org/how-to-become-a-data-analyst-complete-roadmap/>